Kuratorium für Forschung und Technik
der Zellstoff- und Papierindustrie im VDP e.V.

Forschungsprojekte 2012
im Überblick

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VORWORT

Das Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. stellt Ihnen die aktuelle Übersicht über Forschungsprojekte in den Themenbereichen Zellstoff und Papier für das Jahr 2012 vor.

Neben Arbeiten, die aus Mitteln des Kuratoriums gefördert werden, finden Sie zahlreiche weitere Projektbeschreibungen, die die Forschungsinstitute der Papierindustrie zur Kenntnis bringen wollen. Zusätzlich aufgenommen wurden z. B. Projekte, die von der Internationalen Forschungsgemeinschaft Deinking-Technik (INGEDE e. V.) gefördert wurden, sowie Arbeiten von Instituten, die sich an der Koordination der Forschungsgebiete und der Diskussion des Forschungsbedarfs gemeinsam mit dem INFOR-Forschungsrat beteiligen. Zahlreiche Projekte erhalten im Rahmen der industriellen Gemeinschaftsforschung Fördermittel des Bundesministeriums für Wirtschaft (IGF-Projekte).

Folgende Institute stellen Beiträge aus ihrer Forschungsarbeit vor:

- Papiertechnische Stiftung (PTS), München und Heidenau
- Technische Universität Darmstadt
  - Fachgebiet Papierfabrikation und Mechanische Verfahrenstechnik (PMV)
  - Ernst-Berl-Institut für Makromolekulare Chemie und Papierchemie (MAP)
- Technische Universität Dresden
  - Professur für Papiertechnik
  - Institut für Pflanzen- und Holzchemie
  - GWT-TUD GmbH
- Universität Freiburg
  - Institut für Forstbenutzung und Forstliche Arbeitswissenschaft
- Universität Hamburg
  - Zentrum Holzwirtschaft
    - Chemische Holztechnologie
- Hochschule München
  - Verfahrenstechnik Papier und Verpackung

Wir danken den Forschungsinstituten für die Erstellung der großen Zahl von Kurzbeschreibungen.

Diese Broschüre wurde zusammengestellt mit dem Ziel, den Geschäftsführungen und insbesondere den mit Forschung und Entwicklung befassten Mitarbeitern unserer Mitgliedsunternehmen einen kompakten Überblick über die Forschungsergebnisse und laufenden Untersuchungen, die für die Papierindustrie von Interesse sind, zu vermitteln. Firmen, die detailliertere Informationen wünschen, können direkt mit dem bearbeitenden Forschungsinstitut Kontakt aufnehmen. Ansprechpartner finden Sie in der Kopfzeile jeder Projektbeschreibung.

Wir möchten an dieser Stelle auch darauf hinweisen, dass für interessierte Firmen die Möglichkeit besteht, bei Projekten, die über das Kuratorium für Forschung und Technik gefördert werden, in projektbegleitenden Ausschüssen mitzuarbeiten. Unternehmen können direkt an den entstehenden Forschungsergebnissen partizipieren und diese auch mitgestalten. Besonders attraktiv ist die Gemeinschaftsforschung für kleine und mittlere Unternehmen mit geringer eigener Forschungskapazität.

In der Forschungsübersicht 2012 wurden Kurzbeschreibungen von insgesamt 125 Forschungsvorhaben erfasst und nach Forschungsgebieten geordnet. Am Ende der Broschüre finden Sie ein Schlagwortverzeichnis und eine Themenliste, die das Auffinden bestimmter thematischer Schwerpunkte ermöglichen.

Die Forschungsübersicht 2012 steht auch auf CD-ROM zur Verfügung. Wenn Sie Themen zu einem bestimmten Forschungsgebiet suchen, gelangen Sie durch Anklicken der gewünschten Zeile im Inhaltsverzeichnis auf die erste Seite des betreffenden Forschungsgebietes. Über das Themenverzeichnis am Ende können Sie alle enthaltenen Einzelthemen durchsehen und direkt das Projekt anklicken. Ein Schlagwortverzeichnis führt zu den Schlagworten der einzelnen Projektbeschreibungen.

Wir senden Ihnen gerne weitere Exemplare der Forschungsübersicht und der CD-ROM. Bitte wenden Sie sich an das Referat Forschungsförderung per E-Mail e.kloss@vdp-online.de oder unter der Faxnummer 0228/26705-68.

PRODUKT-ZIELE

Forschungsgebiet

Rohstoffe

Holz
Landwirtschaftliche Nutzpflanzen
Altpapier
Füllstoffe, Pigmente
Chemische Additive

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Christian Bienert
Tel: 089/12146-469
Fax: 089/12146-36
E-Mail: christian.bienert@ptspaper.de

Research area: Product aims

Raw materials // Wood

Key words:

Demolition wood, waste wood, sorting, pulp production, particle board production, combustion plants, liquid biofuels production

Title:
Optimisation of material recycling and energy recovery from waste and demolition wood in different value chains

Background/Problem area

There is a significant amount of wood based materials coming from end of life products. The main sources of this recovered wood are packaging materials, demolition wood, timber from building sites, and fractions of used wood from residential, industrial and commercial activities.

The main user of recovered wood in Europe is probably the particleboard manufacturing industry, but other uses are increasing in importance. One of the great advantages of wood is that it can be recycled several times before, eventually, being disposed of by incineration with energy recovery. The pulp industry is not using recovered wood up to now, because in many cases the purity requirements for the pulp process and for the paper quality and characteristics have stopped the use of a raw material which could be contaminated by non biomass materials (metal pieces, paint, varnishes…).

The biomass energy field is certainly the fastest growing sector among the wood users. Considering the very high objectives of development of the biomass energy in Europe, this trend is certainly durable and the biomass demand for energy will grow strongly in the coming years.

At the same time when the wood using sectors are facing some difficulties and economic tensions on the raw material supply, there are still million tons of waste wood which are either not handled properly (disposal by landfilling, incineration or combustion without efficient energy recovery). These situations, which are clearly the worst case scenarios in the frame of the waste national regulations and the waste directive, generate environmental impacts. Moreover, these impacts can reduce the positive environmental profile of wood product. Increasing the level of material recycling and energy recovery from recovered wood is today to a very large extent a regulatory objective and a European wide public policy.

Objectives/Research results

The general aim of the project is to investigate valorisation concepts for maximising the added value of waste wood in value chains such as pulp production for paper products, particle board production and large scale energy recovery systems: combustion plants and liquid biofuels production. This would help saving the forest resource, reducing the environmental impact of waste wood management, while contributing to the objectives of increasing the use of a renewable resource and reducing the greenhouse gases emissions in the materials and energy sectors.

In the second part the project partner analysed the waste wood sources, their amounts and costs and also the management practices in participating countries. These lead to a better knowledge on waste wood sources and management practices in Europe. Estimations and proposals for a classification harmonization and for an observation system were done.

Model systems for laboratory and technical tests were prepared and first tests on detection and sorting technologies for waste wood were done. Also first examinations to use waste wood in the paper making process were performed.

Application/Economic benefits

The results of this project will firstly give a realistic overview about the waste wood sources and paths in some special selected EU countries. With already existing and newly developed innovative detection and sorting techniques will the quality and the quantity of good wood without contaminations be largely extended. After finishing this project, there will be an optimized end-of-life concept for wood based products considering their total life cycle.

Possible decisions can be that good quality waste wood can better be used in the pulp and paper industry while darker fractions can still be used as core material in the particleboard industry. From an environmental point of view, the increased recycling of recovered wood can be seen as a positive evolution because this increases the total volume of CO2 stored in wood-panels or in paper products for many years. However, a negative effect is that waste wood currently contains more contaminants than the fresh wood. With the succeed of the proposed new concepts and in cooperation with the sorting and recycling companies (mainly organized as SMEs) will the amount of contaminants in the waste wood be drastically reduced. Therefore the acceptance of the larger organized paper mill and particleboard companies to take waste wood as a cheap alternative to fresh wood seems reasonable. The results of this project will be disseminated and exploited to the different industrial branches in different way, either directly to the companies in conferences, symposia and on fairs

Period of time: 01.01.2011 – 31.12.2013

Remarks

The research project DEMOWOOD (WoodWisdom-Net, 2nd Joint Call - 2009) is being funded by the European Commission and coordinated by Institut Technologique FCBA (FCBA), France, in cooperation with leading European paper research institutes (PTS, Germany; CTP, France; WKI, Germany; VTT, Finland), and 10 industrial partners: Norske Skog, Golbey Mill, France; Entsorgungstechnik Bavaria GmbH, Germany; Lassila & Tikanoja Oyj, Finland; Finnish Wood Research, Finland; RTT Steinert GmbH, Germany; Schumann-Analytics, Germany; Pfleiderer Holzwerkstoffe GmbH, Germany; SITA Recyclage, France; VEOLIA, France and TITECH GmbH, Germany.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

M. Sc. A. Gottschling
Dr.-Ing. H.-J. Putz

Tel: 06151/16-4315
Fax: 06151/16-2454
E-Mail: gottschling@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Rohstoffe // Altpapier

Schlagworte:

Recycling, Altpapiersortierung, Altpapierqualität

Theme:
Modeling and Systematic Assessment of Recovered Paper Sorting Systems

Background/Problem Area:

Paper for recycling is an important raw material for the European paper industry. The quality of recovered paper can be influenced and improved by sorting. The dry sorting process separates the recovered paper into various fractions and removes unwanted components.

The dominant sorting process for recovered paper is manual sorting. But automated processes are used as well. They include for example screening and optical recognition combined with automatic removal by means of compressed air jets.

Objective/Research Results:

One aim of this project is to develop a simulation software for recovered paper sorting plants. The software should be based on models of processes used in recovered paper sorting and should enable the user to simulate and evaluate various scenarios of dry sorting plants. From this aim the following main work packages are built as follows:

- Development of (semi-)automated measuring methods to collect the relevant data of an adequate number of recovered paper samples.
- Modeling of the most important dry sorting processes for recovered paper.
- Determination of model parameters and verifying of the model in industrial sorting plants.

The second aim is to simulate and compare typical and most modern dry sorting plants. Simulation will also be used to find optimized structures and operating parameters of sorting plants.

Application/Economic Benefits:

The simulation software developed in this project can directly be used by designers and operators to evaluate and improve the potential and efficiency of recovered paper sorting plants. Data obtained in industrial sorting plants during this project can also be used to evaluate sorting plants.

By applying the results of this project presumably higher recovered paper qualities can be achieved. This could offer the possibility to reduce or save processes in the stock preparation of paper mills that work with recovered paper.

Project Period: 01.08.2012 – 31.01.2015

Remarks:

The project IGF 17496 N is being funded by the AiF in the frame of a program for promotion of common industrial research and development (IGF) by the Federal Ministry of Economics and Technology (BMWi).

Research institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Constanze Seidemann
Tel: 03529/551-636
Fax: 03529/551-889
E-Mail: constanze.seidemann@ptspaper.de

Research area: Product aims

Raw materials // Recovered paper

Key words:

paper for recycling, corrugating base paper production, parallel utilisation, fractionation, platform chemicals

Title:
Developing a process concept for the first parallel utilisation of recovered paper for packaging paper and levulinic acid production

Background/Problem area

Packaging paper and board are mainly produced from recycled fibres. Another characteristic of this product segment is the comparatively low reject ratios resulting from highly closed pulp cycles. This leads to increased concentrations of contaminants and minerals lowering the paper-technological usage value of fibrous raw materials. Paper producers must therefore resort to additional technical and/or technological measures which cause extra costs.

Another important trend is the increased use of renewable raw materials for energy production. In this context, the energy recovery from recovered paper has repeatedly been discussed as well.

Because of the ever more difficult economic and technological situation of paper mills resulting from these developments, for example rising energy and additive costs and mounting price pressure, manufacturers are increasingly interested in finding alternative value creation chains for recovered paper. One option is the parallel, profitable production of high-quality goods or materials from the partial pulp flows of stock preparation plants in paper mills.

Objectives/Research results

Aim of this research project is the development of a process concept enabling parallel utilisation paths of recovered paper in packaging paper production through systematic separation of a partial flow in the stock preparation plant and its use in a biorefinery process chain for levulinic acid production. Levulinic acid is just one example for suitable biorefinery processes here. The concept is intended to help the industry decide about practical implementation measures. Presently used production methods for levulinic acid were identified, and their technological and economic performance was evaluated. Different recycled fibre pulps were tested for their suitability as raw materials for chemical conversion.

Another focal point was the identification of suitable pulp flows to be discharged from the papermaking process as raw material for levulinic acid production. For this purpose, several fibre fractions were produced on laboratory and pilot scale to assess their paper-technological properties and the yields achievable by chemical conversion. The economic efficiency of the overall process concept depends mainly on the efficient separation and profitable use of minerals present in the separated partial flow. East Germany was used as a reference region to establish the mass flows of recovered paper and rejects in package production together with relevant logistic and structural data.

Application/Economic benefits

The technological concept of parallel utilisation paths of recovered paper in paper mills is new and profitable. Especially in view of the constantly rising demand for lignocellulosic materials, the extra value generated by this concept will enable paper mills to finance their fibrous raw materials also in the face of mounting competition. This can secure the future of especially small paper mills.

The new concept for the parallel production of packaging paper/board and platform chemicals enables paper mills to adjust higher reject ratios resulting in better properties of the fractions used for papermaking. This offers also a solution to the quality problems caused by increasingly closed paper recycling cycles, a route which had been blocked so far by the unfavourable cost-benefit ratios of the manufacturing structures prevailing in packaging paper and board production.

Period of time: 01.10.2010 – 30.09. 2012

Remarks

The research project IK-MF 100014 has been funded by the Federal Ministry of Economics and Technology (BMWi).

Forschungsstelle:

Hochschule München
Fakultät 05, Verfahrenstechnik Papier und Verpackung
Studiengang Papiertechnik
Lothstraße 34
80335 München

Internet: www.hm.edu

Leiter der Forschungsstelle:

Prof. Dr. St. Kleemann

Projektleiter:

M.Eng. Dipl.-Ing. (FH) Sebastian Porkert

Tel: +49 89/1265-1565
Fax: +49 89/1265-1502
E-Mail: porkert@hm.edu

Forschungsgebiet: Produkt-Ziele

Rohstoffe // Chemische Additive

Schlagworte:

Leimung, ASA, AKD, Leimungsrevision

Thema:
Leimungsoptimierung

Ausgangssituation/Problemstellung

Die Leimung (Hydrophobierung) ist bei der Papierherstellung eine entscheidende Prozessgröße für die Weiterverarbeitung sowie für Produkteigenschaften wie Beschreibbarkeit oder Verpackung von Gütern und Lebensmitteln.

Eigene Untersuchungen haben gezeigt, dass die bisherige Ansicht, ASA und AKD würden überwiegend kovalent an die Faser gebunden, überdacht werden muss. Bisher gefundene Ergebnisse deuten darauf hin, dass große Mengen der heute üblicherweise eingesetzten Leimungsmittel zur gewünschten Leimung so gut wie nichts beitragen, im Papier unter bestimmten klimatischen Bedingungen ein Potential für Nebeneffekte zeigen und bei besserer Kenntnis des genauen Ablauf und des Mechanismus eingespart werden könnten. Dies würde helfen, die Leimungsmittelkosten und -konzentration im Papier/Karton sowie unerwünschte Nebeneffekte zu vermindern.

Forschungsziel/Forschungsergebnis

Es soll ermittelt werden, wie ASA/AKD zukünftig deutlich effizienter als Leimungsmittel eingesetzt werden kann, ohne dass negative Effekte auftreten. Zusätzlich soll eine Schnellmaßnahme entwickelt werden, falls eine rasche Umsetzung wegen störenden Nebeneffekten erforderlich werden sollte. Erste Ergebnisse zur Leimungsreversion liegen bereits vor.

In zweiter Linie sollen wichtige Vorarbeiten zu einem geplanten, mehrjährigen Forschungsprojekt zusammen mit der TU Dresden und Uni Hamburg (AIF-, BMWi, o. ä.) geleistet werden. Darunter fallen die Entwicklung einer validen Labormethode zur Untersuchung der Lagerbedingungen (Dauer, Temperatur, Luftfeuchtigkeit) sowie der Verteilung im Papier in Z-Richtung und die Untersuchung von Zusatzstoffen (Füllstoffe, Additive) auf das Vorliegen störender Nebeneffekte. Darüber hinaus soll analysiert werden, welche Bestandteile der Leimungsmittel überhaupt stören.

Anwendungen/Wirtschaftliche Bedeutung

ASA (Alkenylbernsteinsäureanhydrid) und AKD (Alkylketendimer) macht heute gemeinsam gut die Hälfte des weltweiten Verbrauchs der Leimungsmittel bezogen auf Papier aus. Zu Ihrer Anwendung als kostengünstige Leimungsmittel in Gegenwart von $CaCO_3$ und Altpapier gibt es keine großindustrielle Alternative.

Bearbeitungszeitraum: 01.01.2012 − -31.12.2012

Bemerkungen

Das Projekt (INFOR 159) wird durch das Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

Forschungsstelle:

TU-Darmstadt
Institut für Makromolekulare Chemie und Papierchemie
Petersenstr. 22
64287 Darmstadt

Internet: www.chemie.tu-darmstadt.de/map

Leiter der Forschungsstelle:

Prof. Dr. Markus Biesalski

Projektleiter:

Dr. Melanie Gattermayer

Tel: 06151/166917
Fax: 06151/162479
E-Mail: gattermayer@cellulose.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Rohstoffe // Additive

Schlagworte:

Bioinsiprierte Polymer-Additive

Thema:

Molekulare & Mesoskopische Effekte der Faser-Füllstoff-Additiv Wechselwirkung I: Synthese und Charakterisierung von bioinspirierten Polymeradditiven basierend auf Catechol-funktionalen Copolymeren (Teilprojekt aus dem Ressourcenschwerpunkt 142)

Ausgangssituation/Problemstellung

Aus der Natur kennt man eine Reihe von interessanten Adhäsionsphänomenen, wie zum Beispiel Geckofüße oder Muschelproteine. Letztere verleihen Muscheln die Fähigkeit in wässriger Umgebung mit verschiedensten Grenzflächen organischer, wie auch anorganischer Herkunft extrem feste und stabile Verbindungen auf der Basis koordinativer und kovalenter Wechselwirkungen einzugehen. Auch wenn die molekularen Grundlagen dieser Adhäsionseigenschaften noch nicht vollständig verstanden sind, so weiß man heute, dass organische Catecholfunktionen (o-hydroxi-Phenole) in Muschelproteinen für diese hochinteressanten Adhäsionseigenschaften verantwortlich sind. Im Bereich der Biomedizin wurden speziell hergestellte Catechol-funktionale Polymere bereits als neuartige Klebstoffe beforscht. Im Bereich Papier wurden diese Polymere bisher nicht eingesetzt. Daher liegt es nahe, diese bioinspirierten Polymere für ihren Einsatz zunächst im Bereich des Wet End zu untersuchen. Das Projekt ist Teil des in 2010 eingerichteten Ressourcenschwerpunkts 142 und wird von Mitgliedern des Cluster Papierforschung (CPF) bearbeitet. In diesem Projekt werden die Polymere in Darmstadt (Prof. Biesalski) entwickelt und die Wechselwirkung mit organischen (Fasern) sowie anorganischen (Füllstoffen) getestet. Bei den Projektpartnern werden Untersuchungen zum Einsatz im Wet End (Dr. Miletzky, Dr. Ehrhard, PTS Heidenau), sowie die Verteilung und der Verbleib der Polymere im Papier untersucht (Prof. Fischer, TU Dresden; Dr. Odermatt, TU Hamburg).

Forschungsziel/Forschungsergebnis

In dem vorgeschlagenen Projekt sollen neuartige Polymeradditive entwickelt und hinsichtlich ihrer Adhäsionseigenschaften an anorganischen (TiO_2, SiO_2) sowie organischen (Cellulose) Oberflächen getestet werden. Die chemische Struktur dieser neuartigen Additive soll aus hydrophilen, ungeladenen/geladenen Polymersegmenten sowie aus bioinspirierten, Catechol-funktionalen Segmenten mittels radikalischer Copolymerisation aufgebaut werden und deren Einsatz als neuartiges Papieradditiv getestet werden. Insbesondere soll geprüft werden, ob sich durch den Einsatz dieser Polymere Opazitätssteigerung und effizientere Beladung von Papieren mit TiO_2 erreicht werden kann.

Innerhalb der ersten Projektphase wurden Catechol-funktionale Polymere auf Basis von ungeladenen und geladenen Polyacrylamiden hergestellt und charakterisiert. Hierbei hat sich gezeigt, dass durch eine geeignete Wahl des Polymerisationsverfahrens sowie durch Einstellung der Polymerisationsparameter, die Menge an eingebauten Catecholfunktionen reproduzierbar kontrolliert werden kann. Die von uns entwickelten Polymere zeigen abhängig vom pH-Wert des Umgebungsmediums einerseits sehr gute dispergierende Eigenschaften für TiO_2 in Lösung. Bei Verwendung von geladenen Polymeren ist die Retention der Pigmente vergleichbar mit konventionell eingesetzten Additiven, wie z. B. Percol47. Werden die erreichbaren Opazitäten und Weißegrade von Laborblättern betrachtet zeigt sich eine signifikante Erhöhung der Opazität für ungeladene und kationische Catecholpolymere. Die erhaltenen Werte liegen hier im gleichen Größenbereich wie für Papiere bei denen das kommerziell eingesetzte Retentionsmittel Percol47® verwendet wurde. Der Massegehalt an TiO_2 Pigmenten liegt bei Letzteren jedoch deutlich höher als bei Blättern mit Catecholpolymeren. Eine Ursache hierfür kann eine homogenere Verteilung der TiO_2 Pigmente im Papier sein, was zur Zeit noch geprüft wird.

Anwendungen/Wirtschaftliche Bedeutung

Man kann sich vorstellen, dass der Einsatz von funktionalen, ungeladenen Adhäsionsmodulen in neuartigen Polymeradditiven zu einer Effizienzsteigerung (z. B. geringere Konzentration an zugesetzten Polymeren, effiziente Retention, Energieeinsparung durch gröbere Mahlgrade etc.) im Bereich des Wet-End führen kann. Bis hierzu ein umfassendes Verständnis vorliegt, müssen jedoch noch eine Reihe von grundlegenden Untersuchungen durchgeführt werden.

Bearbeitungszeitraum: 01.05.2010 − 30.04.2012

Bemerkungen

Das Projekt (INFOR 142 R) wird aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. im Rahmen des Ressourcenschwerpunkts gefördert. Im Anschluss an dieses Projekt soll eine Verstetigung im Rahmen eines DFG-Projekts erfolgen. Ein entsprechender Antrag ist in Vorbereitung.

Forschungsstelle 1:

TU-Darmstadt
Institut für Makromolekulare Chemie und Papierchemie
Petersenstr. 22
64287 Darmstadt

Internet: www.chemie.tu-darmstadt.de/map

Leiter der Forschungsstelle:

Prof. Dr. Markus Biesalski

Projektleiter:

Dr. Melanie Gattermayer

Tel: 06151/16-6917
Fax: 06151/16-2479
E-Mail: gattermayer@cellulose.tu-darmstadt.de

Forschungsstelle 2:

Hochschule München
Fachbereich 05 / Papiererzeugung
Lothstr. 34
80335 München

Internet: www.hm.edu

Leiter der Forschungsstelle:

Professor Dr.-Ing. Stephan G. Kleemann

Fax: 089/1265-1551
Tel: 089/1265-1551
E-Mail: kleemann@hm.edu

Forschungsgebiet: Produkt-Ziele

Rohstoffe // Additive

Schlagworte:

Photovernetzbare Nassfestmittel

Thema:
Entwicklung und Einsatz von Photo-reaktiven Polymeradditiven als funktionale Nassfestmittel

Ausgangssituation/Problemstellung

Es gibt eine Vielzahl an Papiersorten, die ausreichend Festigkeit im feuchten oder nassen Zustand in Verarbeitungs- oder Gebrauchsprozessen bewahren müssen. Hierbei kommen zurzeit u. a. Polyamidoamin-Epichlorhydrin Harze, Melamin- und Harnstoff-Formaldehydharze und untergeordnet die Glyoxal Harze zum Einsatz, die alle gemeinsam haben, dass die Ausbildung der chemischen Bindungen zwischen Harz und Faser thermisch erfolgt. Neben thermischen Verfahren kann man sich aber auch andere, z. B. photochemische Verfahren vorstellen, um funktionale Polymere mit Fasern im Papiervlies (oder Komponenten des Papierstrichs) chemisch zu vernetzen. Benzophenon ist als Photoinitiator für Polymerisationsreaktionen, u. a. auch in Druckfarben, schon länger bekannt. Neben der Möglichkeit, Polymerisationen zu initiieren, werden Benzophenone aber auch als Photovernetzer (z. B. in der Biomedizin und Biologie) eingesetzt. Hier wirkt Benzophenon nicht als Photoinitiator sondern abstrahiert u. a. aliphatische Protonen (u. a. aus Proteinen) und rekombiniert dann mit den resultierenden Kohlenstoffradikalen im Aliphat. Implementiert man solche Gruppen in Polymere, so kann man diese so hergestellten photoreaktiven Polymere als Vernetzer in Faservliesen einsetzen und eine chemische Vernetzung von Papierfasern durch eine einfache Belichtungsreaktion initiieren. Die Verwendung von photovernetzenden Additiven bringt den Vorteil, dass man die chemische Vernetzung unabhängig von den auf einer Papiermaschine gewählten Prozessparametern insbesondere auch in Gegenwart von Restfeuchten durchführen kann.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist es, photoreaktive Polymeradditive auf ihren Einsatz als Nassfestmittel und funktionale Papierinhaltsstoffe zu prüfen. Polymere, die in Darmstadt hergestellt und charakterisiert wurden und über photoreaktive Benzophenonfunktionen verfügen, sollen zunächst im Labormaßstab als Nassfestmittel eingesetzt und hinsichtlich ihres Eigenschaftsprofils untersucht werden. Innovativ in diesem Zusammenhang ist, dass die hier eingesetzten Additive nicht wie sonst üblich thermisch, sondern über eine photo-chemisch gesteuerte Reaktion an Papier binden. Des Weiteren ist ein Ziel dieser ersten Arbeiten, bei unserem Kooperationspartner seitens der Hochschule München die Möglichkeiten zur anwendungsnahen Applikation der neuen Additivsysteme auf das Papier zu untersuchen. Insgesamt soll das Projekt als Anschubprojekt für einen gemeinsamen (größeren) Verbundantrag (AiF, Cluster, o. ä.), dienen, bei dem auch die Mitarbeit eines oder mehrerer Industriepartner vorstellbar ist.

Im Projekt wurden zunächst Copolymere (PDMAA-co-MABP) mit unterschiedlichem molaren Gehalt an photoreaktiven MABP synthetisiert und umfassend charakterisiert. Prüfblätter, bestehend aus 80 % Kurzfaser und 20 % Langfaser, wurden an einem Rapid-Köthen Blattbildner mit einem Flächengewicht von 80 +/-1 g/m² hergestellt. Alle Polymere wurden als wässrige Lösung über eine Leimpresse auf die Prüfblätter aufgebracht und anschließend an einem Photo-/Kontakttrockner etwa 130 Sekunden bei 120 ºC getrocknet. Beim Einsatz von etwa 1 % Copolymer bezogen auf otro Faserstoff wurde eine signifikante Nassfestigkeitssteigerung von 10 – 12 % erzielt und somit relative Nassfestigkeitswerte von 14 – 16 % erreicht. Der molare Anteil an MABP im Copolymer zwischen 0,5mol% und 2mol% hat keinen signifikanten Einfluss auf die Entwicklung der Nassfestigkeit. Selbst bei 0,5mol % MABP im Copolymer wurde eine Nassfestigkeitssteigerung von über 10 % erzielt. Die Steigerung der Nassfestigkeit resultierend aus dem steigendem Einsatz von Polymer ist exponentiell und erreicht scheinbar asymptotisch ein Maximum bei einer relativen Nassfestigkeit von 15 – 16 % und dem Einsatz von über 1 % Polymer bezogen auf otro Faserstoff. Ebenso ist ein positiver Effekt des Copolymers auf die Trockenfestigkeit des Prüfblattes zu erkennen. Ein weiterer wichtiger Parameter stellt die Belichtungsintensität dar, die die Vernetzungsrate des Benzophenon bestimmt. Da die Belichtung bei 254 nm im Vergleich zur Belichtung bei 365 nm deutlich kürzer ist, um die äquivalente Belichtungsintensität zu erreichen, wurden die Proben in den meisten Versuchsreihen bei 254 nm belichtet. Selbst mit einer Intensität von nur 0,05 E ½, was einer Zeit von etwa 13 Sekunden bei Belichtung mit 254 nm entspricht, konnte eine relative Nassfestigkeit von über 10 % erzielt werden. In der Referenzreihe mit dem Homopolymer PDMAA von vergleichbarem Molekulargewicht wurde bewiesen, dass die photoreaktive Gruppe Benzophenon verantwortlich ist für die intra- und intermolekulare Vernetzung im Blattgefüge und somit für die sehr deutliche Nassfestigkeitssteigerung. Der Einsatz des Copolymers und anschließender Belichtung hat keinen Effekt auf den Leimungsgrad des Papiers, jedoch einen negativen Einfluss auf Farbort und Weißgrad, da die Belichtung unter UV-Licht durchgeführt wird. Beim Vergleich mit kommerziellem PAAE-Harz konnte dargestellt werden, dass die Entwicklung der Trockenfestigkeit nahezu identisch verläuft. Bei der Performance der Nassfestigkeit sind nur geringfügige Abstriche zu machen beim Vergleich mit kommerziellem PAAE-Harz

Anwendungen/Wirtschaftliche Bedeutung

Sowohl Papierfabriken als auch die Papierverarbeiter können unmittelbar von den Ergebnissen des Forschungsprojektes profitieren. Durch den Einsatz der neuartigen Polymeradditive ist es vorstellbar, eine Nassverfestigung von Papieren zu erreichen, die unabhängig von den gewählten Prozessparametern einstellbar ist. Schließlich wird durch einen teilweisen Ersatz der herkömmlichen Nassfestmittel auch die AOX Belastung in Abwässern weiter reduziert. Unternehmen innerhalb der chemischen Industrie (Zulieferer) eröffnet sich die Möglichkeit, ihr Portfolio im Bereich effizienterer Nassfestmittel zu erweitern.

Bearbeitungszeitraum: 01.05.2011 − 30.04.2012

Bemerkungen

Das Projekt (INFOR 154) wurde aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert. Ein IGF-Antrag zur weiteren Förderung erfolgt im Spätjahr 2012.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Reinhard Sangl
Tel: 089/12146-496
Fax: 089/12146-36
E-Mail: reinhard.sangl@ptspaper.de

Research area: Product aims:

Raw materials // Chemical additives

Key words:

Graphen, barrier, conductivity, strength

Title:
Graphenes in coated paper to enhance barrier properties, surface strength and electric conductivity

Background/Problem area

The Nobelpreis in 2010 has been awarded for two-dimensional carbon structures: graphens. Graphen is structured as a mono layer of carbon atoms and, as a two dimensional material, can hardly classified in common systems.

Product properties of graphen are expected to vary according to its synthesis, i.e. CVD (Chemical Vapor Deposition), GE (Graphite Exfoilation), electro-chemical methods or crystallization processes, because purity and structure and stabilization of particles are influenced by these processes.

Application of graphen in the paper industry as a young material is hardly reported by now.

Graphene can be considered to be the basic elements of carbon nano tubes and fullerenes, which may be included into the investigations.

Objectives/Research results

The objective of the research project is to evaluate the potentials of the ne material for applications in paper.

Literature data concerning the application of graphen are collected and the application of graphen in the paper industry is to be evaluated. Expert opinions are considered very important for this evaluation.

Risks in the use of graphen originate in the risk of nano particles in general. Today it is assumed that no hazardous effects are derived from the use of nanoparticles as they are dispersed in water, while dry primary partlicles are suspect to enter especially the alveols in the lungs and are prone to be cancerogenous.

Many papers have been written on graphen properties, using and enhancing its electonic properties. Barrier properties, strength and surface strength and conductivity, however, are properties, which may be enhanced when graphen is incorporated in paper coatings. An accordance with the technical committee it was decided to follow this application.

This requires to investigate the availability of grapheme on the market. Internet shops indicate a good availabilty at costs between 200 US$ for one single freestanding graphen film of some cm², and about 1$ for one g of nano powder. However, not all products on stock and it often takes months before the product can be delivered. For experiments where the surface properties are investigated it is advised to apply highly purified materials. This purification means that the appearance of carbon black is reduced and conductivity is enhanced as the material shows only 2-3 layers.

Samples of coated papers will be manufactured in the course of the project and their

- barrier against water vapour
- conductivity and
- strength

will be tested in order to derive

Application/Economic benefits

Basic information, collected and put together for a special applications, can be the base for further investigations in individual product groups. It is expected that the extremely high aspect ratio can be used for improving barrier properties of packaging paper. Speciality papers which require electrical conductivity or high strength may also be treated with graphenes in order to reach these properties.

The investigation of paper samples coated with a graphen-based coating colour will give rise to other possible applications in the paper industry.

Economic applications will be identified.

Availability, shape and quality of grapheme on the market will be documented..

Period of time: 01.01.2012 – 31.12.2012

Remarks

Project (INFOR 158) is being funded by Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.

PRODUKT-ZIELE

Forschungsgebiet
Faserstoffe

Altpapierstoff
Holzstoff
Zellstoff

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. D. Voß
Dipl.-Ing. G. Hirsch

Tel: 06151/16-2754
Fax: 06151/16-2454
E-Mail: voss@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Faserstoffe // Altpapierstoff

Schlagworte:

Altpapier, DIP, Hickies, Druckveredelung

Theme:
Recycling Friendly Varnishes - A Challenge for the Paper Product Chain

Background/Problem Area:

Currently there is the significant trend by publishers and printing houses to improve the quality and the attractiveness of printed products by varnishing of cover surfaces or of special advertisements. During the stock preparation varnish particles are created which are not always completely removed from the fibre stock and get into the paper. During the printing such varnish particles can be pulled out of the paper and cause hicky problems in the press room. To avoid such problems the varnishing particles must be removed from the fibre stock. But therefore a measurement method is necessary to evaluate the amount of varnish particles in a fibre suspension. Today there is no method available.

Due to the fact that increasing amounts of print varnishes enter the DIP process with the recovered paper such a test method has to be developed.

Objective/Research Results:

In this project a measurement method for detection of varnish particles in fibre suspensions should be developed and varnished print products should be estimated on its hicky potential. With the knowledge, which varnish applications cause many hickys, approaches are considered in cooperation with printers and ink suppliers to reduce the hicky forming potential and to improve the removability of the varnish applications.

The project is split into five work packages.

1. A literature and internet survey will clarify which varnish systems are used in the area of the production of graphic paper products, what are their market shares and who are the relevant ink suppliers and printers.
2. A lab test method is developed utilising all image analysis techniques available at PMV. The test procedure to be developed for the determination of hickies might become complex and has to cover several measuring techniques. Therefore the measurement results will be compared with results of the conventional macro sticky method (INGEDE Method 4) detecting tacky particles and a new method which detects hydrophobic particles by colouring with fluorescent dyes.
3. A general investigation of varnished products which are available on the market is carried out. The impact of varnishes on DIP quality is evaluated and benchmarked according to the newly developed method. From the survey of varnish systems the relevant once will be tested for their contribution on hickies during recovered paper processing depending on their amount in recovered paper processes. The results will become basic knowledge for material changes in these applications.
4. Together with publishers/printers and varnish/printing ink suppliers the impact of the varnish applications on removability by flotation deinking is investigated to overcome the observed problems.
5. A theoretical concept on additional process steps or process step combinations is considered to master the varnish problems.

Application/Economic Benefits:

A survey on the state-of-the-art varnishing technology for graphic paper products is compiled. A practicable test method for detection of varnishes in DIP is developed. Critical varnishing systems are identified and benchmarked in comparison to other systems. With the results of the project it should be possible to estimate the behaviour of varnishes during DIP processing. Recommendations for recycling friendly varnishes will become available and if manufacturers will support the project significant improvements may be demonstrated which fulfill also the needs of quality and attractiveness of printed products for the publishers.

Project Period: 01.04.2012 – 30.09.2013

Remarks:

The research project (INGEDE 13712) is being funded by the INGEDE.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. D. Voß
Dr.-Ing. H.-J. Putz

Tel: 06151/16-2754
Fax: 06151/16-2454
E-Mail: voss@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Faserstoffe // Altpapierstoff

Schlagworte:

Recycling, Stickys, Stickymessung, Messverfahren

Theme:
Development of an Easy and Fast Laboratory Method for the Assessment of Micro and Macro Stickies

Background/Problem Area:

The use of recovered paper in paper grades of higher quality is limited by the quantity of impurities brought in with the raw material. Stickies which originate from adhesive applications and are included in paper products are the most important source. These stickies have to be removed from deinked pulp so that the quality of the produced new paper can reach similar quality as paper made of virgin fibres.

The estimation of sticky amount in paper stock during stock preparation is essential for benchmarking the process efficiency, monitoring the quality and controlling the production process. Common laboratory methods for sticky evaluation are either steady or complicated or do not gain exact information e. g. about particle size distribution of sticky particles. Most of the methods are based on a screening step with a 100 µm slot width before visualization of sticky particles by powder or coatings. Therefore the limit of detection is above 100 µm equivalent circle diameter (macro stickies). For particles below 100 µm (micro stickies) there is no common laboratory method available. Different methods use gravimetric approach for the evaluation, but thereby the information about the particle size distribution is lost, which is essential for the assessment of screening process efficiency.

Objective/Research Results:

The aim of the investigation is the development of a new laboratory method for the assessment of sticky particles by using a fluorescence agent for marking hydrophobic materials in the paper stock. This fluorescence is afterwards measured using UV light and a CCD-camera. Information about the particle size distribution and quantity will be available. According to the used camera, the limit of detection is near 5 µm; therefore the method can evaluate micro and macro stickies. It is tested, if it is possible to measure laboratory sheets and thus accelerate the method.

To reach the given tasks a new measurement system with CCD-camera and UV light is built up at PMV laboratory. Simultaneously 10 different fluorescing agents are investigated for their use in paper stock to ensure marking only hydrophobic impurities and not fibres. Nil red seems to be a very suitable fluorescing agent as hydrophobic material can be detected as red particles. So the negative influence of optical brighteners (leading to blue illuminated particles) could be reduced. The laboratory handsheets are formed directly from the pulp, the handsheets are afterwards saturated with a nil red solution. At the moment correlation trials between existing sticky methods (INGEDE Method 4) and industrial stock samples are performed.

Application/Economic Benefits:

With the completion of the project a new sticky method based on the measurement of the fluorescence of hydrophobic materials in paper stock is available. As laboratory sheets are used, the method is much faster than existing methods, whilst the accuracy of the method is increased, because macro and micro stickies can be evaluated within the same measurement. Therefore an easy, fast and effective tool for benchmarking the process efficiency, monitoring the quality and controlling the production process will be available.

Project Period: 01.09.2010 – 28.02.2013

Remarks:

The project IGF 16709 N is being funded by the Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Rainer Spörl
Tel: 03529/551-642
Fax: 03529/551-889
E-Mail: rainer.spoerl@ptspaper.de

Research area: Product aims

Pulps // Recycled fibre pulp

Key words:

Recyclability, Components, Varnish, Food-contact paper

Title:

Recycling-oriented and health-friendly design of varnished paper and packaging products for the secure use of recovered paper for food contact papers

Background/Problem area

Paper and cardboard are inevitable for food packaging due to its numerous technical qualities. On the recycled-fibre based papers and boards produced for food contact special requirements are imposed. In addition to the functional properties they must also be safe for the food and its consumers.

Since recovered paper is the most important source of raw materials for the paper industry, including food contact papers, recyclable and environmentally friendly design of paper / cardboard products is of great importance in terms of sustainability and recycling cycle.

In order to initiate developments in sustainable products, it is necessary to establish a method for testing and evaluation. Only with the help of a concept for evaluation, developments of recyclable and environmentally-friendly paper products may be pursued and evaluated.

Objectives/Research results

The aim of the project is the development of guidelines for the recyclable and environmentally friendly design of paper and packaging products, paying particular attention to varnishes (UV coatings, dispersion vanishes, oil based varnishes).

Another goal is the establishment and expansion of recyclability assessment of paper and packaging products, taking into account critical substances.

Recyclability tests of different varnished paper and packaging products showed good defibration as well as trouble-free sheet forming (sheet adhesion test). Differences were analysed regarding the fragmentation behaviour. There was not removal by screening due to the fragmentation. All pulps contained dirt specks that could not be completely removed by flotation. Dirt specks particle size distribution depends on type of varnish used.

Application/Economic benefits

The research project follows the basic approach, to expand the method of recyclability assessment of paper and packaging products to critical substances. This will lead to a significant expansion of basic knowledge about the recyclable and healthy design of paper and packaging products. In this way, the sustainable design of paper and packaging products will be promoted in order to ensure manufacturers of food packaging existing markets.

Period of time: 01.07.2011 – 30.06.2013

Forschungsstelle:

Albert-Ludwigs-Universität Freiburg
Institut für Forstbenutzung und Forstliche Arbeitswissenschaft
Werthmannstraße 6
79085 Freiburg

Internet: http://www.fobawi.uni-freiburg.de

Leiter der Forschungsstelle:

Prof. Dr. Dr. h.c. Gero Becker

Projektleiter:

Prof. Marie-Pierre Laborie, Ph. D

Tel: 0761/203-97617
Fax: 0761/203-3763
E-Mail: marie-pierre.laborie@fobawi.uni-freiburg.de

Forschungsgebiet: Produkt-Ziele

Faserstoffe // Zellstoff // Nebenprodukte

Schlagworte:

Zellulose-Nanofasern, Aminoplastharze, Hochleistungs-klebstoffe, Zellstoffe, Nano-Verbundwerkstoffe, CNFs-verstärkte Aminoplastharze

Thema:

CELLADHEREWOOD: Herstellung umweltfreundlicher Hochleistungsklebstoffe aus Abfallprodukten der Zell-stoffindustrie

Ausgangssituation/Problemstellung

In der Zellstoffindustrie fallen bei der Herstellung von Zellstoff stark zellulosehaltige Abfallmaterialien an. Diese Abfallpro-dukte bestehen weitestgehend aus erneuerbaren Rohstoffen, können derzeit aber noch nicht sinnvoll weiterverwertet wer-den. Der größte Anteil wird - häufig in den werkseigenen Kraftwerken - thermisch verwertet. Mit Hilfe der Nanotechnologie können aus diesen Abfallprodukten Zellulose-Nanofasern (CNFs) hergestellt werden. Bereits kleine Mengen von CNFs (von weniger als 1 % des Volumenanteils) verleihen thermoplastischen Polymeren deutlich bessere mechanische und thermische Eigenschaften. Nur wenige Studien haben sich im Gegensatz dazu bisher mit den Auswirkungen von CNDs auf die Eigenschaften wärmehärtender Polymere beschäftigt.

Forschungsziel/Forschungsergebnis

Im Rahmen des Projekts soll die Anwendung von Nanozellulose verbessert und erweitert werden. Das übergeordnete Ziel ist die Entwicklung einer Technologie, um hochleistungsfähige Aminoplastharze herzustellen. Diese sollen als Hochleis-tungsklebstoff und zur Oberflächenbeschichtung in der Holzwerkstoffindustrie bereitgestellt werden. Für die Herstellung werden Nanoverstärkungen verwendet, die als zellulosehaltige Abfallprodukte in der Holz- und Zellstoffindustrie anfallen.

Das Forschungs- und Entwicklungsvorhaben wird drei Hauptziele und damit verbundene Aufgaben beinhalten:

1. Qualitative und quantitative Bewertung der zellulosehaltigen Abfallprodukte in den unterschiedlichen Produktionsschrit-ten der Zellstoffherstellung für die Produktion von Nanozellulose;
2. Entwicklung der Technologie zur Herstellung hochleistungsfähiger Aminoplastharze mit Hilfe von Nanozellulosefasern;
3. Nachweis der Einsatzmöglichkeit der Technologie bei Faserplatten.

Anwendungen/Wirtschaftliche Bedeutung

Zellulose-Nanofasern (CNFs) vereinen außerordentlich gute mechanische Eigenschaften mit einer hochreaktiven (Hydro-xyden) Oberfläche und sind zudem außerordentlich günstig in der Herstellung. Zahlreiche wissenschaftliche Untersuchun-gen haben das hervorragende Potenzial der CNFs zur Verstärkung und thermischen Stabilisierung von thermoplastischen Polymeren nachgewiesen. Erste Untersuchungen weisen darauf hin, dass CNFs eine ideale und kostengünstige Alternative zu Kohlenstoff-Nanoröhrchen darstellen könnten, um nanoverstärkte umweltfreundliche Beschichtungen und Hochleis-tungsklebstoffe herzustellen.

Bearbeitungszeitraum: Februar 2011 – Januar 2013

Bemerkungen

Das Projekt wird finanziert vom *Ministerium für Ländlichen Raum und Verbraucherschutz* aus Fördermitteln der "Clusterini-tiative Forst und Holz in Baden-Württemberg".

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MINISTERIUM FÜR LÄNDLICHEN RAUM UND VERBRAUCHERSCHUTZ

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dr.-Ing. H.-J. Schaffrath

Tel: 06151/16-2408
Fax: 06151/16-2454
E-Mail: schaffrath@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Faserstoffe // Zellstoff

Schlagworte:

Tropenholz, Bildanalyse, Faserrezeptur, Fasermikroskopie

Theme:
Evaluation of Mixed Tropical Hardwood (MTH) in Paper – a Contribution to Species Protection

Background/Problem Area:

Fibres of mixed tropical hardwood (MTH) are not used as regular source for the manufacturing of paper. Therefore, they are not listed in the common books for identification of fibres by mean of a light microscope. On the other side it has been detected that MTH fibres originating from deforestation of natural rainforests, e.g. to build palm oil plantations, are used in paper and board products.

A significant influence of natural rainforests on the ecological system of the whole earth is generally well accepted, and to protect these regions the use of tropical wood is regulated and has to be confirmed. The European Union (EU) inquires the declaration of species and origin for imported wooden products beginning in 2013, and this includes paper and pulp products, too. In consequence a method has to be established that allows the evaluation of MTH fibres in paper and board products. Examination with a light microscope is already established, but the present literature has to be augmented with some important tropical hardwoods.

Objective/Research Results:

Until now only hints may be found that create a reasonable suspicion on the use of MTH fibres. These hints are the detection of unknown fibres of several genus accompanied by acacia or eucalyptus. The ongoing project will lead to an extended fibre atlas of 25 selected tropical hardwoods. Ecological importance (as mangroves) and frequency of occurrence in the natural rainforests (as shorea) are as well a criterion for selection as degree of threat for a single species (e.g. ramin). This opens the chance to announce the finding of MTH as a precise test result.

In addition, the examination procedure shall be automatised by image analysis and fuzzy classification. This will allow the analysis of much more fibre preparations under the microscope than today which gives higher statistical probability to detect even small amounts of MTH in the range of 1 %.

In several cases it may be of importance to identify a single, protected species. This has to be done by electronic microscopy combined with chemotaxonomic.

Application/Economic Benefits:

Non government organisations (NGOs) as Greenpeace or WWF (World Wide Fund for Nature) are interested to have a reliable test result when analysing paper and board products on the use of MTH. But meanwhile a lot of profit organisations as discounters, press rooms or even paper manufactures that buy pulp on the market are asking for possibilities to control their suppliers on MTH free deliveries.

With the completion of the project some MTH fibres can be detected for sure. Time and expense of an analysis will decrease so that frequency of analysis will increase. The illegal use of MTH as a fibre source will be detected with a high probability and more precise test result. In consequence it will be a risk to use MTH for pulp or paper manufacturing. This will be a contribution in the efforts to decrease the deforestations of tropical rainforests.

Project Period: 01.01.2012 – 31.12.2013

Remarks:

The project AZ 29436-31 is being funded by the Deutsche Bundesstiftung Umwelt (DBU). It's a joint project between PMV (TU Darmstadt), Zentrum für Holzwirtschaft – chemische Holztechnologie (Universität Hamburg), Institut für Holztechnologie und Holzbiologie (Johann Heinrich von Thünen-Institut, Hamburg) and ISEGA – Forschungs- und Untersuchungsgesellschaft mbH (Aschaffenburg).

PRODUKT-ZIELE

Forschungsgebiet
Papier, Karton und Pappe

Graphische Papiere
Verpackungspapiere und -karton
Technische Spezialpapiere

Forschungsstelle:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Leiter der Forschungsstelle:

Dr. Frank Miletzky

Projektleiter:

Dr.-Ing. Rainer Klein
Tel: 03529/551-686
Fax: 03529/551-889
E-Mail: rainer.klein@ptspaper.de

Forschungsgebiet: Produkt Ziele

Papier, Karton und Pappe // Graphische Papiere

Schlagworte:

Messtechniken, Messmethoden, Penetrationsmessung, Papierbewertung, Offsetdruckpapier, Offsetdruck, Druckergebnis

Thema:
Entwicklung eines Systems zur mehrdimensionalen, ortsaufgelösten Messung der Dynamik der Flüssigkeitspenetration in Papier und Karton

Ausgangssituation/Problemstellung

Für viele Verarbeitungseigenschaften sowie die Verarbeitungsergebnisse spielen das Zeitverhalten sowie die Konstanz der Papiereigenschaften in x-, y-, (z)-Richtung eine große Rolle. Die derzeitig eingesetzten Messtechniken zur Papierbewertung liefern jedoch in den seltensten Fällen zeit- und/oder ortsaufgelöste Messdaten und sind damit nur bedingt geeignet Verarbeitungsergebnisse abzuschätzen. Dies wird z. B. an der Druckungleichmäßigkeit (Mottling) deutlich, die durch lokale Druckdichteschwankungen hervorgerufen wird. Diese Schwankungen werden neben weiteren Einflüssen in starkem Maße von den lokalen Unterschieden in der Flüssigkeitspenetration ins Papier hervorgerufen. Derzeit sind jedoch keine Messsyteme verfügbar, die eine orts- und zeitaufgelöste Messung gestattet.

Forschungsziel/Forschungsergebnis

Ziel des Vorhabens ist die Entwicklung eines preiswerten, produktionstauglichen Systems zur ortsaufgelösten Messung der Dynamik der Flüssigkeitspenetration in Papier und Karton (mehrdimensionaler Penetrationsdynamikanalysator) und die Umsetzung in einem Funktionsmuster. Es soll dazu dienen das Verhalten von Papier und Karton im Verarbeitungsprozess abschätzen zu können. Einen hohen Stellenwert haben in diesem Zusammenhang die Bedruckbarkeit und hier besonders die Gleichmäßigkeit in Voll- und Rastertönen. Wesentliche angestrebte Funktionalitäten sind:

- hohe Orts- und Zeitauflösung,
- einfache Probenhandhabung,
- robuster Geräteaufbau (erforderlich für produktionsnahen Einsatz),
- einfache Bedienung (Touch Screen),
- geringe Mess- und Auswertezeit,
- hohe Reproduzierbarkeit,
- ortsaufgelöste Anzeige wesentlicher, materialspezifischer Penetrationskennwerte,
- aussagekräftige Messwertprotokolle,
- grafische Darstellung der lokalen Penetration,
- Datenspeicherung und -verwaltung.

Anwendung/Wirtschaftliche Bedeutung

Die schnelle, reproduzierbare Bereitstellung aussagekräftiger, ortsaufgelöster Penetrationskenndaten, insbesondere von der verarbeitungsprozessrelevanten Materialoberfläche, ist eine wesentliche Voraussetzung für eine zeitnahe Qualitätskontrolle und für die Vorhersage der Verarbeitungseigenschaft. Sie ist damit die Grundlage für eine zielgerichtete Produkt- und Prozessoptimierung und führt zu erheblichen Kosteneinsparungen bei den Herstellern und Verarbeitern von Verpackungsmitteln und Papier. Durch den Einsatz verschiedener Messflüssigkeiten können die verschiedenen Faktoren, die die Bedruckbarkeit beeinflussen, zielgerichtet untersucht werden.

Bearbeitungzeitraum: 01.05.2012 – 30.04.2014

Bemerkungen

Das Forschungsvorhaben ZIM-KF 2037912ST2 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie (BMWi) gefördert. Förderpartner ist emtec Electronic GmbH, Leipzig

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Markus Kleebauer
Tel: 089/12146-387
Fax: 089/12146-36
E-Mail: markus.kleebauer@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

simultaneous printability, print quality, Offset, Flexo, Inkjet

Title:
Computer assisted development of coating concepts for the optimisation of print quality by simultaneous application of offset, flexo and inkjet printing.

Background/Problem area

In the advertising industry but also in the packaging industry the market for printing products with more personal and individual elements is steadily growing. To satisfy the requirements of their customers printing shops were more and more interested in digital printing machines. Thereby the developing potential of inkjet printing is rated very high because inkjet printing heads can be easily installed in conventional printing machines and will be a valuable add-on for the production of individualised products. In the near future these developments in the printing industry will have a significant impact on paper qualities.

Today paper qualities and paper coatings are optimised for only one printing technology. They are not able to handle simultaneously the different types and amounts of fluids in offset, flexo and inkjet printing inks. Especially by combining offset or flexo with inkjet printing appropriate drying of the printing inks and high print quality cannot be assured.

Objectives/Research results

The aim of the research project is to develop coating concepts for pigment coated paper qualities which are printed simultaneously with two different printing methods especially offset – inkjet and flexo – inkjet printing. This aim should be reached by the following means:

Use of computer simulations techniques for the optimisation of sorption and ink penetration properties of coating structures.

Adaptive control of the penetration and drying properties of printing inks for offset, flexo and inkjet printing with tai-lor-made coatings structures and coating layer combinations.

Development of application concepts up to three layers using different coating methods and processes.

Development of new methods for the assessment of ink penetration, ink drying and print quality for offset, flexo and inkjet printing.

Up to now the following research activities were performed:

Printing trials with commercially available papers were carried out to determine the current printing quality of pa-pers in offset, flexo and inkjet printing.

Coating layers with different porosities were applied to two base papers and one plastic foil. Furthermore coating layers with different porosities were combined to make a multilayer approach. The samples were investigated by microscopy and tested in respect of surface tension, porosity and ink penetration.

Based on this results standard coating colours for offset and flexo printing were modified to improve their inkjet printing properties.

Simulation models based on commercially available FEM-Software were developed and tested out on the basis of experimental data. Up to now the basic effects of liquid ink penetration could be modelled quite well.

Testing instruments for ink penetration especially in the case of inkjet printing were built up and tested.

Application/Economic benefits

The results of this project should have a positive economic influence on all industrial sectors along the value chain of print and packaging products. They can perform important contributions for the formation of new business fields along the value chain, namely

In the paper producing industry through new paper qualities with highly flexible printing properties

In the chemical supply industry through raw materials and additives which are necessary for producing such paper qualities.

In the printing industry through new print products like personalised advertising brochures, instruction booklets and packaging.

In the packaging industry via products which can be quickly marked with inkjet printers.

In the supply industry of the printing industry through new printing machine concepts.

Period of time: 01.07.2010 – 31.12.2012

Remarks

The research project IGF 363 ZBG is being funded by the German Federal Ministry of Economics and Technology(BMWi) within the framework of the ZUTECH programme and is being performed together with Fogra.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Markus Kleebauer
Tel: 089/12146-387
Fax: 089/12146-36
E-Mail: markus.kleebauer@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

paper coating, matt papers, markings, nanotechnology

Title:
Coating surfaces of matt finished papers with high resistance to abrasion and markings.

Background/Problem area

During converting or handling of matt or semi matt finished papers glossy areas (so called markings) can appear on the surface of the pigment coating which can strongly reduce the optical properties of the final product. Abrasion and markings appear often during the following processes:

Format cutting, i. e. on the winder and sheet cutter

Web and/or sheet transport in printing and converting processes as well as through the

Final usage by customers

Responsible for the formation and structure of markings are more or less aggressive contacts between the paper surfaces itself or between the paper surfaces and parts of the transport elements in the machinery. The formation of markings is highly detrimental because it is often connected with an increase in maculature and customer complaints. At the moment all available countermeasures lead not to satisfying results. In particular problems with the touchiness of the surfaces resulting from the final usage by customers cannot be solved satisfactorily.

Objectives/Research results

The aim of the research project is to reduce surface markings of matt and semi matt finished, pigment coated papers. Especially during format cutting, converting and printing similar web speeds and similar sheet handling speeds should be achieved as in the case of gloss coated papers. Furthermore the formation of markings during the final use by customers should be minimised.

Based on a conventional abrasion tester (Prüfbau Quartant) and a gloss scanner an image analysis procedure was developed for measuring the sensitivity of paper samples for surface markings.

Using this method the protective effects of coating formulation based on nanoparticles (silicium dioxide, aluminium oxide and zirconium dioxide) were investigated in the laboratory and pilot scale. The formulations are applied in an additional thin layer (about 2-4 g/m²) upon the surface of two matt coated papers. Up to now the following results could be achieved:

The sensitivity for markings could be reduced significantly using nanoparticle protective coatings. Silicium dioxides were among the most effective nanoparticles.

But effects are dependent on the surface composition of the matt coated paper as well.

Gloss was affected only marginal.

Whiteness and opacity were also affected rather little.

Ink setting, mottling and picking resistance were determined in the laboratory and showed that printability in offset printing could be guaranteed.

Due to the additional nanoparticle layer on top of the papers abrasion effects in cutting were slightly enhanced.

Application/Economic benefits

The results of this project should have a positive economic influence on all industrial sectors along the value chain of print products. They can perform important contributions for the formation of new business fields along the value chain, namely

Increase in productivity of paper finishing, format cutting, converting and printing of matt papers through surfaces with higher resistance against abrasion and markings.

Preventing material and human resources in printing and converting of matt finished papers through the reduction of customer complaints.

Higher attractiveness of print products for consumers via a resistant, matt coated paper surface.

New devices and methods for testing the resistance of paper surfaces against markings which can be used for quality control.

Period of time: 01.03.2010 – 30.06.2012

Remarks

The research project IGF 16357 has been funded by the German Federal Ministry of Economics and Technology (BMWi) and was performed together with TU Dresden.

Research institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Klaus Erhard
Tel: 03529/551-627
Fax: 03529/551-899
E-mail: klaus.erhard@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

nanocellulose, microfibrillated cellulose, fibril, filler, calcium carbonate, titanium dioxide

Title:
Filling papers with nanoscale cellulose-based fibre-filler compound particles

Background/Problem area

In papermaking, raw material costs can be saved and energy demand decreased by replacing pulp fibres by mineral fillers. With regard to paper quality, such replacement is only possible if paper strength, high filler retention and equal filler distribution in the fibre matrix are ensured. This will also guarantee the runnability of the paper machine without further loading of the water circuit.

The small particle size of mineral fillers, resulting in a large surface area, and their high refractive index are the reasons for their excellent optical properties. The larger the interface between air and particle and the higher the refractive index, the greater will be the light scattering ability, resulting in high brightness and opacity of the filled paper. Particles tend to aggregate which in turn decreases the optical properties of the filler. If agglomeration can be avoided, e.g. by suitable spacers, no loss in optical properties would occur.

Last but not least, mineral particles are detrimental to paper strength since they cover some of the fibre surface, thus reducing the fibre-fibre contact area.

Objectives/Research results

The aim of the research project is the more efficient use of fillers in paper resulting in better optical properties, higher strength and reduced production costs of high filled paper grades. A suitable compound of cellulosic fibrils (“nanocellulose”) and filler particles must therefore be generated and introduced into the paper. This compound(s) should meet the following requirements:

- stability: assembly of a stable compound/flocs, insensitive to the shear forces in the wet end of the paper machine
- marginal aggregation of filler particles by the use of cellulosic spacers, thus avoiding losses in optical properties
- less detrimental effects on paper strength by masking filler particles in the cellulosic compound

The network of cellulosic fibrils around the filler particles will not only enhance the dry strength of the paper, it will also increase its initial wet web strength.

The coupling between filler particles and cellulosic fibrils and/or whiskers is evaluated among other things by scanning electron microscopy (SEM) and dynamic mechanical analysis (DMA). A dynamic mechanical analyzer from Mettler-Toledo was put into operation within the scope of the project.

The coupling is strongly influenced by

- the charge of the cellulosic fibrils, their state of swelling, their shape and particle size distribution,
- the charge of the filler, its shape and particle size distribution,
- the chemical character, charge density and molecular weight of the polymer used for coupling and
- the coupling conditions, e.g. shear forces and pH.

The effects of filler-fines-flocculation at low consistency led to somewhat higher filler amount in model paper systems. Compounds of fillers (calcium carbonate, clay, titanium dioxide) and different cellulosic fines were also prepared at higher solid content levels which are typical for filler slurries (e.g. 300g/kg). These compounds led to a significantly higher tensile strength (5-8%) for the same filler content compared to non-compounded filler/fines. The introduction of cellulosic fines particles and cationic polymers into typical filler slurries had no strong detrimental effect on slurries viscosities.

Application/Economic benefits

The results of the project will be used by papermakers in producing paper that already has high filler contents, e.g. graphic paper for copying and printing or decorative paper. The project is intended to assist in providing even greater filler content for enhanced product quality, for more efficient use of fillers and for cutting raw material costs.

Period of time: 01.02.2010 – 30.07.2012

Remarks

Research project IGF 16359 BR has been funded by the German Federal Ministry of Economics and Technology (BMWi).

Forschungsstelle:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Leiter der Forschungsstelle:

Dr. Frank Miletzky

Projektleiter:

Dr.-Ing. Rainer Klein
Tel: 03529/551-686
Fax: 03529/551-889
E-Mail: rainer.klein@ptspaper.de

Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Graphische Papiere

Schlagworte:

Papierbewertung, Messtechniken, Messmethoden, Bogenoffsetdruckpapier, Bogenoffsetdruck, Druckergebnis

Thema:
Moderne Messtechniken zur Charakterisierung von Offsetpapieren hinsichtlich Druckergebnis

Ausgangssituation/Problemstellung

Die Qualität eines Druckerzeugnisses resultiert aus dem Zusammenwirken zahlreicher, oftmals in Wechselwirkung zueinander stehender papier- und drucktechnisch bedingter Parameter. Die Komplexität dieses interagierenden Systems lässt bis heute keine zuverlässige Prognose des Verhaltens der Papiere im Druckprozess und der Qualität des fertigen Drucks zu. Dieses Defizit bedingt, dass für die Optimierung bestehender Papiere sowie die Entwicklung neuer Papiere letztendlich immer das fertige Druckprodukt und dessen Bewertung erforderlich sind.

Druckpapiere werden heute mittels einer Vielzahl elementarer Eigenschaften charakterisiert. Die vielfältigen Versuche, Zusammenhänge zwischen diesen Kennwerten und den bei der Weiterverarbeitung tatsächlich relevanten Papiereigenschaften zu finden, brachten bislang überwiegend unbefriedigende Ergebnisse. Die Ursache liegt zum einen in der nicht immer klaren Definition der verarbeitungstechnischen Anforderungen und zum anderen im Umstand, dass die heute verfügbaren Messtechniken weder für diese Aufgaben entwickelt noch optimiert wurden und somit heute oft an ihre Grenzen stoßen.

Die weite Verbreitung der Methoden der konventionellen Charakterisierung beruht auf den Vorteilen einer vergleichsweise einfachen, robusten Technik, der anwenderfreundlichen Bedienung, der Bereitstellung von (Summen-) Kenngrößen sowie auf den verhältnismäßig geringen Anschaffungskosten für die Geräte. Auf dieser Basis wurden in der Vergangenheit zahlreiche Standards erarbeitet, deren Ergebnisse in umfangreichen, belastbaren Datenbanken abgelegt sind. Angesichts zunehmender Anforderungen an Qualität und Qualitätskonstanz sind viele dieser Messtechniken nur noch bedingt geeignet oder bereits an ihre Grenzen gestoßen. In den letzten Jahrzehnten wurden moderne rechnergestützte Messverfahren entwickelt. Diese ermöglichen eine verbesserte und zum Teil neuartige Bewertung von Papier, was insbesondere auch bei der Ursachenforschung bei Verarbeitungsproblemen hilfreich sein könnte.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist die Ermittlung druckrelevanter Eigenschaften von Offsetpapieren und deren Quantifizierung mittels moderner Messtechniken als Grundlage für die gezielte Produktoptimierung und Modellierung der Wechselwirkung Papier-Druckergebnis. Es werden folgende Ergebnisse angestrebt:

- Identifikation der drucktechnisch relevanten Papiercharakteristika für den Bogenoffsetdruck,
- Bewertung der Leistungsfähigkeit eingeführter und neuer Messtechniken zur Erfassung drucktechnisch relevanter Papiercharakteristika (Screening),
- Verifizierung der Eignung der untersuchten Analysetechniken hinsichtlich prozessrelevanter Aussagen und Ausarbeitung entsprechender Messmethoden,
- Betrachtung papierseitiger Eigenschaftsabhängigkeiten im Zusammenhang mit der Rohstoffbasis und der Herstellungstechnologie,
- Herausarbeitung des Papierseinflusses auf das Druckergebnis (Farbwegschlagen, Mottling) unter Berücksichtigung von Druckfarbe und drucktechnischen Parametern,
- Berücksichtigung und Analyse der wechselseitigen Verknüpfung der Einflussfaktoren in einem statistischen Modell.

Anwendung/Wirtschaftliche Bedeutung

Der wirtschaftliche Effekt der angestrebten Forschungsergebnisse wird branchenübergreifend bei den häufig kleinen oder mittelständischen Bogenoffsetdruckern und Messgeräteherstellern sowie in der Papierindustrie erwartet. Konkret sollen die Erkenntnisse zu einer Verbesserung der für die Weiterverarbeitung relevanten Eigenschaften von Druckpapieren führen. Damit soll eine Verringerung der drucktechnischen Probleme und dadurch eine Senkung der durch Reklamationen oder Ausschuss anfallenden Kosten erreicht werden. In diesem Zusammenhang werden die Ergebnisse auch zu einer nachhaltigen Verbreitung moderner, bisher in der Papierindustrie noch nicht etablierter Messtechniken führen und somit die wirtschaftliche Situation der Messgerätehersteller stärken.

Bearbeitungszeitraum: 01.07.2012 – 30.06.2014

Bemerkungen

Das Forschungsvorhaben IGF 16902 BR wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie (BMWi) gefördert. Forschungspartner ist TU Dresden, Professur für Papiertechnik.

OResearch institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Gert Keller
Tel: 03529/551-623
Fax: 03529/551-899
E-Mail: gert.keller@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

Offset printing, dimensional stability

Title:
Modelling the dimensional behaviour of high-quality offset papers during printing

Background/Problem area

Press set-up times and the amounts of misprints produced at the start of printing could be greatly reduced in recent years. Nevertheless printers still need to save costs in order to remain competitive. Simultaneously, the quality demands on sheet-fed offset products have greatly increased. Customers expect highly accurate colour rendering as well as the precise reproduction of demanding printing subjects and technical elements. However, printing processes are still not free from critical effects: The paper substrate absorbs fountain solution and low-viscosity ink components during printing and has to withstand mechanical loads like tensile forces in MD and CD during each single pass through the various print units of the press. Especially in the case of large-size papers, this leads to significant dimensional changes in the printed sheet with various adverse effects on subsequent colour separations. The result is register differences in the print image.

Objectives/Research results

Register differences have been shown to result, among other, from unfavourable extension properties of the paper substrate due to liquid absorption into the paper surface. The project therefore aims to investigate extension processes during printing to elucidate dimensional changes caused especially by the offset printing of large-size sheets. For this purpose, the project has been subdivided into the following tasks:

Measuring major changes in mechanical paper properties caused by the effects of fountain solutions and printing inks - For this purpose, moisture-dependent elastic moduli and extension coefficients will be determined for each paper layer (base paper, coating layers), determining the structure of each layer after short-term moistening together with the resulting changes in physical properties.

Modelling length changes in multiple-coated art papers caused by moisture variations - Paper structures and their properties will be modelled by FEM to simulate the physical behaviour of the paper sheet. The results will also be used to identify critical parameters and requirements for improved and practically feasible paper structures.

Including the results of full-scale printing trials both in the parameterization of models and in the final comparison between model results and printing trials performed with improved paper substrates.

Application/Economic benefits

Envisaged result of the research project is the characterization of coatings and papers offering improved dimensional stability in industrial sheet-fed offset printing. This will increase the quality of sheet-fed offset products. Apart from time savings due to shorter set-up periods, this will enable cost savings through fewer misprints and higher machine availability. Another significant advantage of the improved papers is that printers will be able to print difficult subjects in high quality on both lower-grammage papers and larger sheet sizes after reduced set-up times.

Especially the improved runnability of large-size sheets could encourage smaller print shops to invest into equipment for larger and, thus, more economical print formats.

The project results can be expected to economically benefit mainly the printing sector, including also small and medium-size printers.

Period of time: 01.08.2011 – 31.07.2013

Remarks

The research project IGF 17217 (dimensional stability of offset papers) is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Frank Nießner
Tel: 03529/551-629
Fax: 03529/551-899
E-Mail: frank.niessner@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

ink penetration, printability, coating design, hybrid printing

Title:
Simulation based optimization of coating design and coating composition for printing paper with improved printability through selected ink penetration

Background/Problem area

The market of printing products has changed fundamentally in recent years. Competition of new media such as online portals of classic print media etc. vitalized the market. To meet the growing demands in the future, more and more printers take an interest in hybrid printing technologies, i.e. technologies that combine conventional offset printing technology with Inkjet print heads. These printing technologies define specific requirements regarding the used paper and its coating. However, existing procedures for developing coating design and coating composition for printing paper that is well-suited for a particular hybrid printing process are based on purely empirical methods. This is associated with long development times, low throughput rates of the formulation development and high development and testing costs. Paper manufacturers lack appropriate applicable tools to implement innovative coating concepts (e.g. for combined printing applications) and to derive recommendations for improved coating formulations and coating designs.

Objectives/Research results

The aim of long-term planned research projects at PTS is to support the optimization of coating design and coating composition in respect of better printability by simulation tools. It should be possible to determine the required coating design (layers) and its formulation virtually on a PC and based on the demands of the specific printing procedure.

The current project aims at the development of a first module for the simulation-based optimization of a coating design with a defined ink penetration characteristic. It focuses on offset printing with small amounts of ink in the scope of personalized printing.

Starting point was the preparation of various single and double layer laboratory samples that represent relevant coating formulations. Transparency films have been used in addition to conventional paper substrate in order to study the coating itself. The short time behavior of the penetration processes has been investigated using different methods and several printing inks and fluids. Corresponding results serve as fundament for the development and validation of data-based PLS-models that predict significant properties of the pore structure (porosity, pore size), the coating layers and material constants (particle size, binder). These properties are in turn needed as input for the models that simulate the penetration and absorption processes. Corresponding models are built up as FEM-models based on the COMSOL software. Alternatively, models that base on the Bosanquet differential equation have been composed and implemented in the MatLab software. They simulate the movement of a liquid band in a capillary. In addition, the pore structure has been calculated based on the measurements of Hg porosimetry using the Pore-Core-software. Most of the investigations done so far considered single-layer coatings. Corresponding considerations for double layer are still in progress.

Provisional results show that the models provide good prediction of the expected qualitative progression and temporal relationship of penetration time for the individual fluids. The calculated penetration times are lower than the measured values for typical amounts of fluid. This is particularly relevant for the FEM-models. Nevertheless, the analysis of FEM-models shows that in general fluid transport is stimulated solely by capillary effects without additional force. Fluid movement stops as soon as the liquid has been drawn completely into the capillary.

Application/Economic benefits

The results will be available for users of the print products value chain (paper manufacturers, printers and suppliers respectively). In particular, small and medium enterprises (SMEs) in the areas of printing, packaging manufacturing, and chemical suppliers will benefit from the research results. The optimization of coating formulation could lead to the following technical and economic benefits:

- Cost savings of experiments
- Use of cost-efficient pigment combinations that cause the same printability
- Cost and time savings for the printing industry through papers with combined printing suitability

Considerable advantages can as well be found in applications on pilot coaters. Compared to conventional approaches, a significantly larger number of variants can be studied in less time. Because of this much larger scope of experiments the use of modeling and simulation could bear creation of new paper qualities which so far is not possible due to the limitations of the experimental and empirical approach.

Period of time: 01.10.2010 – 31.12.2012

Remarks

The research project IK-MF 100031 is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Forschungsstelle:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Leiter der Forschungsstelle:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Rainer Klein
Tel: 03529/551-686
Fax: 03529/551-889
E-Mail: rainer.klein@ptspaper.de

Forschungsgebiet: Produkt Ziele

Papier, Karton und Pappe // Graphische Papiere

Schlagworte:

Rollenoffsetpapier, Rollenoffsetdruck, Tonwert, Tonwertzunahme, Prozess Standard Offset

Thema:
Quantifizierung praxisrelevanter Einflussgrößen auf die Tonwertzunahme im Rollenheatsetdruck und ihre quantitativen und wirtschaftlichen Auswirkungen

Ausgangssituation/Problemstellung

Ziel des Druckprozesses ist es, eine Vorlage originalgetreu zu reproduzieren, was eine komplexe Aufgabe darstellt. Eine wesentliche Problematik dabei ist, dass die Farbübertragung von der Platte über das Gummituch auf das Papier generell mit einer Vergrößerung der Druckpunkte – der sogenannten Tonwertzunahme (TWZ) – einhergeht. Diese Druckpunktvergrößerung besteht real aus zwei Komponenten, nämlich der optisch und der geometrisch bedingten Punktzunahme. Wird dieser Druckpunktvergrößerung in der Druckvorstufe nicht gezielt entgegengewirkt, kommt es beim Druck zu Abweichungen zwischen Vorlage und Druckprodukt und kann zu Ausschuss führen.

Wie das gesamte Druckergebnis wird auch die Tonwertzunahme von einer Vielzahl von Faktoren beeinflusst, zu denen Druckmaschine, Druckfarbe und Wischwasser, Gummituch, drucktechnische Parameter, Papier gehören. Eine genaue Quantifizierung des Einflusses der einzelnen Faktoren ist bisher noch nicht vorhanden. Bekannt ist in der Regel die Tonwert(TW)-Kennlinie der Druckmaschine. Die weiteren druckbedingten Einflussfaktoren können seitens der Drucker in gewissen Grenzen variiert werden, wobei deren quantitative Auswirkung auf die TWZ nicht ausreichend bekannt ist.

Eine wichtige Rolle hinsichtlich der TWZ wird dem Papier zugeschrieben. Auch bezüglich seines Einflusses liegen gegenwärtig nur empirische Erkenntnisse vor, die in den Prozessstandard Offset (PSO) (ISO 12647-2) eingeflossen sind.

Insbesondere Kenntnisse zur Abschätzung der TWZ auf der Grundlage elementarer Papiereigenschaften, wie sie von den Papierfabriken zur Charakterisierung ihrer Papiere ermittelt werden, sind nicht verfügbar. Darüber hinaus können auch das Sujet, d. h. die Druckinhalte, über die partielle TWZ das Druckergebnis beeinflussen. Diese Effekte sind ebenfalls nicht ohne weiteres quantifizierbar.

Forschungsziel/Forschungsergebnis

Ziel des beantragten Forschungsprojektes ist die Minimierung der wirtschaftlichen Verluste infolge abweichender Tonwertzunahme im Rollenheatsetdruck bei Gewährleistung der geforderten Druckqualität. Dazu sind die praxisrelevanten Einflussgrößen auf die TWZ im Rollenheatsetdruck zu ermitteln und zu quantifizieren, wobei der Einfluss des Papiers im Vordergrund steht. Die Erkenntnisse sind die Grundlage für eine verbesserte TWZ-Abschätzung im Vorfeld des Druckens und damit die Voraussetzung für eine effizientere Vermeidung von TWZ-Abweichungen durch gezielte Plattenkorrektur in der Vorstufe sowie die Festlegung optimaler Druckbedingungen.

Des Weiteren sollen die Erkenntnisse des Projektes zur Optimierung der Rollenheatsetpapiere durch die Papierhersteller dienen. Hierbei geht es einerseits um die Abschätzbarkeit der TWZ bereits in der Papierfabrik und andererseits um die Konstanz der Papiere bezüglich der TWZ über einen längeren Produktionszeitraum.

Anwendung/Wirtschaftliche Bedeutung

Für Massendruckerzeugnisse konkurriert der Rollenheatsetdruck mit dem Tiefdruckverfahren bei steigendem Papierverbrauch und ist inzwischen mengen- als auch wertmäßig das dominante Druckverfahren. Befragungen und Gespräche mit Heatsetdruckern haben aufgezeigt, dass das Druckphänomen Geistern und die Abweichungen in der TWZ im Rollenheatsetdruck zu erheblichen wirtschaftlichen Einbußen führen. In einer Rollenheatsetdruckerei, die hochwertige Druckprodukte herstellt, werden jährlich durchschnittlich 240 Ersatzplatten pro Maschine aufgrund von TW-Korrekturen angefertigt, was bei einem ca. Preis von 50 €/Platte 12 T€ entspricht. Mit dem erforderlichen Austausch der Platten ist ein Stillstand der Rotation verbunden, der sich auf ca. 120 h/a beläuft. Bei einem durchschnittlich anzusetzendem Maschinen-Stundensatz von ca. 700 €/h ergeben sich hiermit Jahreskosten von 84 T€/a je Druckmaschine, was Gesamtverlusten durch abweichende TWZ von bis zu 100 T€/a und Druckmaschine bedeutet. Von diesen Mehrkosten wird zwangsläufig ein Anteil auf das eingesetzte Papier entfallen. Mit den zu erarbeitenden Forschungsergebnissen soll dieser Anteil minimiert werden.

Bearbeitungszeitraum: 01.02.2012 – 31.01.2014

Bemerkungen

Das Forschungsvorhaben IK-MF110061 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie (BMWi) gefördert.

Research institute:

PTS Munich
Hess-Str. 134
80797 Munich, Germany

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Hermann Schmid
Tel: 089/12146-189
Fax: 089/12146-36
E-mail: Hermann.Schmid@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

Offset paperbimodal grain size distribution, coating,

Title:
Printability improvement of coated offset printing papers by use of coating pigments with bimodal grain size distribution

Background/Problem area

In 2008 the German pulp and paper industry produced 22.8 bn tons of paper and paperboard, 37 % of which were graphic papers. Nearly half of the graphic papers were coated.

Because offset printing accounts for approx. 50 % of the three main printing technologies flexo, gravure, and offset printing, the project focuses on offset printing. Coated offset printing papers are used for many graphical products like books, brochures, catalogues, and magazines. Their surface properties are therefore important to achieve the desired quality in offset printing. To increase the productivity of printing shops, standardized surface properties are required regarding the absorption of ink solvents in the printing process. Until today no technically mature solution could be provided by the pulp and paper industry which permits the simple adjustment of absorption times.

Objectives/Research results

Objective of this project is to improve the absorption time of liquids in offset printing ink solutions through bimodal grain size distributions achieved by the admixture of pigments that have reduced grain sizes compared to the standard grain sizes used in coating colours.

Surface energy and pore structure are main properties of the coating influencing the absorption velocity.

Several different calcium carbonate and silicone dioxide pigments with grain size distributions of around 150 nm and below were selected and initially tested on their influence on absorption velocity. Other paper properties, for example all optical characteristics, were measured as well.

The results obtained on laboratory scale have been reproduced on the pilot coater, showing some differences due to a more equally distributed colour with less surface roughness on the paper surface. These differences may also be due to differences in the properties of the base paper, mainly paper weight, used on the pilot coater. The influence of pigment admixture with reduced grain size was able to be demonstrated.

All additional coatings will be made on the pilot coater and finally on our VESTRA together with printing tests on coated papers.

Application/Economic benefits

Up to now, coated papers have not been standardised with respect to the absorption time of the solvents used in offset printing inks for the offset printing industry. The project aims to improve the technological adjustment of coated papers to offset printing processes.

Cost benefits/savings can be expected from productivity gains, faster production and waste reduction.

The research results to be achieved are mainly related to the field of materials with applications in the fields of chemistry, process engineering, and production of especially the paper, publishing and printing industries.

Period of time: 01.12.2010 – 30.11.2012

Remarks

The research project IGF 16554N is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Timo Kuntzsch
Tel: 03529/551-614
Fax: 03529/551-899
E-Mail: timo.kuntzsch@ptspaper.de

Research area: Product aims

Paper, paperboard and board // Graphic and packaging papers

Key words:

microrobotics, fibre bond strength measurement, fibre bond and network modelling, paper strength improvement, grammage reduction

Title:
Enhancement of Fiber and Bond Strength Properties for Creating Added Value in Paper Products (PowerBonds)

Background/Problem area

Significant research efforts have been undertaken in recent years to reduce energy and raw material consumption in paper making while maintaining the constant mechanical and optical properties. In this respect, reducing grammage (the basis weight) of the paper products at a given thickness, in other words decreasing paper density, is a potential area for improvement. A reduction in paper grammage offers means for cutting paper and board manufacturing costs and ensuring production sustainability.

There are many known challenges associated with the grammage reduction. In printing papers, the web stiffness and the strength reduce with a decrease of grammage. Another problem in the grammage reduction is the loss of opacity influencing the visual perception of printed products. To maintain sufficiently high opacity, the amount of pulp fines and mineral fillers need to be increased in the paper furnish. Some of these particles can reduce the number of effective bonds in the sheet and therefore, decrease the strength even further. The largest challenge, however, is that the role of the strength itself in the paper performance in end-use applications is not well understood.

Objectives/Research results

Understanding the importance of strength and taking steps towards reducing the grammage based on this understanding therefore is the primary goal in this project. To achieve the projects aim the project partners will combine microscopic characterization tools, novel experimental techniques working at a microscale, simulation tools and advanced pulp-processing technology in order to address the outstanding challenge of understanding the paper strength and its role in paper making. Furthermore a detailed particle level modelling approach will be used to capture the very nature of the paper – the stochastic network structure – and to support the materials design by exploring a much greater parameter space than pilot machines can provide. Innovative characterization tools will be used to reveal the details of fibres, fibre bonding and the structure of paper. The advanced experimental tools, such as nano and micro-tomography, AFM and ESEM, and micro- and nanorobotic technologies will enable the fibre scientists to characterize mechanical and morphological properties of fibres and fibre bonds. In addition to the efforts in developing new models and characterization tools, the project aims to improve the fibre strength and bonding capabilities using novel mechanical and chemical fibre modifications.

Application/Economic benefits

This project aims at *new products* by improving the strength and bonding capabilities of fibres. As the improved strength and bonding capabilities of fibres will allow the reduction of fibrous raw material use and starch consumption, and increase in the filler content while still ensuring an excellent performance of paper products, costs can be reduced.

Furthermore, an increase in paper strength has a huge influence on the productivity as well as on the profitability of paper mills. One paper break in a paper machine causes 20-60 minutes downtime and costs from 6.000€ and above. It is not unusual to see some paper machines suffering from 6-9 breaks a day. Thus, a reduction of web breaks increases the output of a production line, reduces the consumption of raw material and energy and improves the paper quality due to a lower variability. Due to large production volumes, saving of only 10 € per ton by resolving the runnability issue for high-end graphics paper translates into 4 millions € profit for a medium size paper machine having a 400.000 ton annual capacity. In a pressroom, on the other hand, the cost of a single break sums up to a lower value (about 1.500 €) but yet the accumulated cost of all the breaks is still immensely high.

Increasing the bonding strength in fibre-based materials will also help to overcome intrinsic mechanical weaknesses in comparison to other, less sustainable, materials. This approach has to be performed by ensuring in parallel the printability and the optical properties of papers. Paper and board have an overall lighter footprint on the environment, better consumer perception, and are on the long term more sustainable, being based on renewable resources, while competing materials are fossil-based.

Period of time: 01.02.2012 – 31.01.2015

Remarks

The research project PowerBonds (WoodWisdom-Net, 3rd Joint Call - 2010) is being funded by the European Commission and coordinated by Tampere University of Technology (TUT, Finland) in cooperation with leading European research institutes for paper technology and microrobotics (Abo Akademi University, Finland; Graz University of Technology, Austria; Grenoble INP-LPG2, France; OFFIS Institute for Information Technology, Germany; PTS, Germany; Royal Institute of Technology, Sweden; VTT Technical Research Centre of Finland) and 7 industrial partners: INNOWEP GmbH, Germany; Munksjö Arches SAS, France; Papeteries Emin Leydier, France; Sappi Finland Oy; Stora Enso Deutschland GmbH; Stora Enso AB, Sweden; UPM-Kymmene, Finland.

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Sabine Hottmann
Tel: 03529/551-663
Fax: 03529/551-899
E-Mail: sabine.hottmann@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Graphic papers, Packaging papers and paperboard

Key words:

Migration, printing inks, , food contamination, coating colour formulation, sorption layers

Title:
Preventing the migration of critical substances by using sorption layers for paperbased packaging materials (SoLaPack)

Background/Problem area

Since the publications of the Official Food Control Authority of the Canton Zurich in 2010 regarding the migration of mineral oil into food the migration problem of (food) packaging has attracted public attention. Mineral oil originating in printed recovered paper made consumers suspicious towards recycled paper based packaging. First reactions of some retailers were therefore the demand to switch from secondary fibre to virgin fibre for food packaging. This however would lead to negative consequences for the packaging paper / board industry and their suppliers as in Europe mainly recovered paper is used as raw material for packaging papers.

According to the EFSA , the BfR and the Official Food Control Authority of the Canton Zurich packaging materials can contain critical substances like amongst others benzophenone, bisphenol A, phthalates and mineral oil in an amount up to 1000 mg/kg. These critical substances originate from UV-inks and UV-varnishes (benzophenone is used as a photo initiator), adhesives and varnishes (phthalates are used as plasticizers), printing inks (mineral oils) and recovered paper (benzophenone, bisphenol A, phthalates, mineral oil). Due to the high recycling rate in Europe (74.6% for packaging materials according to the CEPI Key Statistics 2009) these substances can be found in packaging materials. In the worst case the ADI-value of these substances can be exceeded. Therefore it is essential to ensure that these substances cannot migrate in to the food. One possibility lies in the use of sorption materials like zeolites integrated into a productside coating.

Objectives/Research results

The objective of the project is the development of concepts to incorporate sorption materials into the coating formulation to selectively sorb benzophenone, bisphenol A, phthalates and mineral oil due to inks, varnishes, adhesive and recovered paper. A coating on the product side should prevent the contamination of food by migration of these substances, so that the critical values are not exceeded. Recommendations for sustainable, environmentally compatible and health-preserving packaging materials shall be formulated.

In the first phase of the project the sorption materials and other raw materials will be selected. In the second phase, the incorporation and functionality of the sorption materials into the coating will be examined. In the third phase, the sorption materials will be modified and optimised in regard to their sorption properties of the critical substances. In the last phase the optimised formulations will be examined by applying them onto commercial paper and performing pilot coater trials.

Sorption materials is selected from zeolites, cyclodextrins, starch granules, phyllosilicates, silica and aluminium hydroxide and examined in regard to their sorption capacity and characteristics.

Application/Economic benefits

SoLaPack contributes strongly to the EU's objective to strengthen Europe's global research position and retain high-quality-high-income jobs. The economic situation across Europe now makes this objective even more pressing.

The intended results can be used by the entire value chain: manufacturer of packaging paper, manufacturer of chemical raw materials and additives, paper converters and packaging manufactures, distributors and end-users. Direct economic impact for SMEs representing the packaging manufacturing and converting sector is related to minimise the time and cost necessary for evaluation and selection of appropriate type of sorption materials as typical barrier coating colour in case of specific migration of selected hazardous substances and standard examination methods and procedures based on up-to-date EU regulations regarding the amount and migration of critical substances in packaging and food.

Further technical and economic benefits are obtained by:

- Savings compared to virgin fibre paper and board (paper industry)
- Savings of the development effort of optimised recovered paper containing packaging (paper industry)
- Increased profit due to a better marketing and new markets (suppliers)
- Avoidance of higher costs due to virgin fibre packaging (entire value chain)
- Increased market share by improved consumer protection (distributors)

Period of time: 01.05.2012 – 30.04.2014

Remarks

The research project IGF-Cor 68 EGB is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Steffen Schramm
Tel: 03529/551-679
Fax: 03529/551-889
E-Mail: steffen.schramm@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

paperboard, medium-density fibreboard, recovered paper, thermo-mechanical pulp, energy use, water use, packaging

Title:
Studies on producing paperboard in a dry process

Background/Problem area

The co-operation project between the Institute of Wood and Paper Technology, Dresden, and PTS is relevant to the industrial sector of wood materials and paper technology. The project has as its interdisciplinary goal to study the usability of the technological and economic advantages of the dry process for producing thin, medium-density fibreboard (MDF) for the manufacture of board products. From the point of view of the paper industry, the motivation derives in particular from the necessity of searching for technical solutions designed to further reduce the specific expenditure in raw materials, water and energy in paperboard manufacture. Moreover, there is an expectation that, by using a dry process, board products can be produced that have an enhanced properties profile compared to conventional products. This includes a lower MD/CD ratio of the relevant strength properties, greater strength in the z direction as well as improved dimensional stability under moist ambience conditions. Realising these expectations would continue to strengthen the competitiveness of paperboard compared to petroleum-based plastics for packaging materials. From the point of view of the wood materials sector, the project aims on the one hand at expanding the fibrous raw materials that can be used for fibreboard manufacture by more intense utilisation of more cost-effective recovered paper belonging to ordinary grades. On the other hand, additional technological improvements in fibreboard production are to be developed in the course of the project. This refers in particular to the process control in pulp preparation and the use of environmentally compatible additives to guarantee the desired product properties, even including the material recyclability of such products. Ultimately, this is intended to open up new lines of application for thin, medium-density products. Developing a semi-dry process for board manufacture will incorporate process elements for the production of medium-density fibreboard (MDF) and sub-processes based on the airlaid principle that are used in the production of dry-lay nonwovens. Most of the necessary experimental investigations will be conducted at the pilot facilities of the two research institutes as well as with an external system in the textile research sector.

Objectives/Research results

The objective of the research project is to develop a technological concept for producing paperboard materials in a dry process. The aim is to achieve a grammage range between 300 g/m² and 800 g/m² with thicknesses ranging from 0.4 mm to 1.0 mm. The materials produced should have physical properties that make it possible both to convert them into packaging materials and to meet significant utility value requirements placed on board packaging materials. At the same time, the extent to which new possible uses in the wood management sector might be created for the new materials should be examined. Scientific-technical aims relating to pulp production are to determine optimal process parameters (such as pressure, temperature, time, for example) for the production of suitable wood pulps based on thermomechanical pulping as well as the production of optically homogeneous secondary fibre pulp from recovered paper by mechanical processes with the highest possible solids content. The objective of further studies is to determine a technologically and economically optimum mixing ratio of recovered paper and thermomechanical pulps and their further processing to form sheet materials in modified MDF or airlaid processes. Furthermore, the uses of additives should be studied for both web formation processes that are needed to realise the desired product properties. Starting from the developed technological concept, the specific expenditure of energy, water and funding must be presented that can be expected for industrial implementation compared to conventional processes of board manufacture.

Application/Economic benefits

The results of the research project are of special interest to firms in the wood materials industry, for the manufacturers of packaging materials as well as for firms in the paper industry that manufacture paperboard. Options for producing novel, fibre-based materials utilising a resource-saving technology will be developed both by the exclusive use of wood-based pulps and by using processes with very low specific fresh water requirements. A growing market for such materials can be posited owing to the growing priority placed on sustainability attributes by both manufacturers and consumers alike. Depending on the project findings, new product ranges might be created for the manufacturers of facilities for fibreboard production or possibly also for companies that sell processes and facilities for airlaid technology. It is also feasible that paperboard manufacturers in the paper industry might use dry processes to expand their portfolio of special-purpose products.

Period of time: 01.11. 2011 – 30.04. 2014

Remarks

Research project IGF 16911 BG is being funded by the Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Veronika Beil
Tel: 089/12146-434
Fax: 089/12146-36
E-Mail: veronika.beil@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

packaging, paper, cardboard, green, ecological, recycled, confectionary waste, hazelnut shells, cocoa bean skins, replacement of virgin fibres

Title:
ECO°PAPER: Production of paper and cardboard packaging based on the use of confectionary production waste, in partial replacement of virgin cellulose

Background/Problem area

The increase in the cost of virgin paper, driven by a combination of market pull and the limited size of the European supply, requires technological innovative solutions that are able to reduce the dependence on virgin fibre and provide a larger offer on the European market while limiting the use of forest resources. At the same time, it has to ensure food industry safety and quality standards. In the best case, it also reduces production costs.

New restrictions in the applications for food direct contact of paper and cardboard made with recycled materials and in the short / medium term the absence of safe and economically viable alternatives will force the food industry to move to virgin materials, thus increasing the gap between demand and offer of paper packaging made with virgin fibres.

Objectives/Research results

The project aims at the application in the food packaging industry of paper and cardboard materials made from confectionary production waste (hazelnut shells and cocoa bean skins) to partially replace virgin cellulose with the following specific objectives:

1. improve the efficiency and sustainability of the food industry supply chain by using and thus reducing waste related to confectionary production cycles for packaging applications;
2. Minimize the environmental impact and costs related to waste management;
3. increase resource efficiency by reducing the use of virgin cellulose in food packaging;

The adopted technology is globally known as different waste materials have already been used in paper mixtures. Innovative aspects are related to the recipes to be specifically developed according to the waste material used and the characteristics of the food packaging product to be obtained.

The work programme forecasts the fine tuning of the recipes already proven at the experimental stage within an industrial environment. The optimized products will be tested and certified to produce industrial batches that will be transformed into packaging applications to be used on different confectionary production lines located in different factories in Europe.
The obtained consumer products will be distributed throughout the European market.

Application/Economic benefits

The key deliverable of the project is the definition of an efficient, sustainable and reliable industrial production process of paper and cardboard products incorporating in their recipes process waste originated by the confectionary industry. The process will be fully replicable in smaller production entities as the novel recipes do not require capital investment in technology. Industrial experience and knowhow will be the key to guarantee a rapid roll out into the European market. When the roll out is completed and by absorbing the estimated available waste materials within Europe, this will result into a market potential of 1,5 millions tons of paper products made with the novel recipes.

The proposed solution finds its main targets in the food industry seeking to optimize its value chain through the use of production waste, consequently decreasing the costs related to packaging and waste management. Secondary targets are the paper mills and converters interested in diversifying their offer and thus introduce into their production systems the novel recipes by setting or adjusting their equipments to handle the different physical and mechanical properties.

Period of time: 01.07.2012 – 30.06.2015

Remarks

The research project ECO°PAPER is being funded by the European Commission within the Framework Programme FP7 and is being performed together with Ferrero s.p.a., Alba (Italy) and Stora Enso Packaging Boards, Barcelona (Spain).

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Reinhard Sangl
Tel: 089/12146-496
Fax: 089/12146-36
E-Mail: reinhard.sangl@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

non wood forest products, paper technology, plastics technology, active packaging, biopolymers, cartonboards, Life Cycle Assessment, nano materials, packaging

Title:
New Generation of Functional Cellulose Fibre Based Packaging Materials for Sustainability, NEWGENPAK

Background/Problem area

The NewGenPak ITN is an interdisciplinary research training network of 8 European universities, 3 research institutes and 6 enterprises from 10 European countries (Coordinator: Chris Breen, Sheffield Hallam University, U.K.). It is funded under the Marie Curie Framework 7 programme. The network will deliver a joint multidisciplinary research training programme for ten Early Stage Researchers (ESRs) and two Experienced Researchers (ERs) who have the acumen, enthusiasm and motivation to make a significant contribution to a challenging, interdisciplinary research project. The NewGenPak partnership will encourage and foster the growth of the researchers' skills in scientific expertise, technological knowledge and professional aptitude. The key vehicle in this strategy is a supervised personal, original research project in a critical aspect of sustainable packaging.

Objectives/Research results, general

The aims of the NewGenPak ITN are:

- to conduct top-level research and training and devise innovative solutions for specific EU needs in the area of sustainable packaging,
- to advance the state-of-the-art in wood cellulose based sustainable packaging in three specific areas (a) next generation packaging composites, (b) cellulose-fibre based active packaging and (c) environmental, economic and societal aspects of packaging production,
- to educate the next generation of researchers inside a broad European research training network which includes universities, research centres and industry, thereby accelerating the researchers' advancement in their chosen career,
- to improve the career prospects of ERs and ESRs through complementary training such as; writing and presentation skills; language, effective communication and collaboration; project management and finance; project/product cycles; entrepreneurship; IPR.

Objectives/Research results for PTS

"Meeting packaging requirements for effective product and consumer protection while minimizing environmental impact by using the capabilities of multi-layer curtain coating technologies in packaging production"

The ESR will specify the material properties required to meet the demands during life of the package; e.g. production, filling, shelf exposure, consumer usage and package recycling in cooperation with the NEWGENPAK partners and the producers of paper board. The technical focus will be on how close control of the multilayer curtain coating process, including layer composition and compatibility, curtain stability and drying parameters that ensure vapour transport and eradicate blistering, can be used to minimise energy costs and production losses, and improve the recyclability of the renewable and biodegradable barrier materials produced using this technology. Finally, theoretical and modelling approaches will be transferred to bench scale and pilot scale conditions and process applications.

The ESR has been recruited and work has started.

Application/Economic benefits

- Structuring high quality initial research training capacity throughout Europe
- Contribution of the training programme towards the policy objective of enhancing
- Develop future generations of entrepreneurial researchers
- Attracting young people to research careers and enhancing their career prospects
- Adding to the intersectoral employability of researchers,
- Impact on European research
  - strengthen Europe's global research position and retain high-quality-high-income jobs.
  - establish an active international and interdisciplinary network
  - establish knowledge, expertise and connections in sustainable packaging research
  - enhance the quality of life of Europeans and ensure the future welfare of European citizens by reducing carbon emissions and releasing energy

Period of time: 01.12.2011 – 30.11.2015

Remarks

The integrated research project NEWGENPAK (FP7-PEOPLE-2011-ITN), Project No.: 290098, is being funded by the European Commission in the funding scheme of Marie Curie Actions – Initial Training Networks (ITN) covering three subprojects. PTS tasks concentrate on WP4: Packaging, production; environmental, economical and societal impacts. Partners: are: KaU (SE), ZUT (PL), ITENE (ES), SSCCP (IT), SHU (UK) INIBO (IT), Grenoble INP (FR), STU (SK) DTU (DK), Bumaga (NL), Colorobbia (IT); associated partners are: Stora Enso (SE), Chesapeak (UK), Fraunhofer IVV (DE), PTS (DE), VTT (FI), DLO-FBR (NL) .

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Robert Metz
Tel: 089/12146-385
Fax: 089/12146-36
E-Mail: robert.metz@ptspaper.de

Research area: Product aims

Paper paperboard and board //
Packaging papers and pa-perboard

Key words:

corrugated board, flexo post print, striping, coating

Title:
Reduction of the striping in flexo post printing through optimization of the coating layer properties in such a way that the dependence of the ink uptake from the plate pressure is reduced

Background/Problem area

The market for corrugated board is a sustainable and growing market. According to vdw the turnover in Germany in 2008 increased compared to the preceding year by 4,0%. Products manufactured form corrugated board involve e.g. "point-of-sale" display boards which should attract the attention of consumers. Therefore the print on these boards should be as good as possible, whilst also being produced cost efficiently. Post printing on the finished cardboard is one advantage in terms of cost efficient manufacturing. The other advantage would be to use the "cheaper" printing process which is flexo printing compared to the more expensive offset printing. A known problem with direct flexo printing – and direct printing in general – is the formation of stripes due to the flute-tip architecture of the corrugated board.

One of the possibilities to reduce striping is to use liner with a higher grammage. This results in a significant increase in costs. In practice, there is also often the attempt made to higher the contact pressure in the printing nip until a sufficient amount of colour is transferred, again resulting in less striping. However, this procedure has the great drawback that the structure of the corrugated board is badly affected. A further measure is the adjustment of the hardness (elastic modulus) of the flexo printing plates. The exclusive usage of smaller and stiffer flutes also presents a limitation towards mechanical demands and profitability in certain fields of application.

Objectives/Research results

The aim of the project is the reduction of striping in flexo post printing through optimization of the liner coating. The coating(s) shall be optimized in such a way that the ink transfer becomes pressure independent over a broad range. It is desirable that this is the case especially at low pressure ranges, because of damage occurring to the flute structure at high pressure ranges. It is also desirable to achieve a quantitative correlation of coating parameters to the striping in order to create general predictions for the reduction of striping.

The optimization of the coating should be achieved mainly by varying different types of pigments with small or larger particles and/or narrow or broad particle size distributions. Also mixtures of different pigments are varied. This results in different porosities and capillarities, which definitely influence the speed and /or the amount of the uptake of flexo ink. In combination with pigment variation, further variations such as coat weight, number of layers (2 or 3) and influence of thin barrier layers between pre- and top coating are of interest.

The research started with an analysis of the reasons for striping and existing solutions from the literature. It could be deduced that to a great extent quick absorption of rather large amounts of ink on the liner coating would probably be beneficial to reduce striping. Initial results showed that it is possible to achieve high absorptivity by using certain pigments. PCC and NPSD GCC are more absorbent than BPSD GCC and SiO2. Nano PCCs show good absorptivity as well, one of which being the most absorbent pigment of all pigments tested. The coating structure also influences absorptivity. Calendered papers are less absorbent than uncalendered ones due to reduced porosity and the sealed surface of the coating layer. Blending a GCC pigment with a PCC pigment increases the absorptivity of the coating due to increased amount of PCC.

Initial laboratory-scale print trials (IGT F1) did not reveal any significant changes in the dots. However, the formation of “print donuts” occurred on coated samples with pigments and with high surface tension. Laboratory-scale print trials on corrugated board samples resulted in less stiffness in the printed image when mixtures with nanoscale pigments were used in the coating. A barrier layer between the precoat and top coat did not have any significant impact on stiffness in laboratory-scale flexography. The research work will be continued using the best coating formulations consisting of nanopigments and normal coating pigments and further work steps shall include coating trials on the pilot coater, laboratory-scale corrugated board samples and flexographic trials. As the final step, the best coating formulation will be used to coat linerboard on an industrial scale, and the corrugated board made from it shall be printed by flexographic printing.

Application/Economic benefits

The results of this project are mainly of interest for the industrial sectors paper, publishing and printing. Furthermore, also branches of chemical industry (additives) may profit from this research project. More specifically, the corrugated board and printing ink industry may profit.

The reduction or complete avoidance of striping in corrugated board flexographic post printing bears great potential for the quality improvement of packing materials or e.g. displays manufactured from printed corrugated board. High quality corrugated board products are often printed via the preprint method, which involves additional effort und costs. Through the prevention of striping in flexo post printing, the overall deficits of this method can be crucially reduced compared to the preprinting method.

Period of time: 01.09.2010 – 28.02.2013

Remarks

The research project IGF 16666 N is being funded by the Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Hermann Schmid
Tel: 089/12146-189
Fax: 089/12146-36
E-Mail: Hermann.schmid@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

coating, surface smoothness, optical properties, mechanical properties

Title:
Development of a multi-ply cardboard with a high glossy surface and maximum bending stiffness

Background/Problem area

A growing trend in packaging printing in Germany during the years to come has been projected by PIRA in their study “The Future of European Printing to 2011”. A market share of 30.5 % of the total German printing market is cited in this study. A multi-ply cardboard offers itself as a bulky alternative to a satinated cardboard of reduced bending stiffness.

Therefore the development of a coating concept of high gloss and surface smoothness in the absence of calendering which keeps the bending stiffness of the base board manly unaffected is of major importance.

Objectives/Research results

The lack of gloss through abandonment of calendering has to be overcompensated for by a new coating concept to be developed.

Gloss on a surface is created when light and reflection are directed. Irregularities in the surface finish disturb the direction of reflection and with increasing unevenness/roughness cause undirected reflection. The topography of a surface on a micro-scale therefore has a significant impact on gloss. Calendering cardboard is the standard method for producing smooth surfaces with appropriate gloss.

The project therefore focuses on developing a coating concept which results in a defined macro- and micro-roughness in conjunction with the index of reflection to provide high glossy cardboard surfaces without calendering.

In addition to the required optical properties, the newly developed coating colors must be applied economically in the coating machine and must ensure a smooth processing of coated cardboards during the production of carton packaging.

Application/Economic benefits

Research results are of use along the entire value chain beginning with cardboard manufacturers and ending with producers of cardboard carton. In addition, the results are of major importance for packaging manufacturers and packaging printers in particular.

An economic benefit can be achieved by saving raw materials through the use of lightweight substrates as well as in a reduced number of production steps including the development of a product which does not yet exist in the packaging market.

This means for the individual company involved a cost savings, an expansion of the product portfolio and/or an increase in sales. An increase in competitiveness is also associated with it.

Period of time: 01.06.2012 – 31.05.2014

Remarks

Research project IGF 16928N is being funded by the Federal Ministry for Economics and Technology (BMWi)

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Birgit Kießler
Tel: 03529/551-625
Fax: 03529/551-889
E-Mail: birgit.kiessler@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

reinforced starch, nano-fibrillar cellulose (NFC), synergy

Title:
Development of a starch cellulose composite for utilizing synergy effects in the papermaking process

Background/Problem area

In paper production, starch is mainly used in surface sizing (87%) and in the wet-end. But the increase in paper properties evoked by starch is limited. The adsorption of wet end starch on pulp depends on many factors, especially the amount of dissolved salts and anionic trash in the circuit water and raw material. In addition, the process and the degree of substitution cause degradation of the starch molecules and, as a result, a reduction in strength properties. Native starch intended for surface sizing must be degraded to ensure that the starch solution has the proper viscosity for use in a size or film press. A decrease in molecular mass, however, always means a reduction in binding power.

The immense potential of nanofibrillated or nano-fibrillar cellulose (NFC) to improve the strength properties in paper is well known from the literature. But the application of NFC in pulp suspension brings about an immense rise in freeness. A suitable addition of cationic starch, among other things, can help to regulate this negative effect of the NFC. In addition, the conditions of the fibrils in nano-materials are important. NFC efficiency depends on the homogeneous distribution of the nano-fibrils by subjecting them to intensive shear stress to prevent their re-agglomeration. In-house studies conducted by PTS have also shown an increase in tensile strength in a pulp suspension with a large amount of fillers.

In light of these results, the question therefore arises: Is it possible to exploit the synergies of the two components through reinforcement of the starch using NFC? The synergies derive from the fact that on the one hand NFC increases the binding force of degraded starch and the other starch compensates for the strong freeness influence of NFC.

Objectives/Research results

The objectives of the project are to:

- Develop an innovative starch compound by reinforcing nanofibrillated cellulose for the production of graphic, packaging and specialty papers
- Reduce grammage with the same or better strength properties of papers by using reinforced starch

Currently research results are:

- To fabricate NFC products with different properties for Reinforcement
- To develop blending technologies to produce homogeneous starch NFC compounds
- Reinforced starch compensates the strong freeness influence of NFC

Application/Economic benefits

The applications of reinforced starch are seen in surface sizing and in the wet-end. The exploitation of the synergy effects of the two components starch and NFC as a composite is to achieve economy of a valuable fibrous raw material and to replace the raw material with fillers without any loss of strength properties.

Project period: 01.01.2011 – 31.12.2012

Remarks

The research project IK-MF 100046 is being funded by the Federal Ministry for Economy and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Sabine Hottmann
Tel: 03529/551-663
Fax: 03529/551-899
E-Mail: sabine.hottmann@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

Migration, printing inks, food contamination, coating colour formulation, sorption layers

Title:
Preventing the migration of mineral oil originating from printing inks and recovered papers by using sorption materials in a product side coating

Background/Problem area

According to EFSA (European Food Safety Authority, Italy), the BfR (Federal Institute of Risk Assessment, Germany) and investigations of the Official Food Control Authority of the Canton Zurich packaging materials for food packaging can contain up to 1000 mg/kg mineral oil. The mineral oils found are characterised by a chain length of less than n-C28 and a fraction of up to 25 % aromatic compounds. Due to the short chain length of the mineral oils they are able to migrate into food by evaporation; in the worst case even the ADI (acceptable daily intake) - value can be exceeded.

At the beginning of 2010 the BfR came to the conclusion that the migration of mineral oils originating from printing inks and recovered papers has to be reduced considerably. To achieve this the BfR provided recommendations for action. One recommendation was the ban of recovered paper for the use in food packaging as the mineral oils can be traced back i.a. to the use of recovered paper and the ink contained therein. Especially in Germany the recovered paper rates for packaging materials are very high (97 %), a substitution of recovered paper with virgin paper would neither be economical nor ecological sensible. Therefore other suggestions have to be made to reduce the mineral oil in food due to packaging material. One possibility lies in the use of sorption materials integrated in a product side coating.

Objectives/Research results

The objective of the project is the development of concepts to incorporate sorption materials into the coating formulation to selectively sorb mineral oils due to inks and recovered paper. A porous coating on the product side should prevent the contamination of food by migration of mineral oil so that the critical values (migration value / ADI value) are not exceeded. Recommendations for sustainable, environmentally compatible and health preserving packaging materials shall be formulated.

In an extensive test program variations of sorption materials (type, quantity etc.) as well as variation of typical coating pigments, binder and additives plus variation of the coating thickness, coating weight and coating application shall be made. The prepared coating formulations will be applied on to a reference substrate and the functionality of the coating will be examined i.a. with migration tests. Due to the results of the migration tests the coating formulations will be optimised, applied onto commercial paper and packaging and examined. The examination will include migration tests as well as test regarding their recyclability. At the end of the examinations a profitability analysis will be made.

Over 15 pigments have been part of the screening process. The best pigments have been selected and incorporated into coating colour formulations (on their own and in combination with other sorption materials and typical coating colour pigments) and coated onto a reference substrate (virgin fibre board). In selected sorption layers more than 95 % of the mineral oil was trapped in the coated board. The most promising sorption layers contained zeolites, silica and organoclays as well as calcium carbonate.

Application/Economic benefits

The intended results can be used by the entire value chain. The value chain is composed of: manufacturer of packaging paper, manufacturer of chemical raw materials and additives, paper converters and packaging manufacturers, distributors and end-users. The technical and economic benefits are obtained by:

- Savings compared to virgin fibre paper and board (paper industry)
- Savings of the development effort of optimised recovered paper containing packaging (paper industry)
- Increased profit due to a better marketing and new markets (suppliers)
- Avoidance of higher costs due to virgin fibre packaging (entire value chain)
- Increased market share by improved consumer protection (distributors)

Due to the increased consumer and health protection all companies involved will benefit from an increased public image. This increased public image can lead to a better marketing and therefore an increased market share.

Period of time: 01.02.2011 – 31.01.2013

Remarks

The research project IK-MF 100094 is being funded by the German Federal Ministry for Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Irene Pollex
Tel: 03529/551-611
Fax: 03529/551-889
E-Mail: Irene.pollex@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

paper structure, spectroscopy, C-14 dating, paper, paperboard

Title:
New analytical methods for detecting forgeries using the age determination of paper

Background/Problem area

In many cases, paper can have considerable value and be the subject of forgery and counterfeiting. Printed or written paper, e.g. bank notes, identity cards, documents and wills can cause immense moral and financial damage if forged or counterfeited. The art market is currently complaining about an enormous rise in the number of forgeries which in some cases have been circulated by organised criminal groups, probably due to the desire to safely invest money in valuable paintings and drawings. Both businesses and consumers alike are worried about the large number of forged brand-name products (especially medication) as a result of pirate copies. At the moment, there is heightened activity with a view to protecting consumers from such forgeries.

At the moment, proof of the existence of certain substances or paper structures that were not yet the standard in papermaking at the disputed time can reveal forgeries. If there is no proof of such substances or structures, then it is impossible to restrict the period of time in question. The results of age determination have been unsatisfactory in most of the objects examined during the last few years and thus were of no help in the detection of forgeries and counterfeits.

Objectives/Research results

The objective of this project is to develop a comprehensive method for determining the age of paper in order to detect forgeries and counterfeits. Besides the age determination of historical documents and works of art, the forgeries and counterfeits of current paper productions are to be identified by a fast comparison of structures.

The project objective is to be achieved by the following subgoals:

- To develop mobile image acquisition for the rapid on-site analysis of a suspected forgery or counterfeit
- To develop a method of determining the age of paper using a spectroscopic procedure
- To develop a method for determining the C-14 age of paper measured by AMS (accelerator mass spectrometry) at the actual time the paper was being manufactured.

These methods will give the user the possibility of modular use as a function of the question to be answered (age dating of unknown samples, double-checking dated paper or the fast identification of forgeries and counterfeits).

A collection of approx. 200 different papers of varying composition and age were organised and catalogued in a database to provide a systematic approach. Initial work relating to mobile image acquisition is being evaluated at the moment. Special aspects of the equipment used in standard forensic laboratories have also been taken into consideration. Studies on the inclusion of individual NIR and IR spectra have not yet been concluded.

Application/Economic benefits

The new complex method is intended to be used in the investigatory work at the state criminal police (LKA) in art offences, examining the authenticity of paper documents, providing support for the 15th amendment to the German Law Governing Drugs with reference to the important point of drug safety, and to guarantee sales markets for paper mills by uncovering forgeries and counterfeits.

A number of small and medium-sized companies work in the new Bundesländer in the sectors of papermaking, printing and in the pharmaceutical sector. The results of this project are intended to contribute to strengthening or expanding their market shares.

Period of time: 01.01.2012 – 31.12.2013

Remarks

The research project IK-MF 110047 is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Gert Keller
Tel: 03529/551-623
Fax: 03529/551-889
E-Mail: gert.keller@ptspaper.de

Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words:

Inkjet printing, flexo printing, penetration, printing inks

Title:
Improvement of inkjet printing on packaging papers by detailed analysis of penetration processes during printing

Background/Problem area

At present, packages are mainly printed by offset (folding box board) or flexographic methods (corrugated board). Current market demands show an explicit need for smaller production runs, personalised printing and special labelling (e.g. matrix codes) of packages. For those demands digital printing techniques are highly suitable.

Unfortunately currently used printing substrates lead to insufficient quality when printed by low-cost inkjet methods. Since inkjet printing (digital printing) will gain importance besides the currently predominant offset and flexographic methods, the aim is to modify the surface of packages in such a way that good print quality can be achieved by inkjet printing as well as by the other printing techniques.

Objectives/Research results

Therefore, the project aim is a detailed analysis of penetration processes occurring during the printing of packaging papers. Important requirements on the optimal printing of folding box board and corrugated board materials by inkjet pigment inks are to be identified.

The project is subdivided into 3 parts:

- In the first part, currently available packaging papers and their surfaces are to be characterised in detail, focusing on parameters that are important for printability based on the present knowledge. Especially commonly used coatings are to be analysed concerning their porosity and surface characteristics with regard to printing inks.
- In a second part, penetration processes are to be characterised by several, partly new methods. In industrial offset, flexo and inkjet printing, these penetration processes take place within five seconds and thus still in the printing press. New reverse printing measuring devices for inkjet and flexographic methods as well as fast camera measurements shall be developed to visualise the penetration processes of printing liquids into paper layers (coatings and base papers).
- Finally models will be generated with the help of extensive measuring data to describe and evaluate the penetration processes and their most important parameters, covering both short-term capillary driven penetration processes and subsequent diffusion and drying steps.

Together with the measuring results the models will make it possible to characterize fundamental properties of printing substrates and to derive information on and requirements for better inkjet printability of packaging papers.

Application/Economic benefits

As a result of this research project specifications will be formulated for improved package surfaces enabling considerably better inkjet printing. These changes should lead to higher quality in package printing as well as to more versatile applications of inkjet printing on packages, particularly for smaller print runs and personalised packaging.

The results will help smaller print shops to handle smaller print runs more effectively.

The project results can be expected to benefit mainly small and medium sized enterprises in the printing and packaging industries.

Period of time: 01.07.2012 – 30.06.2014

Remarks

The research project IK-MF 120012 is being funded by the German Federal Ministry of Economics and Technology (BMWi).

PRODUKT-ZIELE

Forschungsgebiet
Endprodukte aus Papier, Karton und Pappe

Druckprodukte
Schachtelprodukte
Wellprodukte
Sonstige

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. D. Voß
Dr.-Ing. H.-J. Putz

Tel: 06151/16-2754
Fax: 06151/16-2454
E-Mail: voss@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton und Pappe

Schlagworte:

Altpapierqualität, Altpapiersammlung, Stickys, Deinking, Recyclinggerechte Papierprodukte, Rezyklierbarkeitsmethoden, LCA, Modellierung

Theme:
Eco Design for the Enhancement of Central Europe Paper Based Products Recycling Loop - ECOPAPERLOOP

Background/Problem Area:

The use of recovered paper in different paper grades causes problems during the production process due to the quantity of impurities which are brought in with the raw material. Important factors of these impurities are one the one hand side printing inks and on the other hand the so called stickies and non-paper components which result from the converting processes. These impurities have to be removed from the paper stock in order that the quality of the produced new paper can reach similar quality than paper made of virgin raw material like wood. Therefore a good recyclability is based on the removability of the impurities.

Recycling activities, like the recycling rate and the assessment and development of recycling oriented paper products, are varying among the different countries in Europe and should be standardised and improved.

Objective/Research Results:

To start the development of paper products which can be recycled easily, a method is necessary to benchmark the recyclability in a laboratory scale. The requirement of this method is that the conditions are close to the industrial scale. To investigate the recyclability of print products methods are already published by the ERPC. For packaging paper products no such method exists. As one objective of the project is the construction of a printed and packaging products recyclability data base, a new method must be developed and distributed to all partners. A packaging recyclability score card will be published. Recyclability will be tested with the laboratory methods for different conventional print and packaging products purchased from regular commerce.

By analysing the impact of the products and their recyclability behaviour, the paper for recycling quality can be modelled and a life-cycle-assessment (LCA) is possible for several products. This information will be used to give recommendations on sustainable paper collection strategies as well as defining recyclability criteria for eco-design and green purchasing.

Application/Economic Benefits:

In this special program technical knowledge about recyclability assessment should be transferred to the Central Europe Region and the respective partners in each country to establish pan-European recyclability procedures and standards.

By collecting knowledge about the behaviour of different paper products during the stock preparation in laboratory scale and with the development of standardised laboratory testing method which represents industrial conditions, some criteria for benchmarking the recyclability of paper products could be established. Based on the collected results a LCA of the products and a modelling of the paper for recycling loops should be possible. In the future, these criteria can be used to give recommendations for the production of paper products to improve collection, recyclability and therefore increase the use of recycled fibres as raw material.

Project Period: 01.09.2012 – 31.12.2014

Remarks:

The research project ECOPAPERLOOP is being funded by the European Union via the Central Europe Program and performed in cooperation with several national and international partners.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dr.-Ing. H.-J. Putz

Tel: 06151/16-2654
Fax: 06151/16-2454
E-Mail: putz@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton u. Pappe // Druckprodukte

Schlagworte:

Rezyklierbarkeit, Deinkbarkeit, Digitaldruck, Zeitungsdruck, Inkjetdruck

Theme:
Recyclability of Printed Products 2012

Background/Problem Area

Tests for the evaluation of the recyclability of printed products are a lasting and relevant part of the INGEDE business. The results of the recyclability evaluations are used for documentation and analysis of the development of recyclability for paper products, as a data basis for discussions with other parties of the paper chain and for optimising of processes.

Objective/Research Results

Annually INGEDE finances a project for the evaluation of the recyclability of printed products. The product property recyclability is divided into two parts, deinkability and sticky forming potential. A former separate research project showed the impact of pH during pulping on DIP quality, resulting in a modifications of the INGEDE Method 11p (formerly INGEDE Method 11) which describes a pH corridor to be maintained. The adoption of pH by changing the chemical formulation is especially necessary for virgin fibre based newsprint and stationeries on woodfree paper grades.

In the evaluations of the project in 2012, it was decided to study more detailed the deinkability of digitally toner and inkjet prints as well as the deinkability of inkjet printed newspapers. The following subprojects were carried out:

1. Investigations of an inkjet newspaper print on conventional newsprint on its deinkability behaviour.
2. Several dry toner laser prints (colour as well as black and white) from different machine suppliers, printed on various copy paper grades from several manufacturers were tested on their deinkability behaviour.
3. Several inkjet prints (colour) from different machine suppliers, printed on various coated and uncoated copy paper grades were tested on their deinkability behaviour.
4. Investigations on liquid toner prints on special coated paper on their deinkability behaviour.
5. Deinkability tests of three offset prints wit UV curing varnish.
6. Several print samples from the Drupa exhibition were tested on their deinkability. Samples included liquid toner prints, inkjet newspapers and several inkjet prints on uncoated and special coated copy papers.

Application/Economic Benefits

The results are used predominantly for discussions with publishers and printers and other partners along the paper chain with the target, to get a common agreement on target values for recycling benign printing applications.

Project Period: 01.01.2012 – 31.12.2012

Remarks

The research project (INGEDE 13612) is being funded by the INGEDE.

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Nicole Brandt
Tel: 03529/551-670
Fax: 03529/551-889
E-Mail: nicole.brandt@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Print products

Key words:

flexographic printing, adhesion, surface tension, wetting

Title:
Appropriate test methods to characterize flexographic substrates for improved ink adhesion and printability (Flexinad)

Background/Problem area

Manufacturers and purchasers are increasingly favouring multi-colour printed, lavishly designed packaging, especially with a view to marketing aspects. In addition to traditional gravure and offset printing, flexographic printing is gaining considerably in importance in some areas for reasons of cost and flexibility. With the further development of flexographic printing in the past few years, this method also offers the great advantage that widely varying materials and finishing processes can be provided with high-quality prints. This, however, is exactly where one of the major problems arises, viz. many possible combinations with a wide range of properties, although up to now these properties have in no way been specified for flexographic printing.

Objectives/Research results

The research project is intended to develop practical methods for users, especially in the flexographic printing and packaging sector, to help them avoid adhesion and printability problems caused by insufficient wetting and adhesion to substrates. The project objective is to better match the components substrate, printing ink and printing process with a view to improving print quality in flexographic printing.

It is planned to execute the research based on the different measuring methods already available on the market, use them on the different materials and their treatments. These results will be compared to the printing results by proof printing and the measurements by the low cost instruments as normally done by the printer. It will be investigated which print defects, related to wetting and adhesion, can be predicted. With the data gathered during the research phase, a database of known problems and the ways to solve them using measurement methods suitable for print shops will be created.

Application/Economic benefits

The project will result in reliable and repeatable test methods for surface wetting and adhesion. Print shops will derive great benefits from these developed measurements procedures. Set-up times for printing presses will be reduced and the production print run can be better controlled. The quality of print products will increase significantly, delivery times can be guaranteed and customer needs will be met. Print buyers will benefit, because the final print will comply with requirements and other after-press handling like folding, cutting, gluing, filling, packing, storage etc. will cause fewer problems.

Period of time: 01.05.2012 – 30.04.2014

Remarks

The research project IGF-Cor 69 EBR is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Irene Pollex
Tel: 03529/551-611
Fax: 03529/551-899
E-Mail: Irene.pollex@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Print products

Key words:

print, printability, mottling, striking, pick

Title:
Development of suitable laboratory test methods for improved communication between printers and paper and ink suppliers

Background/Problem area

The offset printing process is a rotative reproduction process using unilevel printing forms and creating images via the differences of wetting properties during a competition of aqueous (fountain solution for non-image areas) and oily liquids (inks for image areas) simultaneously fed to the printing form. The transfer of the image from the printing form to the substrate is of indirect nature using a transfer cylinder carrying an elastomeric rubber blanket (and therefore to offset the image). This process is bringing together a very complex combination of materials which can be made to match only under very strict conditions. Under pressure of ever increasing demands on speed, quality and diversity of printing materials the tolerances in all parts of the production chain have been reduced and production of the different materials has to conform to very strict specifications.

Due to the smaller allowed tolerances in the final product there is a requirement for a better specification of the different materials down the chain. To reach this, test and evaluation methods for the different materials need to be developed, starting with the highest cost section: the substrate, to be able to specify according to the specific needs of the printer for the specific purpose of the job. All aspects of the image reproduction on the substrate (this research will deal with paper substrates only) are captured under the term printability.

Objectives/Research results

The purpose is to develop reproducible methods to test the relevant paper properties for printability and image reproduction in the printing process. The properties covered in this research are mottling, striking-ink setting and pick. This research will be limited to papers used in sheet fed offset printing.

When evaluating the actual condition of technical and human resources of the partner laboratories were found that the homogeneity of test prints was inadequate in part. Four round-robin tests were done including the properties pick, print penetration and homogeneity. Especially for homogeneity but also for the other two round robin tests were found large differences within individual laboratories. It was necessary to test the repeatability of test print results within the individual laboratories and to evaluate. Previously unexpected factors influencing the print quality (such as the type and condition of the printing plates and the backing of the print paper in the test printing machines) have been identified additional. Appropriate test specifications were developed, selected test materials prepared, carried out the tests and the results were evaluated thoroughly.

New test methods have been developed for the properties, mottling, striking in/setting and pick. The proposed methods were critically evaluated, in joint work completed and upgraded. The project partners evaluate the quality of the developed methods and the reproducibility of test results. The benchmark tests were started for the method striking in/ setting. The material properties of the collected benchmark papers were measured.

Furthermore with the analysis of primary parameters influencing the test results (like printing pressure, printing speed, ink film thickness was begun. In addition, secondary influences like temperature, humidity and cleaning agents and their relation to the printing results have been considered.

For printing trials in the print shops was a specific test form designed to show as much as possible the affects to be investigated in the developed test methods. The printing trials were performed in Munich and Plantin (Belgium) and the project partner currently evaluate the results.

Application/Economic benefits

Based upon these multiple new test methods an improved communication between the printers and paper and ink suppliers will be possible. The tests will result in specific parameters for these printability issues, parameters that can easily be interpreted by all parties.

A focus is laid on test methods that can be used on printability testers, which can be used under well specified conditions and will return a measured value. The outcome will be beneficial to all parties involved: both printers and their vendors (paper, machines, ink and other consumables). With the developed test methods it will be easy to check the paper properties for one of the three printing problems.

Period of time: 01.07.2010 – 30.06.2012

Remarks

The research project IGF 43 EBG has been funded by the German Federal Ministry of Economics and Technology (BMWi) under the Cornet programme. The research partners are Fogra e.V.; AIDIMA; CELABOR; VICG

Forschungsstelle:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: www.ptspaper.de

Leiter der Forschungsstelle:

Dr. Frank Miletzky

Projektleiter:

Irene Pollex
Tel: 03529/551611 089/12146-498
Fax: 03529/551899 089/12146-36
E-Mail: irene.pollex@ptspaper.de

Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton Pappe // Druckprodukte

Schlagworte:

Fluoreszenz, optisch aufgehellte Papiere, Digitalprüfdruck

Thema:
Methodenentwicklung zur Überwindung fluoreszenzbedingter Abweichungen zwischen Prüf- und Auflagendrucken

Ausgangssituation/Problemstellung

Der Fortschritt im Inkjet-Druck hat dazu geführt, dass konventionelle Drucke sehr gut durch Inkjet-Systeme in Form von Digitalprüfdrucken (Proofs) simuliert werden können. Dies ermöglicht Auftraggebern die Freigabe von Auflagendrucken anhand von InkJet-Proofs.

In den letzten Jahren haben sich die graphischen Papiere für den Auflagendruck im Hinblick auf ihre optischen Eigenschaften deutlich verändert. Es hat eine Verschiebung zu bläulicheren Weißnuancen stattgefunden, die vorrangig durch den Einsatz von blauen Nuancierfarbstoffe und oder optischen Aufhellern erreicht wird. Dies führt gegenwärtig zu der Situation, dass Auflagendrucke auf optisch aufgehellten Papieren durch Proofs simuliert werden, die keinen oder nur wenig Aufheller enthalten. Weicht der Farbort des unbedruckten Papiers deutlich vom Farbort des Proofpapiers ab, kann das Proofsystem in der Regel eine farbmetrische Simulation des Papierfarbortes durch Bedruckung erreichen. Muss jedoch ein stärker optisch aufgehelltes Auflagenpapier simuliert werden, zeigen sich sehr große visuelle Abweichungen zwischen dem Proofpapier mit farbmetrischer Auflagenpapiersimulation und dem Auflagenpapier.

Forschungsziel/Forschungsergebnis

Das Ziel dieses Vorhabens besteht darin, eine handhabbare Lösung für die erheblichen Probleme mit der Abgleichung von Digitalprüfdruck und Auflagendruck zu erarbeiten, die von den Unternehmen der Druckindustrie schnell in die tägliche Praxis überführt werden kann. Dazu soll auf die in der Papier- und Druckindustrie etablierten und standardisierten Farbmessverfahren zurückgegriffen werden.

Im Rahmen der geplanten Arbeiten soll eine Methodik zur Verbesserung der visuellen Übereinstimmung von Proofs mit aufhellerhaltigen Auflagedrucken erarbeitet werden. Dazu werden anhand von Prüf- und Auflagendrucken die Auswirkungen von reinen Fluoreszenzänderungen und von gleichzeitigen Fluoreszenz- und Färbungsänderungen auf die farbmetrische Beschreibung von Drucken mit Hilfe unterschiedlicher Farbmesstechniken und unterschiedlichen UV-Anteilen der Beleuchtung der verwendeten Messgeräte bestimmt. In Abhängigkeit vom tatsächlichen UV-Anteil der Probenbeleuchtung erfolgt die visuelle Ermittlung von Toleranzschwellen der visuellen Akzeptanz zwischen Proofs und Auflagendrucken, deren Substrate sich hinsichtlich der Fluoreszenz unterscheiden. Zudem werden Digitalproofs und Auflagendrucke auf Papieren mit abgestuftem Gehalt an optischen Aufhellern farbmetrisch umfangreich messtechnisch beschrieben sowie ihr Alterungsverhalten untersucht. Es kommt die Standard-Messtechnik der Druck- und Papierindustrie jeweils mit und ohne UV-Filter zum Einsatz.

Anwendung/Wirtschaftliche Bedeutung

Die zu erarbeitenden Toleranzschwellen und die Kenntnisse der Abhängigkeit der Fluoreszenzdifferenzen zwischen verschiedenen Substraten vom UV-Anteil der Probenbeleuchtung werden zukünftig eine zielgerichtete Prüfdruckerstellung und deutlich verkürzte Einrichtezeiten im Auflagendruck gestatten und damit bisherige empirische Anpassungsversuche überflüssig machen. Mit diesen Verbesserungen ist eine bessere Kommunikation innerhalb der Druckindustrie und auch in Richtung der Druckeinkäufer und Papierhersteller verbunden.

Bearbeitungszeitraum: 01.07.2010 – 30.06.2013

Bemerkungen

Das Forschungsvorhaben IGF 16607 BG wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie (BMWi) gefördert und in Zusammenarbeit mit der Fogra e. V. durchgeführt.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Markus Kleebauer
Tel: 089/12146-387
Fax: 089/12146-36
E-Mail: markus.kleebauer@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Carton products

Key words:

food packaging, folding boxes, organoleptic properties, odour, gas-chromatography

Title:
Development of strategies for controlling the organoleptic properties of folding boxes based on chemical and descriptive odour analysis

Background/Problem area

To control the organoleptic properties of food stuffs more and more higher standards are established by the food industry. Already very small deviations in odour and taste can be detected with very effective organoleptic tests methods but only assigned in minor cases to a potential source. Often packaging materials are under a strong suspicion to cause changes in the organoleptic properties of food stuffs. Therefore they are often the reason of customer complaints.

Compared with other packaging materials carton boards but also papers have some disadvantages regarding their orano-leptic properties:

- Paper and board are mainly composed of natural fibres and possess nearly in every case a small but not unpleasant odour by itself.
- The fibres of cellulose and mechanical wood pulps are a very good nutrient media for microorganisms which could generate odorous compounds during production and storage.
- Very rapidly fibres adsorb low molecular compounds like solvents or residual monomers. In return the emission of the volatile compounds is very slow.

To avoid customer complaints and losses in market shares the currently used quality assurance measures for monitoring the organoleptic properties of carton board products need to be optimised in the paper and board industry to create a better basis for future optimisation work.

Objectives/Research results

The objectives of the research project include the following points:

- Identification of the main odorous compounds in packaging products made from carton board
- Development of an organoleptic test method for the board industry taking into account the increasing requirements of the food industry
- Improvement of the significance of sensory test results performed with card board and folding boxes with regard to influences from raw materials, additives, varnishes and printing inks.
- Development of a quick gas-chromatographic method for the analysis of the main odorous compounds
- Quick allocation of odorous compounds to the main sources
- Allocation of the sensation of human nose to the main odorous compounds
- Improvement of the quality assurance and quality optimisation of card board regarding to the sensory properties

Application/Economic benefits

The research results can be used along the whole value chain from the carton board production up to the final packaged food product. Especially the following economical advantages are generated:

- Avoiding of customer complaints and product losses via control of odour and taste
- Future use of carton board as packaging material for food stuffs especially in the case of recycling board qualities.

Period of time: 01.04.2012 – 31.03.2014

Remarks

The research project IGF 425 ZBG is being funded by the German Federal Ministry of Economics and Technology (BMWi) within the framework of the ZUTECH programme and is being performed together with Fraunhofer Institute for Process Engineering and Packaging in Freising.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstr. 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr. -Ing. S. Schabel

Projektleiter:

Dipl.-Chem. A. Kersten
Dipl.-Ing. C. Trumpp

Tel: 06151/16-4169
Fax: 06151/16-2454
E-Mail: kersten@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Schachtelprodukte

Schlagworte:

Barrierebeschichtung, Migration, Karton

Theme:
Active Packaging Papers and Boards for Food and Agricultural Goods Containing Micro-Encapsulated Antimicrobial Substances

Background/Problem Area:

The wide range of goods and food in our markets wouldn't be possible without modern packaging. Beside the protective function against a multitude of influencing factors, modern packaging must be informative and promotional. To ensure the food grade, high requirements are necessary since several factors can cause the deterioration of food. Especially problematic is the microbial infestation of the packed good or the packaging.

Active packaging can ensure the quality and the shelf-life of packed goods during storage and transport, by regulating chemical and physical processes. To reduce microbial load, active materials can release antimicrobial substances. Today, the application of preserving agents on fruits, vegetables, flowers and other fresh or agricultural goods is performed directly on the object, often by over dosage, which is neither economical nor harmless. No current preserving method separates substances and food of each other or releases preserving substances as required.

In the specialist and patent literature, numerous products and techniques are specified. To date, these active packaging materials are mainly available and established in Japan, Korea and in underpart as well in other Asian countries and in the United States. Europe has fallen behind in the development of antimicrobial packaging materials, although many manufacturers are positively towards the development. To reduce the gap between European producers and foreign competitors, innovative developments in active packaging technologies are necessary.

Objective/Research Results:

The aim of the project was the development of innovative active packaging materials on base of paper, board and corrugated board. The latter will contain immobilized antimicrobial substances encapsulated into microcapsules of biodegradable plastic material, which will be released when actual microbial infestation is occurring. Additionally, there will be a colour reaction, which indicates a microbial infestation optically.

By using microcapsules, an unnecessary exposure of the packaging material or the packaged good with antimicrobial substances will be avoided reliably. Additionally, preserving agents in the packed good can be reduced. Appropriate materials for the capsules in terms of poly lactid acids and their derivates have been developed so far. Additionally, solid body balls of the same materials, containing the same antimicrobial substances, have been produced to avoid a possible breakage of the capsules and to increase the heat resistance during application and drying process.

Numerous application trials have been realised and most applications methods including spraying, coating, some printing methods and sheet forming with capsules have shown good results. The paper and board products showed equal distribution of capsules and balls, good adhesion and no or little breakage of capsules. The microbiological test methods have been advanced, so that capsules and balls as well as paper products can be tested on their activity and effectiveness.

Application/Economic Benefits:

The products, methods and technologies, developed in this project, will be useful for all kind of packed goods and will enhance the attractiveness of paper and board packaging. Since the antimicrobial substances are separated from the packed goods, the packaging materials will be especially useful for food since the exposure with antimicrobial substances will be minimal. The new materials will be beneficial for small and medium size growers of agricultural products who need to store and transport their perishable products. In general, food industry related producers can offer their food products more flexible by time and region, since enlarged itineraries and storage times will be possible.

The microcapsules can provide high added value to different transport and sales packaging made from paper and board. Small and medium size enterprises will use the project results to produce tailored products. Microcapsules are mostly produced by small and medium enterprises that can expand their markets from technical and pharmaceutical applications into packaging applications. The results will support German enterprises to adjust their competitive disadvantage to Japanese and other foreign competitors, which is not possible for small and medium enterprises single-handed by reason of the complex problem.

The expected results will be useful for the areas of packaging, paper and catering trade as well as for the areas of microbiology, chemistry, paper science, process engineering and food technology.

Project Period: 01.02.2010 – 31.01.2012

Remarks:

The project IGF 16344 N of the research association "Forschungsgesellschaft Kunststoffe e. V." has been funded by the Federal Ministry of Economics and Technology (BMWi) and performed in cooperation with "Deutsches Kunststoffinstitut" (DKI) and "Hochschule Darmstadt, Fachgebiet Mikrobiologie".

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. K. Villforth

Tel: 06151/16-3009
Fax: 06151/16-2454
E-Mail: villforth@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele	**Schlagworte:**
Endprodukte aus Papier, Karton und Pappe // Schachtelprodukte	Rezyklierbarkeit, Verpackung, Smart Label, gedruckte organische Elektronik

Theme:
Printed Organic Circuits and Chips (Polytos)

Background/Problem Area

The project “Printed organic circuits and chips” (Polytos) is launched by the excellence cluster “Forum Organic Electronics” (DaVinci). DaVinci intends to become the world’s leading research, development and production site for organic electronics. The areas of focus are eco-friendly energy generation using organic photovoltaic, economical energy use through organic light-emitting diodes and the resource- and eco-friendly production of electronic components such as circuits, chips and sensors. The special expertise of the cluster lies in printing technology as a cost-effective production method for organic electronic components.

The aim of Polytos is to develop new materials, concepts, components, manufacturing processes and software for printed organic circuits with integrated sensors for applications in the packaging industry. The project is conducted by a consortium headed by Merck. Aside from Merck KGaA (Darmstadt), the consortium partners are BASF SE (Ludwigshafen), Pepperl+Fuchs GmbH (Mannheim), PolyIC GmbH & Co. KG (Fürth), Robert Bosch GmbH (Stuttgart), SAP AG (Walldorf) as well as the Ruprecht-Karls-Universität Heidelberg, the Technische Universität Darmstadt (TUD) and the University of Mannheim. Copaco GmbH & Co. KG (Mainz), Innovation Lab GmbH (Heidelberg) and VARTA Microbattery GmbH (Ellwangen) are associate partners.

The TUD participates in the project with the Chair of Printing Science and Technology (IDD), the Institute of Microelectronic Systems (MES), the Chair of Structural Mechanics (FSM) and the Chair of Paper Technology and Mechanical Process Engineering (PMV). TUD team leader is Jürgen Willmann (IDD).

Objective/Research Results

The objective of Polytos is to develop printed organic circuits with integrated sensors capable of recording data such as temperature, humidity or light exposure. Interfaces are used to read this information. These types of printed organic circuits could be used as printed smart labels in the future.

The contribution of PMV is focused on the recyclability of printed organic electronics (POE) concerning the paper chain. This topic comprises the behaviour of labels in the repulping process, the separation/deposition of label fragments and peeled off components, as well as the identification of harmful substances.

A test method developed by PMV assesses the recyclability of packaging products with and without POE labels. The ZELLCHEMING technical committee ‘Recovered Paper Utilization’ (RECO) with its sub-committee ‘Recycling-Technology’ (TECH) has actually the new method under discussion as a technical leaflet for the paper industry.

According to test results, recyclability of packaging products with smart labels depends mainly on type of adhesives utilised to attach POE plastic label. Some adhesives, particularly dispersion adhesives, release labels due to the rough process conditions of repulping. Layers of printed electronics will detach from the label and may contaminate fibre suspension with detrimental substances. Trials with hot melt adhesive demonstrate that it is possible to retain the label on the coated surface of liquid packaging board without affecting disintegration of the fibre layer.

Application/Economic Benefit

Polytos is aiming to develop an overall organic electronics process that will permit the industrial use of smart labels on an industrial scale. Polytos covers the complete value chain from components, circuit design, printing processes, packaging design as well as software and application development. In this context PMV represents the vital interests of the paper chain by assessing the recyclability of smart labels based on organic electronics.

Project Period: 01.03.2009 – 29.02.2012

Remarks

The excellence cluster project “Printed organic circuits and chips” (Polytos) has been funded by the Federal Ministry of Education and Research (BMBF).

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstr. 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

M. Sc. A. Gottschling

Tel: 06151/16-4315
Fax: 06151/16-2454
E-Mail: gottschling@papier.tu-darmstadt.de

Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton und Pappe // Sonstige

Schlagworte:

Architektur, Design, Notfallunterkünfte, Papiergebäude

Theme:
Functional and Completely Biocompatible Paper Materials for Aesthetic Solutions in Architecture

Background/Problem Area:

In the field of architecture and design paper materials are widely used. Although paper engineers and chemists have various measures to develop paper with defined properties, they commonly don't know the requirements for paper used in architecture. By bringing together architects and designers with paper engineers and chemists in this interdisciplinary project, custom-made paper materials can be developed. This could improve the application of paper materials in architecture and offer opportunities for new products.

One idea of a new product is an emergency accommodation made of paper materials. After natural disasters there is often a need to supply a big number of people with emergency accommodations. Compared to tents emergency accommodations made of paper materials could offer the advantages of biodegradability, a feeling of stability and safety for the inhabitants and a higher aesthetic quality.

Another product idea is the development of a paper material usable for moulding of complex bodies in design. Nowadays a certain type of silicone is the common material for this purpose, but concerning environmental aspects its use is questionable.

Objective/Research Results:

In this project researchers and students from the Departments of Mechanical Engineering, Chemistry and Architecture at the Technische Universität Darmstadt work together. The aim of the project is to develop prototypes for the new products mentioned above, the emergency accommodation and the moulding material.

Various designs for the emergency accommodation have already been created. At the moment the best designs are specified further and after this one design will be chosen for the implementation of a prototype. Two of best designs are displayed in figure 1.

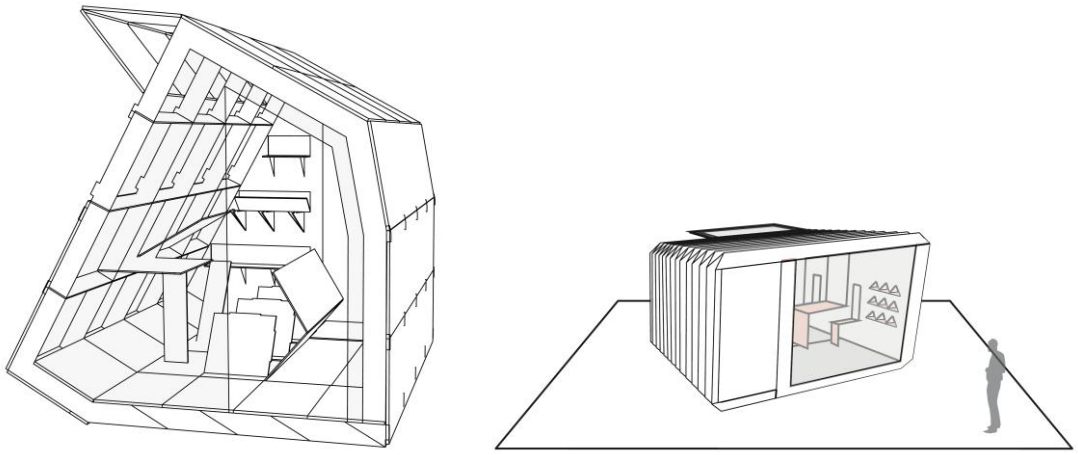

Figure 1: Designs for the emergency accommodation by Thomas Moder (left) and Octavian Lupkowski (right).

Application/Economic Benefits:

The results of this project are meant to be a basis for further research in the field of sustainable materials in architecture. Following projects could for example deal with the question of how paper materials can be used in architecture in general.

Project Period: 01.05.2012 – 30.04.2014

Remarks:

The project is being funded by the Funding Initiative for Interdisciplinary Research at the Technische Universität Darmstadt and performed by PMV in cooperation with the university departments of chemistry and architecture.

Forschungsstelle:

Technische Universität Dresden
Fakultät Maschinenwesen
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/ihp

Leiter der Forschungsstelle:

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Prof. Dr.-Ing. J.-P. Majschak (Fst. 1)
Prof. Dr.-Ing. Harald Großmann (Fst. 2)
Tel: 0351/463-38033
Fax: 0351/463-38032
E-Mail: harald.grossmann@tu-dresden.de

Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier und Karton // Sonstige

Schlagworte:

Tiefziehen, Umformen, Umformverfahren, Verpackungen

Thema:
Entwicklung leistungsfähiger Urform- und Umformtechniken zur Herstellung innovativer Packmittel aus nachwachsenden Rohstoffen

Ausgangssituation/Problemstellung

Die Notwendigkeit, industriell produzierte Verbrauchsgüter zu verpacken, ergibt sich unter den heutigen gesellschaftlichen Bedingungen primär aus der räumlichen und zeitlichen Trennung von Produktion und Konsum. Die Verpackung in ihrer Gesamtheit aus Packmittel und Packhilfsmittel dient hierbei hauptsächlich dem Schutz des Füllgutes, der effizienten Warenverteilung, dem Verbrauch des Packguts sowie als Medium für die zielgerichtete Kommunikation mit dem Konsumenten in Form von Werbung und Information. Die Kommunikationsfunktion gewinnt dabei zunehmend an Bedeutung, da der Konsument nicht bereit und in der Regel auch nicht in der Lage ist, dem stetig wachsenden Warenangebot mit einem analog steigenden Zeitaufwand für seine Einkäufe zu entsprechen. Vor diesem Hintergrund hängt der Erfolg einer Ware in immer stärkerem Maße von der Attraktivität ihrer Verpackung, d. h. vor allem deren eventuellen design- oder funktionsbedingten Alleinstellungsmerkmalen ab. Der etablierte Einsatz synthetisch hergestellter petrochemischer Kunststoffe in der Verpackungsindustrie, insbesondere im Lebensmittel- und Pharmabereich, resultiert hauptsächlich aus deren nahezu konkurrenzlosen Eigenschaftsprofil hinsichtlich Formflexibilität und Barrierewirkung gegenüber Gasen, Wasser und Fett. Die thermoplastische Verarbeitbarkeit aus der Schmelze ermöglicht außerdem eine ökonomische Fertigung unterschiedlichster Massenprodukte wie Folien, Hohlkörper oder Formteile. Ein schwerwiegender Nachteil von petrochemischen Packstoffen ist ihre direkte Abhängigkeit von der fossilen und begrenzten Ressource Erdöl.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsprojekts ist es, die für die Umformung entscheidenden Eigenschaften des Materials Karton zu untersuchen und zu kennzeichnen. Es sollen Maßnahmen erarbeitet werden, mit deren Hilfe die Umformbarkeit von Karton verbessert wird und die in der Papierproduktion umgesetzt werden können, um die Voraussetzungen zur Entwicklung eines neuen zugeschnittenen Materials für das Ziehen von Karton bereitzustellen. Dazu sollen Erkenntnisse zu Wechselwirkung zwischen Materialeigenschaften und Ziehprozess erarbeitet werden, aus denen sich die Maßnahmen für die Papier- bzw. Kartonherstellung ableiten lassen. Zur Quantifizierung dieser Eigenschaften und zur Beschreibung der Umformbarkeit von Karton sind geeignete Standardprüfverfahren auszuwählen und daraus Kenngrößen abzuleiten, die für die Beschreibung der Umformbarkeit des Materials in der Praxis dienen können.

Durch die Verifizierung der Maßnahmen im Rahmen von Umformversuchen gezielt modifizierter Materialien, die auf einer Pilotpapiermaschine hergestellt werden, soll die Wirkung in Bezug auf die Verbesserung der Umformbarkeit sowie die Übertragbarkeit dieser Maßnahmen in die Praxis eingeschätzt werden. Die ökonomische Umsetzbarkeit der Ergebnisse soll durch Einbeziehen der der politischen und gesellschaftlichen Prioritäten bezüglich eines verantwortungsvollen Umgangs mit Ressourcen, der Vermeidung von Abfall sowie der Reduktion anthropogener Einflüsse auf die Entwicklung des Klimas hinsichtlich Material- und Energieeffizienz gesichert werden, um so eine Basis für die verbreitete Anwendung von Material und Prozess zu schaffen.

Anwendungen/Wirtschaftliche Bedeutung

Aus den Ergebnissen des Projektes lassen sich für die Packstoffhersteller, also die Papier- und Kartonindustrie neue Produkte mit überlegener Eignung für den Tiefziehprozess generieren und die breiteren Anwendungspotenziale in der Verpackungsindustrie lassen einen entsprechenden Markt mit ausreichendem Produktionsvolumen erwarten. Die Hersteller der Umformmaschinen und die der dort benötigten Werkzeuge werden in die Lage versetzt, potenzielle Risiken bei der Entwicklung derartiger Produkte für komplexe Umformaufgaben besser einzuschätzen. Die Anwendung der im Projekt erarbeiteten technologisch optimierten Lösungen in den Maschinen sowie eine Implementierung der erarbeiteten Zusammenhänge zwischen Prozess und Material ermöglichen die Integration einer Prozessüberwachungsstrategie und entsprechenden Reaktionsalgorithmen bei der Steuerung der Maschinen, was einen erheblichen technischen Fortschritt darstellt.

Diese Entwicklung ist entscheidend für die Anwendung der Technologie in Verpackungstechniksegmenten mit hohen Ansprüchen an die Qualität der Verpackung und an die Automatisierung sowie die Verfügbarkeit der Maschinen. Dem Packmittelhersteller werden auf diese Weise Material und Maschinentechnik zur Verfügung gestellt, mit denen eine neue Generation von Formteilen und damit neue verpackungstechnische Möglichkeiten für entsprechend innovative Produkte realisierbar sind. Aus diesen Möglichkeiten ergibt sich wirtschaftlich ein erheblicher Wettbewerbsvorteil durch die Generierung und flexible Umsetzung neuer Verpackungen durch eine leistungsfähige und zuverlässige Umformtechnologie.

Bearbeitungszeitraum: 01.06.2012 – 31.05.2014

Bemerkungen

Das IGF-Vorhaben 16578 BR der Forschungsvereinigung Industrievereinigung für Lebensmitteltechnologie und Verpackung e. V. – IVLV wird über die AiF im Rahmen des Programms zur Förderung der Industriellen Gemeinschaftsforschung und -entwicklung (IGF) vom Bundesministerium für Wirtschaft und Technologie aufgrund eines Beschlusses des Deutschen Bundestages gefördert. Das Projekt wird in Kooperation mit der Professur für Verarbeitungsmaschinen/Verarbeitungstechnik der TU Dresden (Fst. 1) sowie der Papiertechnischen Stiftung – PTS-IZP bearbeitet (Fst. 3).

Forschungsstelle:

Technische Universität Dresden
Fakultät Maschinenwesen
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/ihp

Leiter der Forschungsstelle:

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Prof. Dr.-Ing. Bernd Kieback (Projektleiter)
Prof. Dr.-Ing. Harald Großmann (Partner 3)
Tel: 0351/463-38033
Fax: 0351/463-38032
E-Mail: harald.grossmann@tu-dresden.de

Forschungsgebiet: Produkt-Ziele

Produktziele // Endprodukte aus Papier und Karton // Sonstige

Schlagworte:

Duktilität, Keramikwerkstoff

Thema:

European Centre for Emerging Materials and Processes Dresden (ECEMP) - Teilprojekt C3: Formgebung und Fügen multifunktionaler duktiler Keramik-Metall-Werkstoffverbunde mit definierten Nano/Makro-Strukturmerkmalen für die Energie- und Umwelttechnik (CeraDuct)

Ausgangssituation/Problemstellung

Technische Keramikwerkstoffe werden sowohl aufgrund ihrer hohen Kosten als auch wegen der eingeschränkten geometrischen Gestaltungsmöglichkeit vielfach ungeachtet der jeweiligen Eigenschaftsvorteile nicht eingesetzt. Das trifft insbesondere auf keramische Werkstoffe mit eingestellter Porosität zu, die vorrangig als Filtermaterialien und Membranen in der Energie- und Umwelttechnik Anwendung finden. Mit der Entwicklung von Werkstoffverbunden wird versucht, das an sich verschiedene Werkstoffverhalten von Metall- und Keramikwerkstoffen miteinander zu kombinieren und so die Vorteile beider Materialien zu verbinden.

Zur Fertigung von Werkstoffverbunden müssen neben dem verfahrensspezifischen Verständnis genaue Kenntnisse über die grundlegenden werkstoffphysikalischen Mechanismen des Zustandekommens einer Verbindung bei der Formgebung und dem Sintern (Wechselwirkungen zwischen den Werkstoffen an der Phasengrenzfläche) sowie über die sich einstellenden Eigenschaften vorhanden sein. Im Allgemeinen weisen Werkstoffverbunde bedingt durch den schichtartigen Aufbau für sie typische Eigenschaften auf. Neben der sich ausbildenden Gefügemorphologie sind die in einem Werkstoffverbund auftretenden Eigenspannungen sowie die Haftung bzw. Haftfestigkeit zwischen den einzelnen Werkstoffbereichen von entscheidender Bedeutung.

Aufgrund des Zusammenfügens zweier oder mehrerer völlig verschiedenartiger Werkstoffe kommt es über den Querschnitt von Werkstoffverbunden zur Ausbildung unterschiedlicher Gefüge, was durch die Herstellungsverfahren und -bedingungen sowie die Werkstoffe selbst beeinflusst wird. Durch Vorgänge in und nahe der Phasengrenzfläche (Diffusion von Elementen, Lösungsreaktionen) kommt es zu Veränderungen im Gefüge und zur Ausbildung mehr oder weniger stark ausgeprägter Übergangs- oder Reaktionszonen.

Forschungsziel/Forschungsergebnis

Dieses Teilprojekt hatte zum Ziel, das an sich grundsätzlich verschiedene Werkstoffverhalten von Metall- und Keramikwerkstoffen miteinander zu kombinieren. Für die Umsetzung des resultierenden Werkstoffverbundes wurden fertigungstechnologische Konzepte entwickelt. Das vorrangige Entwicklungsziel bestand in einer duktilen Keramik mit bisher nicht bekannten geometrischen Freiheitsgraden für die Realisierung von Strukturen für die Filtration und den Leichtbau. Das Teilprojekt an der Forschungsstelle bestand in der Adaption papiertechnologischer Verfahren – speziell der Streichtechnik – auf die Herstellung keramischer Verbundwerkstoffe. Es hat sich gezeigt, dass sowohl ein dünnschichtiger als auch ein mehrschichtiger Aufbau, der zum Aufbau von Funktionsschichten verwendet werden kann, mit der Streichtechnik möglich ist. Die Festigkeiten der durch Streichen hergestellten Keramiken sind inzwischen mit den konventionell durch Foliengießen hergestellten Keramiken vergleichbar.

Anwendungen/Wirtschaftliche Bedeutung

Kernstück des Projektes ist die kostengünstige und hochproduktive Erzeugung eines endlosen, dünnen Halbzeuges. Dieses Halbzeug soll in anschließenden Konfektionierungs-, Umform- und Verbindungsverfahren flexibel zu verschiedenen, komplexen Erzeugnissen weiterverarbeitet und mittels Sinterung in den Werkstoff umgewandelt werden. Durch die Nutzung von Synergieeffekten, die sich aus der Verbindung von bisher „keramik-fremden“ Technologien mit pulvertechnologischen Verfahren ergeben, wird die serienfähige Fertigung von strukturierten und miteinander verbundenen sehr dünne Einzellagen möglich, wie sie mit konventionellen Verfahren (Foliengießen, Pulverwalzen) allein nicht realisierbar sind

Es wird ein großer Bedarf an neuen Produkten über die bereits genannten Anwendungen (Brennhilfsmittel, Filter) hinaus erwartet. So sind z. B. für Katalysatorenträger, Ballistikschutz, Baukeramik (Fassadenfliesen mit Wärmeisolation) ebenfalls neue Produktgeometrien und Fertigungskonzepte denkbar. Gefordert werden dabei immer geringe Kosten und ein erweitertes Leistungsspektrum, wodurch sich neue Einsatzgebiete für in der Papiertechnik etablierte Verfahren ergeben.

Bearbeitungszeitraum: 01.04.2009–31.03.2012

Bemerkungen

Das Forschungsvorhaben (ECEMP – Verbundprojekt C3) wurde aus Mitteln der Europäischen Union (EFRE) und des Freistaates Sachsen gefördert. Das Teilprojekt wird unter der Leitung der Professur für Pulvermetallurgie, Sinter- und Verbundwerkstoffe zusammen mit den Professuren für Anorganisch-Nichtmetallische Werkstoffe, Leichtbau und Kunststofftechnik und Laser- und Oberflächentechnik der TU Dresden in Kooperation mit den Fraunhofer-Instituten IFAM, IKTS und IWS durchgeführt.

Forschungsstelle:

Technische Universität Dresden
Fakultät Maschinenwesen
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/ihp

Leiter der Forschungsstelle:

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Prof. Dr.-Ing. Bernd Kieback (Projektleiter)
Prof. Dr.-Ing. Harald Großmann (Partner 3)
Tel: 0351/463-38033
Fax: 0351/463-38032
E-Mail: harald.grossmann@tu-dresden.de

Forschungsgebiet: Produkt-Ziele

Produktziele // Endprodukte aus Papier und Karton // Sonstige

Schlagworte:

Keramikwerkstoff, Metall-Keramik-Werkstoffverbunde

Thema:
European Centre for Emerging Materials and Processes Dresden (ECEMP) – Teilprojekt C3: Keramik-Metall-Werkstoffverbundbauteile für die Energie- und Umwelttechnik, deren Herstellung und Charakterisierung (CerMetComp)

Ausgangssituation/Problemstellung

Technische Keramikbauteile werden sowohl wegen ihrer hohen Kosten als auch wegen der eingeschränkten geometrischen Gestaltungsmöglichkeit (Materialvolumen vs. Mechanische Eigenschaften) vielfach ungeachtet ihrer häufig überlegenen Eigenschaften nicht eingesetzt. Das gilt insbesondere für den Bereich von Werkstoffen mit eingestellter Porosität, die vorrangig als Filtermaterialien und Membranen in der Energie- und Umwelttechnik Anwendung finden.

Mit der Entwicklung von Metall-Keramik-, Keramik-Keramik- oder Metall-Metall-Werkstoffverbunden wird das Anwendungsspektrum der technischen Keramiken erweitert. Insbesondere mit Metall-Keramik-Werkstoffverbunden wird versucht, das an sich unterschiedliche Werkstoffverhalten von Metall- und Keramikwerkstoffen miteinander zu kombinieren.

Für die Herstellung solcher Schichtverbunde stehen verschiedene Technologien zur Verfügung. Neben pulvertechnologischer Formgebung können Verfahren wie z. B. thermisches Spritzen, physikalische und chemische Gasphasenabscheidung und Aktivlöten eingesetzt werden. Allen bekannten Verfahren ist gemeinsam, dass die Möglichkeit, komplizierte Geometrien in den einzelnen Werkstoffbereichen herzustellen, sowie Vielfalt und Skalierbarkeit der verarbeitbaren Werkstoffkombinationen beschränkt bleiben.

Forschungsziel/Forschungsergebnis

Ziel ist es, die Duktilität der Werkstoffverbunde zu erhöhen, gezielt elektrisch, thermisch oder Sauerstoff leitende oder isolierende Schichten aufzubauen oder definierte Porositäten von porös bis dicht zu erzeugen. Funktionelle Baugruppen mit hohem Wirkungsgrad erfordern die Herstellung von dünnen Schichten, die mit den bewährten pulvertechnologischen Produktionsmethoden der Keramikindustrie nur unter erheblichem Aufwand produziert werden können. Bei der Papierherstellung und -veredlung werden dünne Mineralschichten, die nur wenige Mikrometer dick sind, mittels Streichverfahren mit hoher Produktivität appliziert. Diese Streichfarben unterscheiden sich grundsätzlich nicht sehr von den Schlickern zur Herstellung von Keramiken durch Foliengießen.

Innerhalb des Projektes wurden Grünfolien durch Streichtechnik erfolgreich hergestellt. Dadurch ist es möglich, großflächige, kontinuierliche dünne Schichten beginnend bei 1 µm (gesintert) herzustellen. Dies ermöglicht eine gezielte Kombination stofflicher und funktioneller Eigenschaften. Trotz der starken Unterschiede im Schwindungsverhalten zwischen Metall- und Keramik-Werkstoffen ist eine Co-Sinterung von mehrlagigen Metall-Keramik-Verbunden bei Einhaltung werkstoffspezifischer Randbedingungen möglich. Bei einseitigen Werkstoffverbunden ist die Schichtdicke bezüglich der verformungsfreien Sinterung begrenzt, was jedoch keine Einschränkung der Technologie darstellt. – Im Gegenteil war es doch das Ziel, dünne funktionale Schichten zu erzeugen, die eine Reduzierung des Ressourceneinsatzes ermöglichen. Bei mehrschichtigem, symmetrischem Aufbau können diese bestehenden Grenzen evtl. deutlich erweitert werden.

Anwendungen/Wirtschaftliche Bedeutung

Kernstück des Vorhabens ist die kostengünstige und hochproduktive Erzeugung eines endlosen, dünnen Halbzeuges insbesondere bestehend aus dünnen multifunktionellen Schichten. Hinter diesem Anspruch verbirgt sich ein großer Bedarf an neuen Produkten über die bereits genannten Anwendungen (Brennhilfsmittel, Filter) hinaus. So sind z. B. für Katalysatorenträger, Ballistikschutz, Baukeramik (Fassadenfliesen mit Wärmeisolation) ebenfalls neue Produktgeometrien und Fertigungskonzepte denkbar. Gefordert werden dabei immer geringe Kosten und ein erweitertes Leistungsspektrum. Auf der anderen Seite ergeben sich daraus neue Einsatzzwecke für Technologien der Papierherstellung und -veredlung.

Bearbeitungszeitraum: 01.04.2012 – 31.03.2014

Bemerkungen

Das Forschungsvorhaben (ECEMP – Verbundprojekt C3) wird aus Mitteln der Europäischen Union (EFRE) und des Freistaates Sachsen gefördert. Das Teilprojekt wird unter der Leitung der Professur für Pulvermetallurgie, Sinter- und Verbundwerkstoffe zusammen mit den Professuren für Anorganisch-Nichtmetallische Werkstoffe, Leichtbau und Kunststofftechnik und Laser- und Oberflächentechnik der TU Dresden in Kooperation mit den Fraunhofer-Instituten IFAM, IKTS und IWS durchgeführt. Dieses Projekt ist das Folgeprojekt des ECEMP-C3-Projektes CERADUCT.

Research Institute:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Irene Pollex
Tel: 03529/551-611
Fax: 03529/551-899
E-Mail: irene.pollex@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Other

Key words:

softness, tissue, handkerchiefs, toilet paper

Title:
Objective assessment of softness of tissue papers and possibility to obtain given softness specifications

Background/Problem area

Besides dry and wet strength as well as water absorption capacity, softness belongs to the most important properties of tissue papers. This particularly applies to handkerchief paper, toilet paper, napkins and kitchen towels. Due to the lack of objective measuring procedures this property is in spite of its importance still assessed in so-called panel-tests which are performed by groups of experts in an entirely subjective way. In addition to their subjectivity these panel tests are extremely time consuming and do not allow a clear distinction between papers from different manufacturers. So far there are a number of measuring techniques available which are based on mechanical, acoustic or optical phenomena. Those give some information about the surface characteristics of these papers but unfortunately they are in no way able to simulate the human perception of softness.

Objectives/Research results

Therefore the intended project aims at developing a cost-effective, objective, repeatable and fast measuring procedure which gives information about the softness of a tissue paper with a very close correlation with the human perception.

Based on a great number of metrological and haptic investigations, a standard panel test was elaborated and a measuring procedure was identified which enable reproducible softness evaluations of tissue paper handkerchiefs.

The procedure was prepared for standardization and presented to the DIN Technical Committee NA 074-02-05 AA ”Test methods for tissue paper and tissue products“.

Moreover, a complex softness evaluation procedure was developed that uses different measuring methods, is related to the conventional haptic evaluation method for tissue paper and provides satisfactory estimates of the target parameter product softness. The following parameters were found to have a significant influence and incorporated in a neuronal model to mathematically estimate the softness of tissue products: tensile strength, tensile energy absorption (TEA), elastic modulus (via the bending stiffness determined by the cantilever method), roughness (GFM Mikro CAD method), unevenness (optical method), FOGRA contact area as well as measurements of the Tissue Softness Analyzer.

The suitability of the Emtec Tissue Softness Analyzer for the softness evaluation of paper handkerchiefs could be proved by extensive investigations. The device - which has only recently been available on the market - uses a complex system of mechanical and vibratory/dynamic stresses to reproducibly measure and evaluate tissue materials, covering most of the measured values found to be relevant in the project.

The data and measurements obtained in the project were systematically evaluated to investigate selected effects of production and converting influences on softness. Among other, the results have shown that full-area printing leads to softness losses in handkerchiefs.

Application/Economic benefits

The project results will enable tissue producers, traders and users to comparably evaluate tissue products by means of a standard procedure. The project has led to a panel test procedure for softness evaluation that includes subjective criteria, as well as to two objective measuring methods that take into account various physical properties found to be significant for the softness of tissue materials.

It could be demonstrated that the panel test procedure and metrological evaluation methods provide comparable evaluation results for the softness of tissue paper handkerchiefs, meaning that all these methods are equally suitable and applicable for softness evaluation.

The participating research institutes have gained enough experience from the project work to offer independent tissue material evaluations as a service to the industry. The developed panel test procedure can be proposed for standardization.

The Tissue Softness Analyzer is a complex device suitable for evaluating the softness of tissue materials – it provides reproducible results and can readily be used in the industry.

The identified influences of major production and converting factors on softness can be used by manufacturers and converters to systematically develop haptically attractive products.

Period of time: 01.09.2009 – 29.02.2012

Remarks

The research project IGF 21 EBR has been funded by the German Federal Ministry of Economics and Technology (BMWi) under the Cornet programme. The research partners are TU Dresden, Professur für Papiertechnik, University of Leipzig, Paul-Flechsig-Institute for Brain Research, Haptics Research Laboratory; AIDIMA; CELABOR

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Research Institute:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dirk Fiedler
Tel: 03529/551-669
Fax: 03529/551-899
E-Mail: dirk.fiedler@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Other

Key words:

titanium dioxide, dispersing, coating, functionalisation

Title:
Increasing the opacity effect of TiO2 by specific modifications of the pigment

Background/Problem area

Decor Papers are Specialty Papers for surface finishing of wood materials. In the area of specialty papers, the decor papers are due to the continuously growing applications on the papers with the highest growth rates. Due to the high claim the highest optical demands are placed on the decor paper. For optimum printability requires the paper a very good formation, smoothness and dimensional stability. The resin impregnation requires an even penetration of the resin in the paper. Prerequisite for successful application is sufficient strength of the paper web.

Decor paper as part of a multi-layer laminate characterized in particular its visual appearance. In bright decor paper grades, titanium dioxide is used as a filler to achieve the required level with regard the opacity and whiteness. These basic quality requirements to the decor paper can be achieved only by using high blanched quality pulp. The distribution of titanium dioxide in the paper plays a crucial role for its visual appearance.

In contrast to most other species is the decor paper, is the pulp not the largest cost factor, but the titanium dioxideWith a market price of 2,300 €/t and an amount of up to 40 % in paper costs exceed the amount of titanium dioxide to the pulp.

Objectives/Research results

The aim of the project is to achieve a reduction of TiO_2 in the decorative paper. This will be ensured through better distribution of titanium dioxide pigments in the paper body. A better distribution is achieved by effectively prevent the agglomeration of titanium dioxide pigments. For this purpose, a screening of different methods are performed, which are tested on both their profitability and also on their functionality. Among the methods:

- steric stabilization, using fixed bond
- Major pigments as a carrier
- TiO_2 composite spheres as a pigment

It should be noted that the specifications are respected for a decorative paper. The wet strength must be maintained. A graying due to the use of modified pigments should be avoided. The impregnation of the paper should not fall. The light fastness must be preserved and the wet opacity as possible should be increased.

Application/Economic benefits

The primary benefit of the developed method is the introduction of modified titanium dioxide pigments for cost reduction of decorative papers, preserving their opacity. This results Decor Papers with a significantly reduced proportion of titanium dioxide with the same opacity or decorative papers with the same content with a much higher opacity.

The enormous investment in research and development in decor paper manufacturers during the last years show the desire to develop new specialty papers. An innovative product that enables a significant increase in the opacity, while retaining the essential qualities of paper, or a reduction of expensive titanium dioxide content in the same opacity permits should have excellent market entry opportunities. The modified titanium dioxide pigments should bring significant cost advantages in th production.

After a systematic investigation of the necessary equipment and process parameters at pilot scale can be a rapid technology transfer into industrial practice. The official proof of technical feasibility by becoming aware of reference products should be implemented quickly as possible.

Period of time: 01.10.2010 – 30.09.2012

Remarks

The research project IK MF 100025 has been funded by the German Federal Ministry of Economy and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dirk Fiedler
Tel: 03529/551-669
Fax: 03529/551-899
E-Mail: dirk.fiedler@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Other

Key words:

superparamagnetism, nanoparticle,coating, functionalisation

Title:
New product protection by using of superparamagnetic nanoparticles

Background/Problem area

The imitation or counterfeiting of products is a problem that leads to high economic losses. Despite manifold possibilities to protect products against counterfeiting (eg, holograms, micro-taggants), the number of counterfeits and thus the economic loss constantly rise. Counterfeit products to manufacturers of branded products created according to estimates by the European Commission every year a loss of about € 300 billion. The Organization for Economic Cooperation and Development (OECD) is based on a claim in the amount of approximately € 500 billion. For this reason, the product protection is an emerging area which has currently about double-digit growth rates. The market for this type of security technology is used by the industry currently valued at approximately € 4.5 billion.

In addition to a legal protection of products, there are also a number of technical aids for the protection of branded goods. The following considerations should be considered when choosing an appropriate method, but always respected. The protection should be:

- exclusiv
- firmly connected with the product
- visible and invisible elements contained
- easy to control and detect
- not to copy, modify, or remove
- a reasonable cost/benefit ratio

The use of such tools should always be accompanied by a strictly complied internal security plan.

Objectives/Research results

The objective of this research project is to develop a printing ink or a coating material that protects against counterfeiting of products. As a safety feature superparamagnetic nanoparticles where used. These can be heated by alternating fields, and have no remanent magnetization after irradiation. Both the incoming heat and the absence of evidence remanet magnetization can be easily measured. To implement the project, it is necessary to adapt the established sol-gel technique onto the field of printing ink. This selective use of the properties of the nanoparticulate superparamagnetic particles in the coating composition or printing ink is made possible. The temperature changes are detected by an infrared thermometer. Using a Tesla meter (fluxgate magnetometer), the corresponding remanence of the coatings or the printing can be controlled. This allows to differentiated simple ferrite systems that are not nanoscaled.

Application/Economic benefits

A calculation of the financial benefit is difficult to estimate because of the universal applicability. The damage due to product and brand piracy are currently in Europe estimated at € 35 billion (Ernst & Young). Apart from averting the loss of revenue provides protection also benefits the developed product on the field of reputation damage, loss of market share to illegal competitors as well as to minimize the costs of the seizure and prevent counterfeiting. The financial benefit is oriented so depending on the product to be protected. In the low-budget range is naturally less than for the benefit of high-end products. Examples here could be exclusive or expensive perfumes and drugs with building materials such as Cement are compared.

The aim of the project proposed works on the development of a technologically sophisticated product protection. With this, valuable items such as expensive brand perfumes, car spare parts or pharmaceutical products provided and be suitably protected against illegal copying. The target clientele is here next match brands the packaging and printing industries.

Period of time: 01.05.2011 – 30.04.2013

Remarks

The research project IK MF 110012 is being funded by the German Federal Ministry of Economy and Technology (BMWi).

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Johann Strauss
Tel: 089/12146-491
Fax: 089/12146-36
E-Mail: johann.strauss@ptspaper.de

Research area: Product aims

End products made of paper, paperboard and board // Other

Key words:

Light-weight construction material, fire protection, core systems, moisture resistance

Title:
Developing flame-retardant and moisture-resistant paper core material as well as light-weight construction elements based on these core systems

Background/Problem area

Light-weight construction elements based on paper cores (sandwich structures consisting of core material and top liner) are highly attractive for many applications due to their low weight and nonetheless good mechanical properties. They provide a great deal of design freedom in manufacturing construction materials (e.g. laminating and coating capability). Whereas top liners or décor surfaces are available for these sandwich constructions with properties of flame retardancy and moisture resistance, the core materials in the low-priced segment based on paper (virgin / secondary fibres) do not exhibit the requirements regarding fire protection and moisture resistance. The possible uses of light-weight construction panels produced with them are therefore limited. Appropriate materials and the resulting light-weight structure therefore constitute a lucrative expansion of the range of possible uses.

Objectives/Research results

The aim of the overall project is to develop light-weight construction elements in the low price segment on the basis of paper cores with specific product properties focusing on moisture resistance and flame retardancy. An essential part is to develop appropriately application-oriented paper cores. The aim is to incorporate or enhance the flame-retarding function of the core material and to improve the moisture resistance whilst maintaining other properties (convertibility, mechanical stability, costs …). The fire protection goal for these core elements and for the light-weight construction elements is building material class B1.

The first step towards this end is to develop the base papers for core material production. Core elements will then be made from these base papers in an application-oriented manner in an innovative process (folding structure – folding core). These will then be used as the basis for producing sandwich structures. Ready-to-use light-weight construction elements will then be manufactured by selectively combining commercially available top plies with the corresponding innovative core materials.

Application/Economic benefits

As the result of this project in the project network, cost-effective flame-retardant and moisture-resistant sound elements/light-weight construction elements (paper core sandwiches) are to be made available. By virtue of their material properties, paper folded core structures in a flame-retardant and moisture-resistant design offer an expanded property profile and range of possible uses of the light-weight construction elements thus produced. This opens up additional fields of application in the product range of light-weight construction elements. In addition to using them as sound elements or light-weight construction elements, it is also feasible to use them in previously non-existent sales markets as partitions for toilet facilities, exhibition wall partitions, use of light-weight walls in rooms with intermittently high atmospheric humidity (storage halls / production halls).

Period of time: 01.03.2012 – 28.02.2014

Remarks

Research project ZIM KF2037911WZ2 is being funded by the German Federal Ministry of Economics and Technology (BMWi) and is being performed together with Richter Furniertechnik GmbH & Co. KG.

Forschungsstelle:

Albert-Ludwigs-Universität Freiburg
Institut für Forstbenutzung und
Forstliche Arbeitswissenschaft
Werthmannstraße 6
79085 Freiburg

Internet: http://www.fobawi.uni-freiburg.de

Leiter der Forschungsstelle:

Prof. Dr. Dr. h.c. Gero Becker

Projektleiter:

Jun.-Prof. Dr.-Ing. Pieter Samyn

Tel: 0761/203-9239
Fax: 0761/203-3763
E-Mail: pieter.samyn@fobawi.uni-freiburg.de

Forschungsgebiet: Produkt-Ziele

Endprodukte // Sonstige

Schlagworte:

bio-based materials engineering, nanotechnology, processing

Subject:
FORESNAB: Sustainable use of forest resources as nano-scale building blocks for functional bio composites and devices

Starting situation/Statement of the problem

The integration of bio-based materials into polymer nanocomposites offers high potential to replace traditional petroleum-based polymers. This leads to more sustainable resource management and has an important impact on global warming, energy supply and disposal problems. Especially side-products from the main papermaking processing stream can be further valorized into technical applications. While extraction methods are nowadays developed to recover polymeric wood components such as cellulose and lignin at the nanoscale, there remains little experience in further incorporating those nanoscale materials in final applications at large scale. The main problems remain in compatibilizing the constituents into a biopolymer composite and processing them under optimum conditions. Therefore, this research will especially focus on efficient processing technologies and assembly of bio-based nanocomposites.

Research objective/Research result

The compatibility between the nanoscale wood components, such as micro fibrillated cellulose as a model compound or others, will be tuned by interface engineering that is based on phyisco-chemical interface effects or absorption of functional nanoparticles to the interface in order to tune the hydrophilic/hydrophobic equilibrium at the nanoscale. The modified particles will be assembled in combination with bio-based polymers into functional bio composites with good processing properties. The mechanical performance of the biopolymer composites will be analyzed at different levels, where phase transitions and energy dissipation by interfacial processes will be related to the visco-elastic material properties.

Applications/Commercial relevance

We focus on obtaining fundamental and practical knowledge for creating new materials in the areas of bio-based nanocomposites, advanced papers, coatings, adhesives, membranes, optical active materials, barrier layers for packaging, advanced textiles and fibers, encapsulates for slow release, conductive circuits, responsive or sensor materials.

Operating time: June 2011 – June 2016

Remarks

This project is financially sponsored by the Robert-Bosch Foundation in the frame of a ‚Juniorprofessor' program.

Robert Bosch Stiftung

PROZESS-ZIELE

Forschungsgebiet
Faserstofferzeugung

Zellstoffherstellung
Holzstoffherstellung
Altpapieraufbereitung
Faserstoffbehandlung

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstr. 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Chem. A. Kersten

Tel: 06151/16-4169
Fax: 06151/16-2454
E-Mail: kersten@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Bisphenol A, Altpapier, Kontaminanten, Umwelt

Theme:
Bisphenol A in the Process of Paper Production from Recovered Paper

Background/Problem Area:

Bisphenol A (BPA) is a widely used processing chemical in the production of thermal paper. The amount of BPA in thermal paper is nearly 1.6 % by mass. Every year, in the area of the European Union approx. 140 000 tons of BPA containing thermal paper are produced. According to the European Thermal Paper Association (ETPA) in 2004 nearly 50 % of the produced thermal paper is used for point-of-sale-receipts, 30 % for self-adhesive labels and each 10 % for lottery tickets and fax paper. Due to the different points of use BPA containing papers are constituents of different recovered paper grades and thus it enters the production of recycling paper continually. Trace amounts of BPA can be determined in nearly all recycling paper sorts. The toxicological assessment of BPA in paper is not yet finished. The possible risk of impaired fertility of animals especially of aquatic organisms under the influence of BPA traces has been discussed since many years. Therefore the obligation for determination of BPA in different recycling papers is fixed since 2009 in the award criteria of the Environmental Label “Blue Angel” and in the revised Recommendation XXXVI of the German Federal Institute for Risk Assessment for food contact paper.

Objective/Research Results:

Until now the information about BPA distribution in the different recovered paper grades, in recycling papers (total amounts and amounts in the migration tests), in effluents and residues of the paper production is very incomplete. Thus, in extended test series the amounts of BPA in 30 different recycling papers (tissue paper, graphic papers, packaging papers) have been investigated. The total amounts of BPA in the methanol extract are in the range of 0.4 to 46.0 mg BPA per kg paper and board (average amount 12.9 mg/kg). In the cold water extract the determined BPA amounts are by a factor of 3 to 9 lower in comparison to the solvent extract of the same paper and board sample. A migration of BPA from the packaging paper samples into the food simulant Tenax® did not occur in measurable quantities. In none of the 12 investigated samples contents were found above the detection limit of 0.01 mg/dm2 paper. For the chemical analyses the gas chromatography with MS detection has been applied.

Additionally, BPA investigations of the most important recovered paper grades (1.02, 1.04, 1.11, 2.05 and 4.03 according to the EN 643 “European List of Standard Grades of Recovered Paper and Board”) have been carried out. The results of the BPA amounts in the methanol extracts of the recovered paper samples (after disintegration, drying and homogenisation) show no significant differences between the different grades. All BPA amounts in the tested recovered paper samples vary between 3.9 and 39.9 mg/kg. They are at the same level as the results in the produced papers. Balancing investigations in paper mills to determine the sinks of BPA in recovered paper processing have been carried out. In the last work package analyses have been concentrated on the determination of BPA in paper mill waste water (before and after industrial waste water treatment) and in the sludges of the waste water treatment plant (WWTP). In the effluent of WWTP the amounts of BPA are in the range of 0.5 – 30 ng/l. The load of the influents of the WWTP is higher by a factor of 170-400. A significant part of the BPA amount in the process water has biologically degraded or adsorbed on the surface of the sludge in the anaerobic and aerobic treatment. After evaluation of the results, possible technical solutions for removal of BPA in the recycling circuit have been derived.

Application/Economic Benefits:

The results will support German paper mills using recovered paper for the production of new paper in the assessment of the possible amounts of BPA in their paper products and in foodstuffs which may come into contact with these papers. With this information the current discussion about permitted BPA amounts in recycling papers should be supported.

By balancing of BPA amounts in the raw material, the fibre suspensions in the recovered paper processing, in the produced paper, in the residues and paper mill effluents recommendations for removing BPA have been developed. The reduction of BPA amounts in the recycling papers is an important aim in the current discussion about contaminants in recycling papers.

The results will be useful for the co-operation with the environmental authorities. Nevertheless, BPA is the most important endocrine disruptor that is discussed in the paper mill effluents in the moment.

Project Period: 01.01.2010 – 31.12.2010

Remarks:

The research project (INFOR 139) is being funded by Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstr. 8
64283 Darmstadt

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Chem. A. Kersten

Tel: 06151/16-4169
Fax: 06151/16-2454

Internet: www.pmv.tu-darmstadt.de
E-Mail: kersten@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Phthalate, UV-Fotoinitiatoren, Recycling, Papier, Kontaminanten

Theme:
Phthalates and UV-Photoinitiators in Recycled Paper and Board and Possibilities of Removal

Background/Problem Area:

Phthalates belong as plasticizers to the most important industrial chemicals. Mainly they are used for flexibilisation of plastics, but they are used in many other industrial products like adhesives and printing inks, too. The phthalates are only physically dissolved in the different matter but not chemically bond. Due to their high vapour pressures they may migrate from the paper and board packaging via the gas phase into the packed foodstuffs, but in the atmosphere, too. The toxicological effects of phthalates to the human beings are not finally assessed. A few representatives of this compound class are classified as toxic to reproduction and mutagenic. In the process of paper production the phthalates are not specifically added. But they are constituents of some recipes of printing inks and adhesives and reach the paper loop via recovered paper processing.

Procedures to dry furnishes and printing inks by means of UV radiation are widely spread in a lot of printing technologies, e. g. in offset printing, in gravure printing, in flexo printing, in ink jet printing processes but in electro photography, too. The advantages of UV technologies are avoiding of drying of printing ink in the colour deck of printing machine and very fast drying on the print substrate after printing by radiation with UV light. Due to the wide spread application of UV printing technologies the possible pathways into the recovered paper are growing more and more. Both, graphic recovered paper grades and packaging recovered paper grades may contain UV printed papers. Due to their high reactivity, optimum light absorption, good workability and no releasing of toxic fission products especially benzophenone and its derivatives, quinone derivatives and thioxanthones are widely used. During the last years amounts of 2-isopropylthioxanthone (ITX) and 4-methylbenzophenone in foodstuffs have been published and discussed. The toxicological effects of these compounds are not finally evaluated.

Therefore limit values for the maximum permitted amounts of any phthalates and photoinitiators have been fixed since 2009 in the revised Recommendation XXXVI of the German Federal Institute for Risk Assessment for food contact paper.

Objective/Research Results:

Until now the information about phthalate and photoinitiator distribution in the different recovered paper grades, in recycled papers (total amounts and amounts in the migration tests), in effluents and residues of the paper production is very incomplete. Thus, in extended test series the amounts of phthalates and photoinitiators in 30 different recycled fibres containing papers have been investigated. The total amounts were compared with the amounts determined in different food simulants as cold water, ethanol and Tenax®. For the chemical analyses of photoinitiators the liquid chromatography (HPLC) with UV detection was applied. The quantitative determination of phthalates was carried out by means of a gas chromatography with MS detector.

Additionally, balancing investigations in three recovered paper processing paper mills have been done. Thus, balancing and evaluation of sources and sinks of phthalates and photoinitiators in the production process are possible. These investigations included the analyses of the contaminants in the waste water and sludges in different steps of waste water treatment plants. After evaluation of the results, possible technical solutions for removal of phthalates and photoinitiators in the recycling circuit have been recommended.

Application/Economic Benefits:

The results will support German paper mills using recovered paper for the production of new paper in the assessment of the possible amounts of phthalates and photoinitiators in their paper products and in foodstuffs which may come into contact with these papers. With this information the current discussion about permitted phthalate and photoinitiator amounts in recycling papers should be supported.

By balancing of the phthalate and photoinitiator amounts in the raw material, the fibre suspensions in the recovered paper processing, in the produced paper, in the residues and paper mill effluents recommendations for removing of these restricted compounds have been developed.

The outcome will be useful for the co-operation with the environmental and consumer protection authorities.

Project Period: 01.01.2011 – 31.12.2011

Remarks:

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Forschungsstelle 1:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle 1:

Prof. Dr.-Ing. S, Schabel

Projektleiter:

Dipl.-Ing. C. Ewald

Tel: 06151/16-2409
Fax: 06151/16-2454
E-Mail: Ewald@papier.tu-darmstadt.de

Forschungsstelle 2:

Papiertechnische Stiftung (PTS)
Heßstraße 134
80797 München

Internet: www.ptspaper.de

Leiter der Forschungsstelle 2:

Dr. F. Miletzky

Projektleiter:

Dr.-Ing. E. Hanecker

Tel: 089/1214-6495
Fax: 089/1214-636
E-Mail: E.Hanecker@ptspaper.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Altpapier, Mineralöl, Entfrachtung, Kontamination

Theme:
Removal of Mineral Oils from Recovered Paper Suspensions

Background/Problem Area

In the last months, mineral oil contents in recycled paper and their toxicological relevance were discussed intensively in many workshops, conferences, seminars, and working groups. They were even subject to an opinion of the German Federal Institute for risk assessment (BfR). The explosive nature of this topic resulted in several TV and newspaper reports. Even if the most favourable solution against mineral oil contamination was a substitution of mineral oil based inks it has become clear that significant improvements are not to be expected in the near future. All in all, experts agree that the reduction of mineral oils in recovered paper will follow a decay curve which is why producers of recycling paper and board are requested to think about technologically and economically reasonable solutions to influence and reduce directly the mineral oils during food packaging paper production. Especially, as mandatory values for MOSH and MOAH concentrations are under discussion.

Objective/Research Results

The objective of the project is to evaluate different processes for mineral oil removal from recycled fibre suspensions in laboratory scale and to evaluate the potential for an industrial application. Two different project proposals from PTS and PMV which are based on different approaches were brought together.

a) The mineral oil removal by **fines separation.**

b) The mineral oil removal by **pressure swing adsorption processes** in combination with **selective absorbents.**

Approach a:

At PMV the potential of mineral removal during fines separation is being discovered. Preliminary trials showed that most of the mineral oil contaminants are located in the fines fraction. Therefore, a selective removal of fines could be a possible sink for mineral oils during recycled fibre processing. By contrast, this would cause considerable fibre losses which needed to be replaced by additional fibre input. However, it is not clear whether mineral oils are mainly absorbed to organic or inorganic fines as both coexist in form of agglomerates.

For separation the flotation and sedimentation process will be applied after disintegration, fractionation with 150 µm hole screen, and dispersion. Fractions with different ash content will be generated and the mineral oil concentration will be analysed according to the BfR-method. Four different raw material mixtures will be used: newsprint, corrugated board, folding boxboard (also used for food applications), and cardboard. In case of a preferred adsorption of mineral oils a technical solution for the removal of contaminated fines will be evaluated. At the same time a strategy for minimizing the raw material losses will be worked out.

Approach b:

At PTS the focus of investigations will be placed on offset newspaper. The approach of the PTS tests is divided into the processes supporting the desorption of the mineral oils from the components in the recycled pulp suspension, the stabilization or adsorption of the desorbed hydrophobic mineral oils and the effluent of the stabilized or adsorbed mineral oil components.

It is to examine if adsorbed mineral oils can be desorbed by treatment with mechanical high frequency (Cavitron) by positive pressure and the subsequent shock-like relaxation and the use of a hydrodynamic jet by changing the velocity and pressure gradient. Surfactants are used to stabilize desorbed mineral oils in the suspension. Additionally, adsorbents will be added before mechanical treatment with pressure swing processes, to ensure that desorbed hydrophobic mineral oil components will be stabilised in the pulp suspension and will not reattach to recycled pulp components. Aim is the adsorption and separation of desorbed mineral oils. The selection of the adsorbent based on the criteria pore size, high surface area, high binding capacity for hydrophobic substances, removability and cost. The subsequent flotation is used to assess the removal.

Application/Economic Benefits

In view of the extensive discussion about mineral oil components and other contaminants that may migrate from recycled packaging into foodstuffs, paper industry is requested to make an active contribution to reduce these substances during paper production. Especially in concurrence with fresh fibre products and plastic packaging, the safe use of recycled paper is becoming more and more an essential sales argument. In this regard, it is particularly important to find economical and reasonable solutions to remove mineral oils. The current research project will contribute new findings to this topic.

Project Period: 01.11.2011 – 31.12.2012

Remarks

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Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. C. Ewald
Dipl.-Chem. A. Kersten

Tel: 06151/16-2409
Fax: 06151/16-2454
E-Mail: ewald@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Altpapier, Mineralöl, Kontamination, Entfrachtung

Theme:
Removal of Mineal Oils from Recovered Paper Using Thermal-Mechanical Processes

Background/Problem Area

Recently, mineral oil contamination in food packaging which are coming from offset coldest inks had been subject of very intense discussions. These mineral oil mixtures are considered to be of toxicological concern and may migrate into foodstuffs at ambient temperature. This migration even happens if contaminated packaging materials are not in direct contact with foodstuffs. To prevent mineral oil migration into foodstuffs the BfR proposed five potential solutions in 2009 being:

1. the use of virgin fibre based board and packaging,
2. the separation of recovered paper fractions with high concentrations of mineral oils from the main stream,
3. the use of barrier coatings or plastic bags,
4. the use of mineral oil free inks, and
5. the removal of mineral oils and other contaminants from recovered paper and board.

The use of virgin fibre packaging would eliminate the presence of contaminants but it would not solve the problem, as primary packaging is usually transported and stored in corrugated boxes which also contain large amounts of mineral oils. Besides, the use of virgin fibre products would have severe economic and environmental effects. Also the separation of mineral oil containing recovered paper grades would not be a solution since a complete separation is technologically not feasible. The use of additional protective inner plastic bags and/or high barrier coatings would be a possibility to reduce mineral oil migration into foodstuffs. Nevertheless, both barriers would highly increase the cost of the final food packaging and would require additional and adapted packaging systems. Moreover, these barriers have only satisfying barrier properties for mineral oils if materials with crystalline structures are used. A substitution of mineral oil based inks by mineral oil free inks would be the most promising solution but it is not to be expected for the near future, why technologically and economically feasible solutions for mineral oil removal from recovered paper and board have to be found.

Objective/Research Results

The intention of this project is to investigate new processes for the removal or reduction of mineral oils in recovered paper and to compare them to an optimized flotation process. As recovered paper used for the production of food packaging is composed of different paper grades, three representatives - newspaper, cardboard, and corrugated board - and different mixtures of these will be analyzed. Based on the fact that the volatility of mineral oils increases with increasing temperature, recovered paper will either be treated with heat in a disperser during stock preparation or before disintegration using a steam or hot-air chamber. A further approach to decrease process cost will be the treatment of partial flows after fractionation.

First investigations focused on the optimization of the flotation process. It could be shown that a mineral oil removal rate of more than 80 % is possible for a single-stage flotation process. In fact the flotation chemistry has the highest impact on the removal efficiency. However, typical flotation chemistry does not fulfil the requirements. For best effects highly emulsifying chemicals have to be used in optimized mixtures and dosing sequences. Process parameters like flotation time and pulp consistency had only minor effects on mineral oil removal rates.

Moreover, the best removal rates could be found for raw materials with high ash contents, indicating that mineral oils have a high affinity to filler particles. For graphic recovered paper products a correlation between Ink Elimination and mineral oil removal could be found, which leads to the conclusion that most likely a large quantity of mineral oils was still attached to ink particles. Furthermore the migration of mineral oils during mixed storage of the three paper grades was analysed. It was found that the migration process follows an exponential evolution and is almost completed after two weeks storage. The level of contamination seemed to depend on the ash content in paper and the degree of ink coverage on the paper surface.

Application/Economic Benefits

With the development of new processes for mineral oil removal, producers for food packaging papers and boards will have the possibility to influence directly the mineral oil content in their products and to meet mandatory limits that might be imposed by legislative authorities in the near future. Moreover, paper producers could guarantee the harmlessness of their products making them in the long term competitive with fresh fibre products and plastic packaging.

Project Period: 01.09.2011 - 28.02.2014

Remarks

The project IGF 17272 N is being funded by the Federal Ministry of Economics and Technology (BMWi).

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. G. Hirsch
Dr.-Ing. H.-J. Putz

Tel: 06151/16-7029
Fax: 06151/16-2454
E-Mail: hirsch@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Altpapier, Faserstoffqualität, Deinking, Zeitungsdruckpapier

Theme:
Opportunities and Limits of the Use of "Mixed Papers and Boards" (Grade 1.02) for the Production of Graphic Paper

Background/Problem Area:

In last two decades the stock preparations plants were continuously extended for managing quality variations of the recovered paper grades and having the opportunity to produce different paper qualities. For this reason the stock preparation plants of paper mills, which produce newsprint, contain more process step as it is necessarily to prepare recovered paper of grade 1.11 (sorted graphic paper for deinking) for producing standard newsprint.

Thus there is the question whether such paper mills also can manage the use of the recovered paper grade 1.02 (mixed papers and boards) for producing standard newsprint.

Objective/Research Results:

In this project the effect of brown, half-bleached or unbleached fibre material as well as of the printing ink from packages on quality properties of deinked pulp should be investigated.

In a first step the influence of different cardboards and corrugating boards in a mixture of old newspapers and magazines are investigated on deinking results of a single-stage flotation process. With the knowledge of the influence general conclusions are made.

In the second step the deinking process is optimised to get the best optical quality with grade 1.02 as raw material. Therefore a process concept with two flotation steps, a dispersing step and a bleaching sequence is regarded. After the optimisation the obtained deinking results are compared with typical deinking results of the grade 1.11.

In the third step the results of all trials are used for developing a mathematic model which describes the relation between deinking results of a recovered paper mixture and the content of packaging material in the mixture.

The most important packaging materials are corrugated boards with kraftliner and testliner, which are printed with flexo inks, and coated and uncoated cardboards, which are printed with offset inks. The cardboards with the greatest market share are GC, GD, UC, UD and chipboard.

Application/Economic Benefits:

The investigations results contribute to use recovered paper more efficiently. Paper mills can eventually use recovered paper grade 1.02 for the production of standard newsprint and reduce their raw material costs. Further the modelling helps to identify the quality requirement to a recovered paper grade for producing standard newsprint.

Project Period: 01.10.2011 – 30.09.2013

Remarks:

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Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. C. Ewald
Dr.-Ing. H.-J. Schaffrath

Tel: 06151/1624-09
Fax: 06151/1624-54
E-Mail: ewald@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Stickyentfernung, Recycling, Ölextraktion

Theme:
Alternative Removal of Impurities by Oil-Extraction

Background/Problem Area

The use of recovered paper for production of high quality recycled papers is limited due to considerable contents of impurities resulting from finishing and converting as well as printing processes of paper. The amount of impurities varies between different recovered paper grades. One of the main classes of impurities, are the so called stickies which result of adhesive applications and glues used in graphic paper products and for paper converting. These stickies need to be removed from the paper stock in order to achieve similar product qualities like paper produced from virgin fibre material. Furthermore the machinery has to be protected from adhesives accumulating to prevent problems like web breaks and sheet faults during paper production. But still, the removal efficiencies of different process steps during stock preparation are low, accompanied by high losses of fibre material. The only removal criteria used, are the particle size for screening processes and particle weight for cleaning processes which apply centrifugal forces to the pulp. An alternative removal criterion is the hydrophobicity of tacky particles. It is already applied during flotation, but not optimized for the removal of stickies.

Objective/Research Results

Focusing on the hydrophobic behaviour of stickies a new removal technology is being established, using the hydrophobic property of oil to extract stickies from fibre suspensions. By mixing vegetable oils or oleic acid into the pulp suspension sticky particles can be accumulated at the boundary layer between the oily and aqueous phase. After segregation of both phases the fibre suspension can be removed. This method so far allows the removal of more than 80 % of stickies from the paper suspension.

As basic research, different oils (on a natural basis) and model stickies were tested on their interdependency. Also the optimal ratio between oil and paper suspension as well as the pulp consistency were investigated by using statistical test plans based on a design of experiments. Oleic acid was found to be the better extraction solvent. All tested pressure sensitive adhesives from labels as well as latex binders showed a good affinity to oleic acid. For vegetable oils affinities could only be found for some of the tested adhesives. For different ratios between oil and fibre suspension no changes on separation efficiency could be determined by the statistic test plan. Nevertheless, the residual oil content was found to be higher for a higher oil ratio and a higher pulp consistency. As optimal parameters a ratio of 1:12,5 from oil to pulp and a consistency of 0,5 % was set. Another important factor that could be discovered is the segregation time. During segregation the mixture has to be stirred easily to achieve a good separation between both phases. Despite, the fibre suspension still had to be processed after oil extraction in order to remove the residual oil content. However, for various model stickies removal rates of more than 90 % could be reached when using oleic acid.

After the basic research, investigations were focussing on a continuously operating extraction process, consisting of a mixing device with stirrer and a separation cell equipped with an oil outlet weir. With this experimental setup similar removal rates to those of the discontinuous trials could be achieved. However, for increasing throughputs higher residual oil concentrations were measured in the cleaned pulp suspension. For that reason a post flotation was installed which reached an oil reduction of 99 % for oleic acid and 80 % for coconut oil, when deinking chemicals were applied.

Latest investigations were focussing on the treatment of recycled fibre suspensions from the production of liner, newsprint and tissue. In fact some of these suspensions showed some interactions with oil why further research work is now focussing on process adjustments and optimization to certainly exclude negative effects on the papermaking process and to find the right process application to guarantee high efficiencies.

Application/Economic Benefits

With the completion of the research project a new process for the removal of hydrophobic debris, like stickies or printing ink particles, should be available for the paper industry. This process is supposed to be more efficient than other state-of-the-art technologies like screening or cleaning, having higher removal rates and lower fibre losses.

Project Period: 01.06.2010 – 31.05.2013

Remarks

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Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. G. Hirsch

Tel: 06151/16-7029
Fax: 06151/16-2454
E-Mail: hirsch@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Altpapier, Faserstoffqualität, Trennung, Feinstoff

Theme:
Sustainable Cycle of Materials in the Paper Industry – Potentials by Selective Removal of Low-Grade Fibre Materials for Energetic Use

Background/Problem Area:

Germany is one of the largest producers of paper in the world and pioneer in recycling of recovered paper. Currently the recycling philosophy is that almost all components of the recovered paper are used for producing new paper.

But is the reuse of all recovered paper components reasonable? If it is more sensible to remove some components, how can the removal of these components be done efficiently?

Objective/Research Results:

In this project the removal of low-grade material from recovered paper suspensions is investigated. Thereby, the removal of fine particles is in the focus and the effect of the fine particle removal on paper properties is regarded. Furthermore the removed fine particles shall be separated in an organic and an inorganic fraction and possibilities are examined for a further utilisation of both fractions.

In recovered paper suspensions disturbing materials like inorganic particles, ink particles and VOC/SVOC substances are concentrated in the fines fraction. A removal of fine particles from recovered paper suspensions effects a reduction of such disturbing materials in fibre suspensions. But also fibre fines, which influence paper strength positively, can be lost by a fines particles removal.

A recycling of removed fibre fines can make sense if the fibre fines are separated from disturbing substances. If recycling is not sensible the thermal use of fibre fines is possible. But also for incineration the separation of fibre fines from inorganic particles is favourable because the heating value rises linear with decreasing inorganic content.

Flotation as well as sedimentation can separate recovered paper fines in an organic and an inorganic enriched fraction. But for a successful separation the fine particles suspension must be pretreated in a dispersion process. After the separation process the organic and the inorganic fraction can differently used.

The inorganic fraction is more contaminated with VOC/SVOC substances than the organic fraction but also the organic fraction contains a lot of VOC/SVOC substances. Thus a reuse of the organic fraction is not always reasonable and a thermal use of the organic fraction should be preferred in some cases. The inorganic fraction can be used for example in the cement industry.

Application/Economic Benefits:

The investigations about unsuitable components for their reuse and possibilities of their removal deliver new knowledge and new possibilities for the sustainable recycling of recovered paper. With the new view on recycling of recovered paper by using only suitable components of the recovered paper for producing new paper some problems in stock preparation plants and during the paper production process might be solved by approaching larger basic knowledge.

Project Period: 01.03.2009 – 31.09.2012

Remarks:

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Forschungsstelle:

TU Dresden
Professur für Papiertechnik
01069 Dresden

Internet: http://tu-dresden.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Dr.-Ing. Matthias Wanske
Tel: 0351/463-38029
Fax: 0351/463-38032
E-Mail: matthias.wanske@tu-dresden.de

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Adsorption, Polymergranulat, Deinking, Energieeinsparung

Thema:
Adsorptions-Deinking – Ein innovatives Verfahren zur Druckfarbenentfernung bei energieeffizientem Recyceln von Altpapier

Ausgangssituation/Problemstellung

Bei der Herstellung von Papier, Karton und Pappe werden natürliche Fasern verwendet, wobei zwischen Primär- oder Sekundärfasern unterschieden wird. Im Jahr 2010 lag der Altpapiereinsatz, bezogen auf die Papierproduktion, in Deutschland bei 70 %, was die Wichtigkeit dieses Rohstoffs für die deutsche Papierindustrie unterstreicht. Typischerweise muss das Altpapier nach seiner Sammlung und Lagerung zunächst von Verunreinigungen wie Metall, Sand, Glas und Kunststoffen befreit werden, bevor es in den Auflöseaggregaten unter der Wirkung von Wasser und einer geringen Menge an chemischen Hilfsstoffen zerfasert wird. Wenn aus dem Altpapier graphische Papiere hergestellt werden sollen, stellt die Entfernung von Druckfarben, welche durch den typischen Gebrauch von Papier als Informationsträger an den Altpapierfasern haften einen wesentlichen und unverzichtbaren Bestandteil der Prozesskette dar. Ziel ist es hierbei, die Farbe möglichst vollständig von den Fasern abzulösen und anschließend aus der Stoffsuspension auszutragen. Der Druckfarbenaustrag erfolgt nach dem aktuellen Stand der Technik in sogenannten Flotationszellen, wo durch das Einblasen kleiner Luftbläschen, an welchen die abgelösten Druckfarbenpartikel anhaften, ein beladener Schaum erzeugt wird, der dann abgezogen werden kann.

Um akzeptable Austrageraten der Druckfarben zu erreichen, sind heute die Prozesse der Druckfarbenentfernung oft mehrstufig ausgeführt und durch häufiges Verdünnen und Eindicken der Faserstoffsuspension gekennzeichnet. Der Kernprozess des Deinkings, die Flotation, wird bei sehr geringen Stoffdichten (ca. 1 %) betrieben. D. h., beim Transport und bei der Bearbeitung von 1 kg Faserstoff müssen gleichzeitig 99 kg Wasser mitbewegt werden. Zwangsläufig geht dies zum einen mit einem enormen Verbrauch an Elektroenergie für Pumpen und periphere Aggregaten einher, andererseits aber auch mit einem hohen Wasserverbrauch. Jedes Verfahrenskonzept, das die Erhöhung der Stoffdichte oder die Reduktion der Zahl der einzelnen Verfahrensschritte erlaubt, würde somit ein erhebliches Energie-Einsparpotenzial erschließen.

Forschungsziel/Forschungsergebnis

Das geplante Projekt zielt ab auf die wissenschaftliche und technologische Entwicklung eines innovativen Verfahrens zur Druckfarbenentfernung (Deinking) im Rahmen des Recyclings von insbesondere graphischen Altpapieren. Die Innovation des Verfahrens liegt in dem Einsatz von Polymergranulaten als „Druckfarbensammler“ anstelle der Luftblasen in der dem Stand der Technik entsprechenden Flotations-Deinkingverfahrens. Der Vorteil des neuen Verfahrenskonzepts resultiert aus dem Umstand, dass die Adsorption abgelöster Druckfarbenteilchen an das Polymergranulat bei vielfach höheren Stoffdichten erfolgen kann als ihre Anlagerung an fein verteilte Luftbläschen gemäß dem klassischen Verfahren. Die weitaus höhere Stoffdichte schlägt sich unmittelbar in einer ebenfalls weitaus höheren Energieeffizienz dieses unverzichtbaren Teilprozesses der Aufbereitung graphischer Altpapiere nieder.

Das gesamte Verfahren gliedert sich in folgende Teilschritte: Ablösen der Druckfarbenpartikel von der Faser – Anlagerung der Druckfarbenpartikel an das Polymergranulat – Ausschleusen des Polymergranulates – Regeneration des Polymergranulates.

In dem hier beschriebenen Projekt besteht die Aufgabe für den dritten der oben genannten Schritte, die Abtrennung des Polymergranulates aus dem Faserstoffstrom, eine Lösung in Form eines Trennaggregates zu finden.

Anwendungen/Wirtschaftliche Bedeutung

Vor dem Hintergrund der aktuellen Umwelt- und energiepolitischen Zielsetzungen können im Falle der erwarteten positiven Projektergebnisse erhebliche Impulse für die Verbesserung der Energieeffizienz der Papierindustrie – einer zu den besonders energieintensiven Industrien zählenden Branche - erwartet werden. Diesbezüglich signifikante Fortschritte sind das erklärte Ziel der von der Papierindustrie in jüngerer Zeit intensiv forcierten Forschungsaktivitäten.

Bearbeitungszeitraum: 01.03.2012 − 28.02.2014

Bemerkungen:

Das ZIM-Projekt KF 2418608SL1 wird über die AiF Projekt GmbH vom Bundesministerium für Wirtschaft und Technologie aufgrund eines Beschlusses des Deutschen Bundestages gefördert. Das Projekt wird in Kooperation mit der Papierfabrik Hainsberg GmbH und der Maschinenfabrik Raschau GmbH bearbeitet.

DResearch Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Elisabeth Hanecker
Tel: 089/12146-495
Fax: 089/12146-36
E-Mail: elisabeth.hanecker@ptspaper.de

Research area: Process aims

Pulp production // Recovered paper treatment

Key words:

Deinking, prints with cohesive and cross-linked inks

Title:
Process oriented deinking of prints with cohesive and cross-linked inks in laboratory scale Part 2

Background/Problem area

The technology changes in printing industry from standard technologies (coldest/heatset, rotogravure) to individual solutions based on digital printing. Some printed products with cohesive and cross-linked inks are “not suitable for deinking” according to ERPC Deinkability Score. The impact of additional process steps on deinking potential of prints with cohesive and cross-linked inks should be analysed in the INGEDE project 130 09. In lab scale a methodology should be developed to simulate 2 loop deinking process.

During the project period, the project team decided changes in the work program. The original research program could not be finalised so far. There is a need for further research regarding the impact of additional process steps on deinking potential of prints to simulate 2 loop deinking process in lab scale.

Objectives/Research results

The objective is a continuation of INGEDE project 130 09. The target of the project should characterise the deinking potential of prints with cohesive and cross-linked inks based on different available technologies. It should be shown the actual situation of such prints recycling by using technologies which represent the state of the art of deinking lines. Pulping, dispersing and flotation have to be tested by using different parameters.

Application/Economic benefits

The project will improve the understanding in deinking behaviour of digital prints and lead to a more comparable and repeatable methodology for its characterisation.

Period of time: 01.08.2011 – 31.10.2012

Remarks

The research project INGEDE 130 is being funded by the International Association of the Deinking Industry INGEDE e.V.

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Tiemo Arndt
Tel: 03529/551-643
Fax: 03529/551-889
E-Mail: tiemo.arndt@ptspaper.de

Research area: Process aims

Pulp production // Pulp treatment

Key words:

microfibrillated cellulose,, nanocellulose, graphical papers, paper and paperboard, speciality papers, nanoparticles

Title:
Scale-up Nanoparticles in Modern Papermaking (SUNPAP)

Background/Problem area

Europe is still at the moment the most attractive market place for paper products, due to the size of the markets and relatively high average market prices. In order to increase growth, the European paper industry has to beat the product commoditization trap and renew its product base with more value-added products to gain competitive advantage against the low-cost commodity producers in countries with lower cost structure. Within SUNAP 23 partners from industry and research institutes working together to in order to establish pilot-lines to introduce the preparation and application of cellulosic nanoparticles in different papermaking processes. The main problem is that results from basic research indicate a very high potential for new industrial processes and products but the technical transfer into practice is not yet solved.

The European SUNPAP (Scaling Up Nanoparticles in Modern Paper Making) project aims to demonstrate that it is possible to manufacture high-quality functional paper and packaging products on a pilot scale by using flexible, energy-efficient and environmentally friendly processes. Nanocellulose is being researched globally, primarily at the laboratory scale. With the SUNPAP Project, the intention is to take research to the next level – to pilot scale and all the way through to the end product.

Objectives/Research results

The project will update the current processes of paper manufacture and coating and identify new product opportunities through the use of functional fibre-based materials instead of synthetic petroleum-based materials. The benefits include independence from oil prices, lighter products and the creation of new functionalities and applications in the future. The new coating techniques will allow material-efficient, thin layers to be spread across the paper surface. The main targets are:

1. Development and up-scaling of novel processes for the energy efficient production of nanomaterials, namely NFC, in pilot scale.
2. Development and up-scaling of NFC modification processes to address the challenges of papermaking and to provide added-value active functionalities.
3. Building and demonstration of pilot lines to alleviate take-up of nanotechnologies, both for the production and the utilisation of NFC, to the modern papermaking processes.
4. Exploitation of innovative sustainable solutions for the whole paper industry value chain by integrated sustainability assessment approaches based on economical, social and environmental impact assessments.
5. Risk assessments to guarantee the safe introduction of nanotechnologies in the whole value chain of traditional industrial paper production processes and final paper based products.

The project aims to promote the competitiveness of the forest industry and create new products and markets. This will benefit paper manufacturers and the packaging industry, as well as the consumers of fibre-based products.

Application/Economic benefits

By utilizing the properties of NFC innovative, recyclable and bio-degradable fibre-based products, which exhibit properties well beyond state-of-the-art, can be created. NFC´s have the novel potential to influence the cost efficiency of the coating process as well as the coated paper quality. The variety of potential applications of these innovative fibre based products is quickly expanding. A number of applications such as organic and printed electronics are already at the market or in the entry phase and according to some estimates the markets for these products alone could value as much as 200 billion € by 2025. Other possible applications of NFC based products include high performance recyclable, anti-smog air filters, which are made from non-renewable resources today, and capacitor and insulator papers used in the electronics industry, where NFC based papers can yield not only performance improvements but also advance the environmentally friendliness of the products through improved recyclability.

Because the European paper industry sector is still very fragmented and it consists of a large number of small mills, the NFC based processes developed in the project are also especially suitable for rebuilds of smaller paper mills to change and modify production orientation into more competitive processes and products. The increase of the production flexibility will ensure long term competitiveness.

Period of time: 01.07.2009 – 30.16.2012

Remarks

The research project SUNPAP (EU-FP7-NMP-2008-LARGE-2) is being funded by the European Commission and coordinated by VTT, Finland, in cooperation with leading European paper research institutes (PTS, Germany, CTP, France; InnovHub, Italy; FIOH, Finland; INP, France), and 4 Universities (UAVR, Portugal; KAU, Sweden; TUT, Finland; TTK, Finland), and 13 industrial partners: Colorobbia, Italy; Cavitron, Germany; Zimmer, Austria; Hansamixer, Germany; Felix Schoeller, Germany; BioSafe, Finland; Poyry Forest Industry Consulting, Finland; Nanosight, United Kingdom; JRS, Ger-many; StoraEnso, Sweden; UPM, Finland; and Ahlstrom, France

Forschungsstelle:

Hochschule München
Fakultät 05, Verfahrenstechnik Papier und Verpackung
Studiengang Papiertechnik
Lothstraße 34
80335 München

Internet: www.hm.edu

Leiter der Forschungsstelle:

Prof. Dr. Stephan Kleemann

Projektleiter:

Prof. Dr. Helga Zollner-Croll

Tel: 089/1265-1547
Fax: 089/1265-1560
E-Mail: belle@hm.edu

Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Faserstoffbehandlung

Schlagworte:

Flockung, Entwässerung, Schlammbehandlung, Phasentrennung

Thema:
Entwicklung eines Schlamm-/Medienvorbehandlungsverfahrens mittels Kavitation zur Wasser- und Ressourceneinsparung in Filtrationsprozessen. Teilvorhaben: Die Effekte der Kavitation auf die Entwässerung

Ausgangssituation/Problemstellung

Feststoffsuspensionen werden in zahlreichen industriellen Prozessen erzeugt. Große Mengen Schlamm fallen bei der Abwasseraufbereitung als Klärschlamm und im Prozess der Papierherstellung als Papier- und Faserschlämme an. Nach einer Schätzung liegt das Aufkommen in der Papierindustrie in Deutschland bei ca. 1,2 - 2,4 Mio. Tonnen bei einer Jahresproduktion von Papier und Karton von ca. 24 Mio. Das entspricht in etwa 5 - 10 % der Produktionsmenge. Der Wasseranteil von Klärschlämmen liegt etwa bei 95 – 98 %, bei Papierschlämmen niedriger. . In der Aufbereitung besteht die Aufgabe, das enthaltene Wasser möglichst effizient von den darin enthaltenen Feststoffen zu trennen. Das kann jedoch aus physikalischen, aber auch aus wirtschaftlichen Gründen nicht zu 100 % gelingen. Ziel ist es deshalb, durch Anwendung verschiedener Verfahren mittels Kraft- und Energieeinwirkung den Feststoffgehalt im Schlamm zu maximieren.. Dabei soll eine Zustandsänderung des Schlammes herbeigeführt werden.Ursprünglich sind die Schlämme flüssig und pumpfähig, werden aber über die Verfahrensstufen von stichfest und breiartig bis krümelig oder sogar streufähig bzw. staubförmig. In allen Fällen ist ein sehr hoher Aufwand an Kosten und Energie erforderlich, um das Wasser möglichst maximal aus den Schlämmen und Suspensionen zu entfernen. Es sind zahlreiche Ansätze zur Optimierung der Entwässerung bekannt. Beide Partner verfügen in diesem Bereich über umfangreiche Erfahrungen und haben bereits eigenständig, bzw. in Kooperation mit anderen Partnern, diverse Verfahren und Systeme entwickelt, die erfolgreich vermarktet wurden. Dies reicht von neuen Ansätzen der chemischen Entwässerung über die mechanische Entwässerung von Klärschlämmen bis Papierschlämmen.

Forschungsziel/Forschungsergebnis

Innerhalb des geplanten Vorhabens werden ein Verfahren und die zur Anwendung geeignete Anlagentechnik zur Verbesserung der Entwässerbarkeit von Schlämmen entwickelt. Die getesteten Schlämme stammen vorwiegend aus den Bereichen Papiererzeugung, Kläranlagen oder anderen Recyclingprozessen. . Aufgabe ist es, durch eine Vorbehandlung der Schlämme mittels Dampfdruck-Impulsen Kavitationskräfte zu erzeugen, die eine Zustandsänderung in der Schlammstruktur hervorrufen. Die vorbehandelten Schlämme sind so leichter entwässert werden. Daraus soll sich ein energiesparender Prozess als Alternative zu bisherigen Entwässerungstechnologien entwickeln.

Anwendungen/Wirtschaftliche Bedeutung

Die Arbeiten zwischen den Partnern sind entsprechend ihrer komplementären Kompetenzen aufgeteilt. Der Schwerpunkt im Teilvorhaben der Hochschule liegt in der Analyse des Anlagenkonzepts, experimentellen Untersuchungen der Kavitationswirkung und der Entwicklung geeigneter Prozessbedingungen. Die Validierung der Ergebnisse erfolgt an der Testanlage und an der Versuchspapiermaschine. Das Geschäftsmodell zum geplanten Projekt sieht vor, das Verfahren mit einer speziell dafür entwickelten Anlagentechnik zu vermarkten. Reiflock stellt dabei die Systeme mit Unterstützung durch externe Auftragnehmer in Serie her. Die Vermarktung erfolgt ebenfalls durch die Firma Reiflock. Schwerpunktmärkte sind hierbei die Papierindustrie und die Klärschlammaufbereitungsunternehmen. Reiflock verfügt über einen leistungsfähigen Außendienst mit direktem Zugang zu Kunden im Bereich kommunaler Kläranlagen und baut aktuell bereits bestehende Systeme in Papierfabriken. Darüber hinaus werden innerhalb der Projektlaufzeit weitere Kooperationen eingegangen, um die Anlagen auch in größerer Stückzahl und Marktbreite sowohl national als auch international zu vermarkten. Die Hochschule München wird Mitarbeiter weiterqualifizieren und Wissenstransfer vorantreiben.

Bearbeitungszeitraum: 01.11.2011 − 31.10.2014

Bemerkungen

Dieses Projekt wird über die Hightech-Strategie für Deutschland über KMU-Innovativ vom Bundesministerium für Bildung und Forschung gefördert.

PROZESS-ZIELE

Forschungsgebiet
Papier- und Kartonherstellung

Stoffaufbereitung
Papierherstellung
Oberflächenbehandlung

Forschungsstelle:

GWT-TUD GmbH
Blasewitzer Str. 43
01307 Dresden

Internet: www.gwtonline.de
http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Claus-Peter Held

Projektleitung:

Prof. Dr.-Ing. H. Großmann
Dipl.-Ing. Toni Handke
Tel: 0351/463-38014
Fax: 0351/463-38032
E-Mail: toni.handke@tu-dresden.de

Forschungsgebiet: Prozess-Ziele

Papier- und Kartonherstellung // Stoffaufbereitung

Schlagworte:

Altpapier, Trockenzerfaserung, Adsorptionsdeinking

Thema:
Energieoptimierung der Papierherstellung auf der Basis des physikalisch notwendigen Energiebedarfs ausgewählter Teilprozesse

Ausgangssituation

Der aktuelle spezifische Energieverbrauch bei der Papiererzeugung ist die Summe der spezifischen Verbräuche einer großen Zahl an Teilprozessen. Die leistungsfähigsten heute hierfür zur Verfügung stehenden Technologien (Best-Available-Technologies, BAT) sind überwiegend das Ergebnis Jahrzehnte langer intensiver und erfolgreicher Optimierungsarbeit.

Es ist deshalb zu erwarten, dass die durch eine weitere nur evolutionäre Weiterentwicklung dieser Prozesse bezüglich des spezifischen Energieeinsatzes erschließbaren Einsparpotenziale nur noch sehr begrenzt und deshalb alleine nicht ausreichend sein werden, um die hohen, von Politik und Gesellschaft gesetzten Ziele bezüglich Energieverbrauch, CO_2-Ausstoß und Environmental Footprint mittelfristig zu erreichen.

Vor diesem Hintergrund sollen deshalb im Rahmen des Projektfelds 1 des INFOR-Ressourcenschwerpunkts Papier 2030 Ideen für innovative, gegebenenfalls für die Papiererzeugung völlig neue Techniken entwickelt und ihre technische und wirtschaftliche Realisierbarkeit geprüft werden. Parallel hierzu soll eruiert werden, ob in anderen Industriebereichen ähnliche Aufgabenstellungen energieeffizienter gelöst werden und – falls dies zutrifft –, ob und wie weit diese Lösungsansätze auf die Papiererzeugung übertragen werden können.

Forschungsergebnis

Von der Forschungsstelle wurden die Prozessschritte Zerfaserung und Deinking betrachtet. Der minimal physikalisch notwendige Energiebedarf ist ermittelt worden und liegt um bis zu 5 Größenordnungen unter der heute eingebrachten Energie. Sie arbeiten noch weniger effektiv, als in der Literatur bisher angenommen.

Es wurden deshalb zwei alternative Verfahren betrachtet, die Trockenzerfaserung und das Adsorptionsdeinking.

Die Trockenzerfaserung gewährleistet eine vollständige Vereinzelung der Fasern bei 95 % Trockengehalt. Der Energiebedarf liegt hier jedoch über der heute eingesetzten Auflösetechnologie. Da jedoch Fasern und Asche im trockenen Zustand vorliegen, könnte auch eine separate Abtrennung erfolgen, die Kombination ergibt völlig neue Möglichkeiten und muss weiter untersucht werden.

Granulat vor und nach dem Adsorptionsdeinken

Beim Adsorptionsdeinking werden Granulate dem Auflöseprozess zugegeben, diese lagern große Anteile der im Papier vorhandenen Druckfarbe an ihre Oberfläche an. Der Weißgradgewinn nach Abtrennung der Granulate liegt bei 10 bis 12 Punkten. Die Stoffdichte im Auflöseprozess kann zwischen 5 − 25 % liegen. Weiter werden verbleibende Druckpartikel durch die erhöhte Reibung zerkleinert. Auch der Mineralölanteil wurde in ersten Messungen um 75 % reduziert. Das Adsorptionsdeinking könnte nach einer erfolgreichen Praxiseinführung so mindestens eine Flotationsstufe und wenn es der Prozess zulässt Eindicker und Disperger einsparen. Die Einsparungspotenziale in der Stoffaufbereitung wären höher als jegliche heute erhältliche Optimierung.

Wirtschaftliche Bedeutung

Vor der in Deutschland tätigen Papierindustrie steht die Herausforderung, den massespezifischen Energieverbrauch bis 2020 um 40 % zu senken [Schabel]. Dies ist auf dem Wege ausschließlich evolutionärer Technologieentwicklung schwierig. Das Potenzial für die untersuchten Technologien aus anderen verfahrenstechnischen Bereichen ist sehr hoch und für alle altpapierverarbeitenden Papierfabriken von Interesse und könnte einen Beitrag zu den von der Politik vorgegeben Einsparzielen leisten.

Bearbeitungszeitraum: 01.04.2010 − 31.03.2012

Bemerkungen

Das Projekt (INFOR 141 R) wird aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

Forschungsstelle:

GWT-TUD GmbH
Blasewitzer Str. 43
01307 Dresden

Internet: www.gwtonline.de
http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Claus-Peter Held

Projektleitung:

Prof. Dr.-Ing. H. Großmann
Dipl.-Ing. Thomas Schrinner
Tel: 0351/463-38026
Fax: 0351/463-38032
E-Mail: thomas.schrinner@tu-dresden.de

Forschungsgebiet: Prozess-Ziele

Papier- und Kartonherstellung // Stoffaufbereitung

Schlagworte:

Altpapier, Trockenzerfaserung, Adsorptionsdeinking

Thema:
Möglichkeiten und Grenzen der Kombination der Prozessschritte Zerfaserung, Dispergierung und Druckfarbenentfernung bei der Altpapieraufbereitung und Bewertung des technologischen und wirtschaftlichen Potenzials.

Ausgangssituation

Die im Rahmen des INFOR-Projekts 141 R durchgeführten Untersuchungen offenbarten für die Teilprozesse der Zerfaserung und der Druckfarbenentfernung ein erhebliches Einsparpotential. Um dieses zu nutzen, d. h. die Differenz des aktuellen spezifischen Energieeinsatzes zum theoretischen Minimum deutlich zu reduzieren, wurden alternative Konzepte der Druckfarbenentfernung und der Zerfaserung entwickelt und deren Einsparpotentiale anhand orientierender Versuche bewertet.

In Anbetracht der niedrigen Stoffdichten der Flotation, welche maßgeblich für die schlechte Energiebilanz der industriellen Druckfarbenentfernung verantwortlich sind, wurde ein neu patentiertes Trockenreinigungsverfahren der Textilindustrie als grundsätzlich geeignetes Alternativkonzept identifiziert und auf die Gegebenheiten der Druckfarbenentfernung übertragen. Die Innovation des alternativen Deinking-Verfahrens – nachfolgend Adsorptionsdeinking genannt – besteht in der Eignung von Polymergranulaten Druckfarbenpartikel an ihre Oberfläche anzulagern und anschließend zu entfernen.

Neben dem Nachweis der grundsätzlichen Eignung des Adsorptionsdeinking konnten eine Reihe anderer interessanter Effekte beobachtet werden. Durch die Verwendung der Polymergranulate in einem Laborpulper als Hochkonsistenz-Mischapparatur ergeben sich die Vorteile des Adsorptionsdeinking – neben der immensen Wassereinsparung im Vergleich zur Flotation – durch die Integration der indirekten Druckfarbenentfernung in den bestehenden Teilprozess der Zerfaserung. Darüber hinaus wird diese Art der Faserstoffbehandlung von einem Dispergiereffekt begleitet. Eine Kombination des Adsorptionsdeinking mit der Dispergierung – dem energieintensivsten Teilprozess der Altpapieraufbereitung – würde das Einsparpotential des alternativen Verfahrens deutlich erhöhen.

Für die Zerfaserung wurden ebenfalls neue Verfahren angewandt und hinsichtlich der resultierenden Faserstoffeigenschaften untersucht. Insbesondere die Trockenzerfaserung, bei der die Stoffdichte nicht nur erhöht, sondern gänzlich auf die Wasserzugabe verzichtet wurde, ergab durchaus interessante Ergebnisse. In halbtechnischen Untersuchungen konnte das Fasergefüge des verwendeten Altpapiers gänzlich ohne die Zugabe von Wasser in Einzelfasern zerlegt werden.

In weiterführenden Untersuchungen stellte sich zudem heraus, dass der alternativ zerfaserte Altpapierstoff ohne weiteres einer Trockensortierung zugeführt werden kann. Durch geeignete Siebe oder Trennaggregate können somit auch nachfolgende Prozesse trocken, d. h. ohne Wasserzugabe erfolgen. Insbesondere unerwünschte Bestandteile wie Druckfarbenpartikel könnten so deutlich wirtschaftlicher abgetrennt werden als mit der wasser- und energieintensiven Flotation. Auch durch die trockene Abtrennung anderer Teilfraktionen, wie beispielsweise Fein- oder Füllstoffe, ließe sich eine Eigenschaftsverbesserung des Faserstoffs wassersparender und energieeffizienter realisieren.

Forschungsziel/Forschungsergebnis

Aufgrund der auftretenden Synergieeffekte bei den untersuchten Alternativverfahren liegt es nahe, das Potenzial dieser Effekte für eine Kombination entsprechender Teilprozesse sowie einer innovativen, energieeffizienten Prozessgestaltung intensiver zu betrachten. Im Vordergrund steht dabei die Eruierung der Möglichkeiten und Grenzen einer Substitution von insbesondere energieintensiven Teilprozessen durch die genannten Alternativverfahren und eine Verbesserung der energetischen Gesamtbilanz des Altpapieraufbereitungsprozesses.

Ziel des beantragten Projekts ist die Abschätzung der Realisierbarkeit einer mit dem Adsorptionsdeinking kombinierten Dispergierung durch die Polymergranulate und der damit einhergehenden Möglichkeit für den Wegfall bzw. der Reduzierung der klassischen Dispergierstufe. Für die Trockenzerfaserung gilt es insbesondere das Potenzial einer nachfolgenden trockenen Ascheabtrennung – d. h. einer Entfernung von vor allem Druckfarben, aber auch Füllstoffen – hinsichtlich einer Substitution der herkömmlichen Flotation zu untersuchen.

Anwendungen/Wirtschaftliche Bedeutung

Potenzielle Nutzer der im Rahmen der Projekts angestrebten Projektergebnisse werden grundsätzlich alle Hersteller graphischer, Altpapier haltiger Papiere und große Teile der Hersteller von Verpackungspapieren und Kartons, insbesondere für den Bereich der Lebensmittelverpackungen, sowie Hersteller altpapierhaltiger Tissuepapiere sein.

Die technologische Bedeutung der angestrebten Projektergebnisse ist in der Vereinfachung der Prozesskette zu sehen, der starken Reduktion des energieintensiven Stofftransport als Folge der höheren Stoffdichten und der Kombination bisher eigenständiger Verfahren mit ihren ebenfalls energieintensiven zwischengeschalteten Verdünnungs- und Eindickungsstufen.

Bearbeitungszeitraum: 01.01.2012 – 31.12.2012

Bemerkungen

Das Projekt (INFOR 161) wird aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Constanze Seidemann
Tel: 03529/551-636
Fax: 03529/551-899
E-Mail: Constanze.Seidemann@ptspaper.de

Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

paper for recycling, strength properties, stock preparation, flotation

Title:
Guaranteeing corrugated base paper strength by the selective flotation of inorganic constituents (de-ashing)

Background/Problem area

The conditions under which corrugated base paper is manufactured are aggravated considerably by existing developments aimed at increasing the proportion of mineral substances in the recovered paper grades used and decreasing the grammage of the finished products. Both trends necessitate suitable additional measures to raise the initial strengths and the strength properties of the paper products.

Existing technologies can meet these requirements suitably to a limited extent only. A new approach is to improve the strength values by reducing the mineral substances contained in the pulp using the flotation process.

Objectives/Research results

The project objective was to develop a process concept in stock preparation that increases the strength of recycled fibre pulp by more than 20%. This was to be achieved by implementing a flotation stage for de-ashing the paper for recycling as well as low-intensity refining in the stock preparation process of corrugated base paper. The operation of the flotation process was to be made very selective as a result of the use of chemical additives.

This research project seeks above all to achieve the following results:

Determination of the type and amount of flotation chemicals needed to increase selectivity and the efficiency of the flotation process

Evaluation of the suitability of the flotation process to increase the strength properties in the corrugated base paper product

The following findings were obtained from laboratory- and pilot-scale trials:

Compared to initial flotation, the use of flotation agents results in an improvement in the selectivity of the discharge for mineral substances and to an increase in the material volume discharged per time unit.

Selected anionic, cationic and non-ionogenic flotation agents exhibit a comparable selective effect regarding the separation of mineral substances by flotation, i.e. the ionogenity of the flotation agents is not critical for the amount of CaCO3 and kaolin discharged.

Using flotation agents with the greatest selective effect, the proportion of minerals in corrugated base paper dropped from 16% to 9% with a total flotation loss of 20%. This corresponds to a relative reduction of -44%.

In addition, trials with three flotation cells that differ in volume, geometry, air supply and hydrodynamic parameters showed that these parameters do not affect the selectivity of the separation of mineral substances.

Flotation trials using a cloudy filtrate demonstrated that even low flotation stock consistency and an upstream separation of pulp cannot upregulate the selectivity of the discharge for mineral substances.

Application/Economic benefits

The project results can be allocated to the subject fields of raw materials, production and process engineering. The primary utilisation domain is the papermaking sector. Combining the selective flotation method and low-intensity refining makes both cost savings in surface thickness possible as well as the use of cost-effective fibrous raw materials. Removing minerals and other contaminants increase enhances the runnability of the paper machine which also makes an increase in productivity possible by eliminating the application of starch in the dryer section.

Period of time: 01.02.2010 – 31.07.2012

Remarks

Research project IGF 16358 BR has been funded by the Federal Ministry of Economics and Technology (BMWi)

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Tiemo Arndt
Tel: 03529/551-643
Fax: 03529/551-889
E-Mail: tiemo.arndt@ptspaper.de

Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

refining, cavitation, fluid dynamics

Tittle:
Replacement of the mechanical pulp refining process in stock preparation by the hydrodynamic modification of chemical pulp fibres

Background/Problem area

The refining process is an energy-inefficient process in the stock preparation line of a paper mill. During refining only a minor share of the fibres is directly treated by the bars or grooves, fibre treatment is uneven, and the strength potential of the pulp is not used completely. Alternative technologies have been investigated for several years based on ultrasound and high frequency mechanical forces. The main mechanism of these technologies is based on cavitation. It has been demonstrated that the strength properties can be increased, but the technologies cannot compete with traditional refining technology because of economic constrains. However, cavitation can be much easier and has a lower energy demand generated in two or three phase fluidics by means of hydrodynamic effects.

Objectives/Research results

The aim of the research project is to replace the traditional industrial refining process by using hydrodynamic forces, whereby a reduction in energy consumption can be achieved. From the scientific point of view, the objective is to understand the mechanism of hydrodynamic cavitation forces on pulp fibre. In addition, the observed effects on structural and morphological changes on the fibre level will be investigated. Besides this, a method is to be developed to evaluate the cavitation process and to find indicators to measure the excess of the observed cavitation effects. Based on these results, the objective is to develop a system which can be introduced into a stock preparation line of a paper mill. To evaluate cost competitiveness, the capacity, energy, maintenance, and process control of the mill will be considered.

Since the start of the project, suitable experimental equipment has been developed based on a nozzle construction where power consumption, static pressure pattern, and flow velocity can be measured. Initial tests showed that pulp suspensions with solids content up to 2% can be transferred through the nozzle. Starting at a certain volumetric flow, cavitation could even be observed within the pulp suspensions culminating in an enhancement in the water retention value and tensile properties. It was seen that recycled fibres react more sensitive on the cavitation forces than chemical pulp fibres.

In order to evaluate the intensity and excess of the cavitation forces in the nozzle, a method was developed based on the decomposition of potassium iodide. Potassium iodide has very good solubility in water. Its decomposition can be observed due to changes in the transmission of the solution. Decomposition was in good agreement with the effect of ultrasound. But for multi-phase fluids like pulp suspensions a more suitable method to evaluate the cavitation intensity was developed based on acoustic emissions measured by a force sensor.

Application/Economic benefits

The results can be used to develop new aggregates and machines by supplying the mechanical engineering industry to help paper mills reduce the energy consumption of chemical pulps in stock preparation. But implementing this technology into a paper mill has to be adapted with respect to the composition of the raw materials and production capacity. That requires the highly flexible construction of the systems which can be especially supported by small- and medium-sized companies. Because cavitation is a complex state of fluids, companies with special know-how in modelling simulation will also benefit from the development.

However, the principal user of this technique will be paper mills as they will have the opportunity to reduce the energy consumption in the pulp refining operation. It is expected that the savings in refining energy will originate not only from the reduction in specific refining energy, but also from the total refining energy consumption because, by using hydrodynamics, the no-load energy consumption is zero. It is also expected that the fibre treatment will be more homogeneous, because all fibres have to pass through the reaction one.

Period of time: 01.01.2011 – 31.12.2012

Remarks

The research project IGF 16817 BR is being funded by the Federal Ministry of Economics and Technology (BMWi)

Research Institute:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: http://www.ptspaper.de

Heads of the research institute:

Dr. F. Miletzky

Project leader:

Tobias Brenner
Tel: 03529/551-624
Fax: 03529/551-899
E-Mail: tobias.brenner@ptspaper.de

Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

annual plants, recovered paper, virgin fibres, strength properties, ultrasonic, ultrasound

Title:
Sonication of natural fibres and agro-waste for production and up-grading of papermaking pulps and biogas

Background/Problem area

Agro-waste is a specific type of biomass produced as by-product from agriculture. Agro-waste includes several types of materials like straw - rice, wheat, barley, oat, maize -, corn cobs, cotton and maize stover, rice husk etc., and are based on annual plants. Agro-waste/annual plants have an economic potential for energy conversion and pulp production. The use of annual plants for pulp production have some advantages like lower lignin content or the high annual yields per hectare, despite a constant supply of raw material to the mill and storage capacity are still some issues to be analysed.

The use of ultrasound has long been practiced successfully in many industries, e.g. disintegration of biological, non-destructive testing or ultrasonic cleaning. Ultrasound causes different effects, whereby the most interesting phenomenon during treatment of fluids or suspensions are acoustic cavitations. This project includes a new approach based on the progress in ultrasound technology made in the past five years – high power ultrasound technology.

For graphic and especially packaging papers strength properties are the key criterion, which is why the strength potential and especially bonding power of single fibres is of major importance. Usually refining is employed to increase the strength and bulk of paper by increasing the swelling capacity of fibres and bonding-active contact areas between them. As compared to other stock preparation processes, refining is the most energy-intensive sub-process. High-power ultrasound technology has the potential to improve the traditional refining process with regard to the development of fibre properties without affecting the fibre length and by means of less energy.

Objectives/Research results

The objective of this research project is to develop a process principle for producing pulps for paper manufacturing from annual plants, including agro-waste, utilising high-power ultrasonic pulping technology and to influence by means of Ultrasound the pulps used in papermaking to develop the desired fibre properties. Further valorisation of by-products and other residues will be investigated in a biorefinery approach. Environmental and logistic aspects will also be considered.

Paper properties that are important for corrugated base paper – for example short span compression strength (SCT) or strength in z-direction (Scott-Bond) - will be increased by adding wheat straw, rice straw or slightly refined flax to the conventional raw material recovered paper (grades 1.02, 1.04).

Overall objectives are to achieve more energy and resource efficient processes and to broaden the fibre supply to the paper industry, while making value out of materials which are traditionally wasted or neglected. One key technological component of the project will be the investigation of operational parameters (design of reactors, of Ultrasound sources, of process parameters) that allow the production by Ultrasound of fibres technically and economically valuable for the paper industry. Another essential technological module will be the investigation of the potential of high-power Ultrasound technology in the up-grading of cellulosic fibres traditionally used by the paper industry. Here wood cellulose and recovered paper will be considered. Key success indicators will be specific energy consumption and strength performance of the treated fibres.

Ultrasonication of fibre suspensions including recovered paper (grades 1.02, 1.04) can increase the paper strength by up to 14% with a limited increase in drainage resistance, limited fibre shortening and specific energy consumption of less than 50 kWh/t.

Application/Economic benefits

The concept of this project is to investigate a zero-waste production of pulps from annual plants and agro-waste by targeted application of new and more efficient ultrasound technology. Due to the dispersion of these raw materials over relatively large territories, the industrial application will require rather small production units, and is therefore typically relevant for SMEs. The objectives are avoiding future bottlenecks in the supply of low-cost fibres for papermaking (focus on annual plants / agro-waste available in large quantities, as alternatives to wood or recovered paper used as raw materials) and possible new applications for fibres obtained from annual plants / agro-waste in other industries.

Established stock preparation and -treatment technologies (fibre treatment by mechanical contact – beating/refining) have little room for improvement regarding quality and energy savings. Exploring the potential of high-power ultrasound treatment in this respect is a key objective of SONOPULP.

Period of time: 01.01.2010 – 30.06.2012

Remarks

The research project Cornet SONOPULP 28 EBG has been by the German Federal Ministry of Economics and Technology (BMWi) and performed together with Agrotechnology and Food Innovations, CELABOR, ITENE, JOANNEUM, University of West Hungary.

Forschungsstelle:

GWT-TUD GmbH
Blasewitzer Str. 43
01307 Dresden

Internet: www.gwtonline.de
http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Claus-Peter Held

Projektleitung:

Prof. Dr.-Ing. H. Großmann
Dipl.-Ing. Tobias Brenner
Tel: 0351/463-38026
Fax: 0351/463-38014
E-Mail: tobias.brenner@tu-dresden.de

Forschungsgebiet: Prozess-Ziele

Papier- und Kartonherstellung // Papierherstellung

Schlagworte:

Entwässerung, Ultraschall, Papiervlies

Thema:
Einsatz von Hochleistungs-Ultraschall zur Steigerung der Entwässerungsleistung in der Pressenpartie

Ausgangssituation

Die klassischen Techniken zur Entwässerung/Trocknung von Papier und Karton bieten nur noch sehr begrenzte Optimierungspotenziale. Da die Trocknung zu den energieintensivsten Teilprozessen der Papiererzeugung gehört, können nur von neuen Techniken, insbesondere solchen, die bereits vor der thermischen Entwässerung, also der Trocknung einen höheren Anteil des Wasser mechanisch entfernen, nennenswerte Energieeinsparungen erwartet werden. Dieses Einsparpotenzial ergibt sich daraus, dass für die mechanische Entfernung von Wasser aus einem porösen Medium ein etwa 80 % niedrigerer Energieaufwand erforderlich ist als für die thermische Entfernung (Verdampfung) der gleichen Wassermenge. Das dieses Potenzial grundsätzlich gegeben ist, belegen u. a. die Untersuchungen von Prof. Naujock (INFOR-Projekt 141R), in denen gezeigt wurde, dass der Anteil freien – also grundsätzlich mechanisch entfernbaren - Wassers nach der Pressenpartie signifikant über dem heute erreichbaren mechanisch entfernbaren Anteil liegt.

Der in der Papierindustrie allenfalls sporadische und überwiegend auf die Papierverarbeitung (Schneiden, Kleben und Laminieren) beschränkte Einsatz von Hochleistungs-Ultraschall (US), ist das Resultat einer nach wie vor gegebenen, ausgeprägten Skepsis hinsichtlich der Leistungsfähigkeit und der Zuverlässigkeit dieser Technik. Die Ergebnisse eigener Forschungsarbeiten auf den Gebieten der US unterstützten Glättung, Mahlung sowie Druckfarbenentfernung führen jedoch zu anderen Schlussfolgerungen.

Vor diesem Hintergrund wurden an der Forschungsstelle Versuche zur Ultraschall unterstützten Entwässerung durchgeführt, deren Ergebnisse belegen, dass auch der Trockengehalt nasser Papiere und Kartons auf diese Weise signifikant gesteigert werden kann. Wenn die beobachteten Phänomene in großtechnischem Maßstab ohne Beeinträchtigung der wesentlichen Produkteigenschaften umgesetzt werden könnten, ergäbe sich ein Energieeinsparpotenzial, das weit über diejenigen der in jüngerer Zeit erreichten Prozessoptimierungen hinausgehen würde.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsprojektes ist die Bewertung des möglichen Beitrags des Hochleistungs-Ultraschalls zur Reduktion des Energieeinsatzes bei der Entwässerung/Trocknung von Papier und Karton durch die Erhöhung des Einlauftrockengehaltes in die Trockenpartie.

Auf einer labortechnischen Versuchsanlage der TU Dresden, Professur für Papiertechnik mit einem Ultraschallsystem (20 kHz, 1 kW Generatorleistung) und mit einer Arbeitsbreite von 50 mm werden die grundlegenden Wechselwirkungen der Beschallung von feuchtem Papierfaservlies untersucht. Die Versuchsanlage ist so ausgerüstet, dass unterschiedliche Anordnungen von Pressfilzen und Papier – vergleichbar mit der Behandlungssituation in konventionellen Pressen – simuliert werden können. Hierdurch soll abgeschätzt werden, an welcher Position der Presse die Ultraschallapplikation am sinnvollsten ist. Darüber hinaus bietet die Versuchsanlage eine vakuumunterstützte Absaugung der aus dem Papier entfernten Feuchtigkeit.

Die Schallankopplung an das Medium (hier der Filz-Papieraufbau) ist bei jeder Ultraschallapplikation von zentraler Bedeutung. Eine grundsätzlich ungeeignete Installationsvariante, aber auch eine ungünstige Kombination der Prozessparameter (Anpressdruck, Amplitude und Geschwindigkeit) kann aufgrund der hohen Energie- und Leistungsdichten des Ultraschalls zur Beschädigung des behandelten Gutes führen. Solche Applikations- und Prozessparametervarianten sollen in den labortechnischen Untersuchungen identifiziert und beschrieben werden. Aus den gewonnen Daten soll eine möglichst allgemeine Beschreibung der Vorgänge einer Beschallung feuchter Papierbahnen ermöglicht werden.

Einen wesentlichen Schwerpunkt der Untersuchungen wird die Bewertung der Filze vor und nach einer Beschallung ausmachen. Hierbei geht es vor allem um die Bewertung einer möglichen negativen Beeinflussung (Verschließen, Verdichten) der Filzstruktur durch die Hochleistungs-Ultraschallanwendung. Am Ende der Untersuchungen erfolgt eine Kosten-Nutzenabschätzung dieser Technologie. Hierbei sollen die Investitions- und Betriebskosten für die Ultraschallanlage den möglichen Einsparungen durch einen verminderten Energiebedarf in der Trockenpartie aufgrund des geringeren Eingangsfeuchtegehalts gegenüber gestellt werden.

Anwendungen/Wirtschaftliche Bedeutung

Die Entfernung von Wasser aus der Papierbahn stellt, unabhängig von der produzierten Papiersorte, die zentrale Aufgabe des Papierherstellungsprozesses dar. Aufgrund der bekannten energetischen Vorteile einer mechanischen Entwässerung gegenüber den Prozessen des thermischen Austragens von Wasser setzt diese Forschungsarbeit an der Idee einer energieeffizienteren Produktion von Papier- und Karton an. Es soll im Wesentlichen Energiesparmaßnahmen mit dem Einsatz von Hochleistungsultraschall, weniger mögliche Produktionssteigerungen, welche sich gleichermaßen aus einem positivem Ergebnis der Arbeit ergeben würden, angestrebt werden. Hieraus ergibt sich der Nutzen der Forschungsarbeit, weitgehend unabhängig von der produzierten Sorte, für die gesamte Papierindustrie.

Bearbeitungszeitraum: 01.01.2011 – 31.12.2011

Bemerkungen

Das Projekt (INFOR 150) wurde aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

Forschungsstelle:

Hochschule München
Fakultät 05, Verfahrenstechnik Papier und Verpackung
Studiengang Papiertechnik
Lothstraße 34
80335 München

Internet: www.hm.edu

Leiter der Forschungsstelle:

Prof. Dr. Stephan Kleemann

Projektleiter:

Dipl.-Ing. (FH) Jürgen Belle

Tel: 0177/411 62 13
Fax: 089/1265-1560
E-Mail: belle@hm.edu

Forschungsgebiet: Prozess-Ziele

Papier- und Kartonherstellung // Papierherstellung

Schlagworte:

Papiermaschine, initiale Nassfestigkeit, Fasermorphologie, freier Zug

Thema:
Initiale Nassfestigkeit von Papier

Ausgangssituation/Problemstellung

Es gibt eine Vielzahl von Veröffentlichungen, die empirisch zeigen, dass die initiale Nassfestigkeit von Papierbahnen durch Additive, mechanische oder chemische Fasermodifizierungen beeinflusst werden kann. Dem gegenüber gibt es jedoch kaum Hinweise in der Literatur, welchen chemischen oder physikalischen Mechanismen die initiale Nassfestigkeit folgt und wie diese gezielt beeinflusst werden kann.

Die initiale Nassfestigkeit stellt im Papiererzeugungsprozess die wichtigste Größe zum Einstellen des ersten freien Zuges in der Papiermaschine dar und ist damit der wichtigste Parameter zur Verringerung von Abrissen innerhalb der Papiermaschine. Insbesondere für Papiere, die ein niedriges Flächengewicht haben und/oder die auf Maschinen mit offener Bahnführung nach der Sieb- oder Pressenpartie gefertigt werden, ist dieser Parameter sehr wichtig.

Immer höhere Maschinengeschwindigkeiten in der Folge von Produktivitätssteigerungen führen zu größeren Zugbeanspruchungen der Papierbahn, die häufig zu Abrissen führen. Der Wirkungsgrad einer Papiermaschine ist dabei immer nur so gut, wie der schwächste Abschnitt der Anlage. Der erste freie Zug mit noch initial nasser Papierbahn kann daher den Gesamtwirkungsgrad empfindlich reduzieren.

Forschungsziel/Forschungsergebnis

Das Ziel dieses Projekts ist es, die Mechanismen der initialen Nassfestigkeit zu identifizieren und dieses Wissen zu nutzen, um die initiale Nassfestigkeit in der Produktion von Papieren gezielt zu steigern und damit eine wirtschaftlichere Papierherstellung zu ermöglichen.

Anwendungen/Wirtschaftliche Bedeutung

Die Faserstoffe und Additive werden von der Industrie bereitgestellt: Messungen im Nanobereich werden in Zusammenarbeit mit dem Team von Prof. Dr. Clausen-Schaumann der Fakultät 06, Feinwerk- und Mikrotechnik, Physikalische Technik, Hochschule für angewandte Wissenschaften München durchgeführt. Hierbei wird eine bestehende interdisziplinäre Kooperation vertieft.

Die Herstellung der Muster für die Mikro- und Makroanalytik wird über die Blattbildner im Labor der Hochschule München erfolgen, oder über die Versuchspapiermaschine vom Institut für Verfahrenstechnik Papier e.V.. Diese hat eine Siebbreite von 22 cm und eine Zwei-Nip-Presse. Über die Einstellungen in der Sieb- und Pressenpartie kann der Trockengehalt der Muster sehr variabel eingestellt werden. Sie eignet sich daher optimal zur schnellen Generierung unterschiedlicher Muster.

Die Papierindustrie und die entsprechenden chemischen Zulieferfirmen bestätigen immer wieder die gute Reproduzierbarkeit der Ergebnisse auf einer solchen Maschine.

Die bayerische Papierindustrie produziert mit großen, schnelllaufenden Maschinen an verschiedenen Standorten Druck- und Verpackungspapier sowie auf langsamer laufenden Maschinen Spezialpapiere. Beide Gruppen haben ein großes Interesse an den Ergebnissen dieses Projekts. An den Maschinen mit großer Tonnage und Geschwindigkeiten sind es besonders die Adhäsions-und Fliehkräfte, die eine hohe initiale Nassfestigkeit in der Presse erfordern. Bei den Spezialpapierherstellern sind es vor allem freie Züge und damit verbundene Zugspannungen zwischen den einzelnen Prozessschritten, die dem noch nassen Papier hohes Kraftaufnahmevermögen abverlangen.

Bearbeitungszeitraum: 01.05.2012 − 30.4.2015

Bemerkungen

Das Forschungsprojekt wird gefördert durch die Bayerische Forschungsstiftung, München. An diesem Kooperationsprojekt beteiligen sich sieben Unternehmen aus der Wirtschaft.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Ralf Gericke
Tel: 089/12146-406
Fax: 089/12146-36
E-Mail: ralf.gericke@ptspaper.de

Research area: Process aims

Paper and paperboard production // Surface treatment

Key words:

co-binder, self-levelling, metering blade, scratches

Title:
Developing concepts for co-binder systems regarding the enhancement of the self-levelling properties of paper coating colours with the aim of reducing the intensity of application-induced damage to the coating

Background/Problem area

The paper coating process nowadays normally involves contact application. After application of the coating colour, the coating is levelled through contact with a blade which has the advantage of creating well levelled surfaces suitable for printing. However, a problem associated with such blade metering systems are defects in the coating which can occur either through solid pollutants/impurities in the coating colour, rheology problems of the coating colour or defects in the blade. The scratches/grooves produced present a problem, especially in high-quality sheet fed offset printing.

Several co-binders, especially casein and crosslinked poly(vinyl alcohol) are known to be self-levelling in various applications. It may be possible e.g. for casein, due to its complex supramolecular structure, to link self-levelling phenomena to self organisation. Such special behaviour is also known from self-levelling cementitious floor screeds which contain casein as the plasticizer. This kind of self-levelling behaviour might also work to some extent for paper coating colours.

Objectives/Research results

The goal of this project is to develop concepts for co-binder systems aimed at enhancing the self-levelling properties of paper coating colours to thus avoid defects caused by the application process (metering blade or rod). Therefore, classic systems known to provide a smooth surface will be investigated regarding their levelling mechanism. The ensuing knowledge will then be transferred to new co-binder systems obtained from renewable resources such as modified starches for example in order to find and develop sustainable co-binders for the above-described goal.

Up to the middle of the last century, casein used to be one of the main binders for paper coatings. Since then, synthetic polymers have completely taken over due to the manifold possibilities of property design and low costs. However, casein was always well-known for achieving nicely levelled, smooth coatings. In order to regain these properties and as a starting point for this project, an offset paper coating colour was prepared containing 50% casein as the binder. It was compared to the standard without casein. An appropriate amount of synthetic thickener was added to produce comparable rheological properties. The microscopic images reveal that the grooves which were applied on purpose are much less pronounced in the formulation containing the casein.

Levelling is dependent on the one hand on the amount and type of co-binder and on the other hand on coating colour rheology. Water retention was found to have a minor effect on the self-levelling properties of the coating.

This knowledge will then be transferred to other renewable resource materials such as starches or other polysaccharides. In addition, the mechanical treatment of the paper web which might also lead to better levelling was investigated, although it did not reveal any improved levelling behaviour of the coating colour. Finally, the overall most promising new self-levelling coating colours will be tested on a pilot scale. Industrial-scale printing trials will ultimately determine the quality of the finished coated paper products.

Application/Economic benefits

The results of this project are mainly of interest to the industrial sectors of paper, publishing and printing. Furthermore, branches of the chemical and agricultural industries (additives, starches) as well as mechanical engineering may also profit from this research project.

Application benefits include better levelled coatings and in some cases a potential reduction in calendering. Economically speaking, moving away form fossil oil based products is an important objective of this project, since it results in the generation of new markets for renewable resource materials (e.g. starch or other polysaccharides).

More specifically, prevention of scratches/grooves in the coated paper has advantages for the printer, because less discard is produced as the number of defective sheets diminishes. This project also gives smaller enterprises who are suppliers of additives or chemicals in the area of co-binders/rheology admixtures a cost-efficient basis on which to develop new special products that cannot be produced economically on a large industrial scale. Manufacturers of special vibration machines as well as machine manufacturers may acquire new business fields by successfully working out the mechanical treatment of the paper web in this project.

Period of time: 01.03.2010 – 31.08.2012

Remarks

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Research Institute:

PTS München
Heßstr. 134
80797 Munich

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dirk Fiedler
Tel: 089/12146-0
Fax: 089/12146-36
E-Mail: dirk.fiedler@ptspaper.de

Research area: Process aims

Paper, paperboard and board // Surface treatment

Key words:

rapeseed, protein, starch, binder

Title:
Replacement of synthetic binder and cobinder by a combination of starch and especially prepared rapeseed proteins for cardboard coating

Background/Problem area

Binder systems in conventional coating colours for coated cardboard contain mainly synthetic products. The shortage of fossil raw materials and the changing political framework, e.g. due to emissions trading, call for a change in thinking. Besides reducing the specific water volume and optimising the use of energy in papermaking, the use of regenerative raw materials must be accelerated in converting. Starch has been used successfully as a binder and cobinder in coating technology, although at present the share of the binder system is limited to about 2/3 depending on the paper grade.

Objectives/Research results

Within the scope of the research project, a binder system for coating cardboard is to be developed on the basis of purely vegetable raw materials. Starch derivatives and especially modified rapeseed proteins can be used as a possible replacement for fossil raw materials whilst at the same time guaranteeing product quality.

The use of rapeseed proteins on an industrial scale has not yet occurred. Appropriate procedures for the specific use of rapeseed proteins in cardboard coatings are to be developed in order to transfer the results both from the laboratory and pilot scale to the industrial scale. This research project is therefore aimed at developing a new approach for reducing the use of fossil raw materials for this application. Moreover, the research project aims to transfer the results of laboratory trials to the pilot scale and to prepare samples for pre-industrial processing.

The project comprises a first part aimed at producing suitable rapeseed proteins which in a second part of the project will then be studied with respect to the application of protein-containing coating colours and the effects on the quality of the coated cardboard.

Protein-containing coating colours will be examined within the scope of laboratory-scale and pilot trials with respect to their qualitative impact on coating colour rheology and attainable cardboard quality. The objectives of this research are to evaluate the produced rapeseed proteins in the coating formulations by conducting coating trials and to identify the requirements on the protein preparation process to achieve the desired binder properties. Furthermore, coated cardboard samples will be prepared on the pilot coater of the research institute. The suitability of these samples for manufacturing folding boxes will be examined in industrial-scale print trials. The relevant converting properties such as creasability and gluability and the recyclability of the folding boxboard will also be investigated.

Application/Economic benefits

At the conclusion of the project, the expanded use and manufacture of vegetable protein products of rapeseed from domestic cultivation and the processing of the same for industrial board manufacture in compliance with the European quality requirements will have been achieved. This will give rise not only to the development of new business lines for oil seed processing and individual sectors of mechanical engineering as well as a higher value added for the rapeseed meal from the oil pressing.

Rapeseed meal will be raised to the next stage of the food chain, and new sales markets will open up for plant engineering due to new processing capacities. Cost savings in the formulation amounting to approx. 8% can be achieved by replacing 12 parts of latex binder and 0.5 parts of synthetic additives in the coating colours by 10 parts of starch and 6 parts of rapeseed protein.

Period of time: 01.03.2010 – 31.08.2012

Remarks

Research project IGF 16410 N (short header: RAPBI) has been funded by the Federal Ministry for Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Tobias Brenner
Tel: 03529/551-624
Fax: 03529/551-889
E-Mail: tobias.brenner@ptspaper.de

Research area: Process aims

Paper and paperboard production // Surface treatment

Key words:

starch preparation, packaging paper, surface sizing, cavitation, ultrasound, ultrasonic

Title:
Preparation of surface starch by using cavitation for the corrugated base paper production

Background/Problem area

Corrugated base paper is basic material for the production of corrugated board. The production volume of corrugated board in Germany is more than 7 million tonnes per year. Required strength properties as well as stiffness properties of corrugated base paper is mostly achieved by surface sizing of the paper with starch within the drying section of the paper machine. A new starch preparation process by using cavitation should improve the workability of the starch and also its bonding power.

To ensure a penetration of the starch into the base paper in the size press or film press it is necessary to decrease the viscosity of the starch solution. This will be achieved by a molecular degradation of the starch by a treatment with thermo-oxidative or enzymatic treatment. Though the degradation the starch loses bonding power and adhesion force that result in a decrease in strength potential.

Objectives/Research results

The objective of this research project is to detect the applications limits, operating conditions and achievable efficiency of the cavitation to prepare surface starch for the production of corrugated base paper.

For the preparation of the starch two methods will be investigated - high frequency vibrations (ultrasound) and hydrodynamic generation (Venturi nozzle). The comparison in assessing the distinction of the new cavitation based process with the conventional preparation processes (thermo-oxidative and enzymatic) will have the focus on the rheological properties und thus workability of the starch during surface sizing and also achievable increase in strength properties of the paper.

First investigations were carried out by the ultrasonication of wheat starch solutions. This investigations show a decrease of viscosity to lot less than the half of the initial value by cavitation treatment of the starch solution for a consistency in the range of 3 g/l up to 100 g/l.

Application/Economic benefits

The project is aimed at the use of a new process for starch preparation for the sizing of paper by application of surface starch. Main product group is corrugated base paper with recovered paper as raw material due to the high market volume of this product group.

An economic production of corrugated base paper requires the use of recovered paper of the ordinary grades (Group 1) mainly mixed papers and boards (sorted) and supermarket corrugated paper and board. However this fibre raw material offers an insufficient strength potential. Important strength properties of corrugated base paper are the bursting strength and the compression strength, particular in cross direction.

The new cavitation based preparation process offers a new possibility to set the molecular weight and hence the strength potential of the starch. On the one hand this could make it possible to process the starch at a higher consistency with the same strength properties that would reduce energy costs in the following drying section. On the other hand this could provide a starch with a higher strength potential at the same level of viscosity that would make it possible to reduce the needed amount of starch.

The size press and film press vary in the consistency of the starch solution. Film presses run with a higher consistency of more than 100 g/l. Due to the increased use of film presses for surface sizing the cavitation based preparation of starch shall be carried out with a high consistency.

Period of time: 01.01.2012 – 31.12.2013

Remarks

The research project IK-MF 110143 is being funded by the German Federal Ministry of Economics and Technology (BMWi).

PROZESS-ZIELE

Forschungsgebiet

Ausrüstung

Forschungsstelle:

GWT-TUD GmbH
Blasewitzer Str. 43
01307 Dresden

Internet: www.gwtonline.de
http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Claus-Peter Held

Projektleitung:

Prof. Dr.-Ing. H. Großmann
Dipl.-Ing. Ina Greiffenberg
Tel: 0351/463-38028
Fax: 0351/463-38032
E-Mail: ina.greiffenberg@tu-dresden.de

Forschungsgebiet: Prozess-Ziele

Ausrüstung

Schlagworte:

Oberflächenstaub, Schnittkantenstaub, Messtechnik

Thema:
Staubprobleme bei der Herstellung und Verarbeitung von Papier: Charakterisierung der wichtigsten Ursachen und Bewertung der Eignung der verfügbaren Analytik

Ausgangssituation

Der Anfall von Staub bei der Ausrüstung von Papier und Karton noch innerhalb der Papier- oder Kartonfabrik, bei der Weiterverarbeitung bzw. dem Bedrucken sowie im Gebrauch papierbasierender Fertigprodukte ist unvermeidlich. Dies gehört zu den wenigen negativen Aspekten dieser Werkstoffe und ist unmittelbare Folge ihrer ansonsten überlegenen Umweltkompatibilität bezüglich der Ressourcenbasis, die überwiegend aus nachwachsenden Rohstoffen besteht und ihrer hervorragenden, für kaum einen anderen Werkstoff gegebenen Rezyklierbarkeit.

Wenn die technischen, technologischen oder ökonomischen Auswirkungen aufgrund Art oder Menge des generierten Staubs ein nicht mehr akzeptables Maß annehmen, müssen geeignete Abhilfemaßnahmen getroffen werden. Für eine erfolgreiche Suche nach solchen Maßnahmen sind die Voraussetzungen für den Staubanfall, die Bedingungen (Ursachen), unter denen er auftritt, und die Probleme, die er nach sich zieht, sorgfältig zu unterscheiden.

Die durch Papierstaub hervorgerufenen Probleme können sich äußern in Form von

- Schmutzablagerungen
  Im einfachsten Fall äußern sich Staubprobleme nur in Form von Schmutz oder staubinduzierten Ablagerung an oder in der Umgebung von Maschinen oder Geräten. Solche Probleme können meist relativ einfach behoben werden, aber mitunter nur zu dem Preis eines höheren Aufwands, höherer Kosten oder gar Beeinträchtigungen der Produktivität (kürzere Reinigungsintervalle).
- Beeinträchtigung der Prozess-/Qualitätskontrolle
  Wesentlich schwerwiegender werden die Probleme, wenn die Arbeit von insbesondere optischen Sensoren zur Prozess- oder Produktüberwachung durch Staub beeinträchtigt wird, insbesondere dann, wenn die hiervon hervorgerufenen Störungen nicht sofort erkannt werden können. Wenn nicht gleichzeitig Beeinträchtigungen der Produktqualität auftreten, können solche Probleme durch die Installation leistungsfähiger Absauganlagen bzw. die Auswahl entsprechend robuster Sensorik gelöst werden.
- Beeinträchtigung der Produktqualität und der Weiterverarbeitbarkeit
  Diese in manchen Fällen außerordentlich kostenintensiven und im ungünstigsten Fall erst von den Kunden bemerkten Ausprägungen von Staubproblemen sind wohl am besten bekannt und werden traditionell am intensivsten bekämpft. Vorrangig führen sie in Weiterbearbeitungsbetrieben und dort überwiegend in Druckereien zu Problemen, und zwar sowohl beim Tiefdruck als auch beim Rollenoffsetdruck
- Gesundheitliche Risiken
  Papierstaub ist brennbar und bei entsprechender Konzentration in der Luft (aufgewirbelt) auch explosionsfähig. Tatsächlich gibt es bereits Berichte über Staubexplosionen in Offsetdruckereien. Die mögliche gesundheitliche Belastung an Büroarbeitsplätzen durch Papier oder dessen Staub (z. B. durch Einatmen von Papierstaub bei der Aktenvernichtung) führte in der jüngeren Vergangenheit vereinzelt zu Besorgnis. Verunsicherungen lösten auch Berichte über mögliche Papierstaubemissionen beim Betrieb von Druckern und Kopierern aus.

Forschungsziel/Forschungsergebnis

Ziel des Projekts ist die Erarbeitung von praxisrelevanten Empfehlungen für möglichst objektive Methoden zur Bewertung der Staubneigung von Papier- und Kartonprodukten. Entsprechend der Vielfalt der Produkte und ihrer Anforderungen werden diese Empfehlungen z. T. spezifisch sein müssen. Die im Rahmen des Projekts zu berücksichtigenden Produkte sollten in jedem Fall graphische Papiere/Kartons umfassen. Weitere Produkte sind mit dem Projekt begleitenden Ausschuss zu vereinbaren.

Anwendungen/Wirtschaftliche Bedeutung

Nutzer der im Rahmen der angestrebten Projektergebnisse werden sowohl der Großteil der Hersteller von graphischen Papieren, ein erheblicher Teil der Hersteller von Verpackungspapieren und Kartons als auch die weiterverarbeitende Industrie sein. Die technologische Bedeutung der Projektergebnisse ist vor allem in dem Beitrag zur objektiven und praxisgerechten Charakterisierung der eigenen Produkte zu sehen. Daraus leiten sich wirtschaftliche Vorteile durch die Vermeidung von Reklamationen und die Verbesserung der Wettbewerbsfähigkeit ab.

Bearbeitungszeitraum: 01.01.2012–31.12.2012

Bemerkungen

Das Projekt (INFOR 160) wird aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

PROZESS-ZIELE

Forschungsgebiet
Weiterverarbeitung

Trennen
Verbinden/Fügen
Umformen
Beschichten

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. P.-P. Post (PMV)
Dipl.-Ing. D. Huttel (PtU)

Tel: 06151/16-3060
Fax: 06151/16-2454
E-Mail: post@papier.tu-darmstadt.de

Forschungsgebiet: Prozess-Ziele

Weiterverarbeitung // Umformen

Schlagworte:

Tiefziehen, wirkmedienbasiertes Umformen, mehrdimensionaler Spannungszustand, Materialcharakterisierung

Theme:
Fundamental Aspects for the Production of Suitable Papers for Forming Processes

Background/Problem Area:

Deep drawing of paper is an only rudimentary explored process which is merely in use for special applications. A more widespread use of deep drawing processes in paper converting is currently restrained by a lack of understanding of the factors that influence the forming results. This implies that simulation possibilities for design and layout of new geometric shapes do not exist. Suitable material laws that could be used for description of the material behaviour under multiaxial load are not available. In addition, the production of complex three-dimensional structures is constrained by the typically poor ductility of paperboard.

As a consequence, the converting processes of paperboard significantly differ from those predominantly used in metal or plastics forming. A commonly used variety of sheet metal forming is called hydroforming. It allows the production of complex shapes at high degrees of deformation. By now, forming of paperboard does not benefit from the advantages of hydroforming, such as substitution of the punch, minimization of the material thinning and enhancement of the forming degree.

Objective/Research Results:

The aim of the research project is to create test and simulation methods adjusted to deep drawing as well as to gather information on material properties that are beneficially influencing the forming results. On the long run it is essential to get fundamental knowledge on the interrelationship between material properties, process design and process variables occurring in deep drawing. This shall lead to efficient as well as environmentally and economically sound production processes.

A bulge test method suitable for paperboard testing has been developed, analyzed and optimized. The obtained mechanical properties were compared to those obtained from standard tensile tests. The test data was used to evaluate the influences of different raw material compositions as well as laboratory treatments on the deep drawing ability of paper.

In the observed forming process both, the achievable deformation degree and the workpiece quality, strongly benefit from a high breaking strain. Therefore in particular those factors that influence paper's elongation were investigated in detail. This included the intentional creation of curled fibres as well as an analysis of the effects of free shrinkage and moisture content.

A particularly adapted hydroforming process has been used to produce three-dimensional paperboard structures. Furthermore, an online measurement device to describe the mold-filling behaviour has been developed. The experimental results were compared to the results obtained with a finite element analysis (FEA) investigation. The investigations showed the possibilities of the new forming process, as well as the advantages of FEA methods used to pre-define the process parameters. Tests revealed that besides the elongation the level of yield stress considerably influenced the forming results.

Further steps of the project included investigations of the Poisson's ratio of paper, which was optically detected. The forming test was equipped with a heating to investigate the influences of temperature on the forming results. Also a deeper look into anisotropy, friction and the drying conditions was taken.

Application/Economic Benefits:

By collecting knowledge about the influences of different process conditions and production methods on the deep drawing behaviour of handsheets, some criteria for benchmarking the formability of paperboard could be established. The finite element models that were set up can be used for further investigations concerning a quick and reliable forecast of the producibility of certain deep drawn paperboard structures. Appropriate modelling tools would thus considerably broaden the range of economically producible paperboard geometries that would be a sustainable alternative to e. g. plastic packaging. The gained knowledge concerning favourable stock compositions and production methods can be of interest for board mills as well as manufactures of different other paper grades.

Project Period: 01.02.2010 – 31.01.2012

Remarks:

The research project (DFG-Scha1246/2-1) is performed in cooperation with the Institut für Produktionstechnik und Umformmaschinen (PtU) at the TU Darmstadt and is funded by the German Research Foundation (DFG).

PROZESS-ZIELE

Forschungsgebiet
Messen/Steuern/Regeln im Prozess

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Gerhard Gärtner
Tel: 03529/551-652
Fax: 03529/551-889
E-Mail: gerhard.gaertner@ptspaper.de

Research area: Process aims

Measuring // Monitoring and control systems

Key words:

terahertz spectroscopy, thickness, grammage

Title:
Development of a online measuring system for thickness and grammage based on Terahertz-Technology

Background/Problem area

Grammage and thickness are the parameters most online measured at the production process of paper and cardboard. They affect the function of the paper product significant. The measurement is essential for an effective production. The amount of used material and energy for preparation and finishing is proportional to these parameters. They have a direct influence on the costs. State of the art is the measurement using radiation from isotopes. The use of radioactive isotope sources involves safety-related risks and conditions. It is subject to authorisation. The natural decay of the sources causes periodic costs. The limitation of the amount of source activity is also limiting the accuracy of measurement and the number of gauges in a production unit. The search for an alternative solution is ongoing for a long time.

The progress of terahertz-technology offers a possibility to develop a method based on electromagnetic radiation without isotopes. The Terahertz waves radiograph the material non-destructive. They are interacting with the material. It is possible to calculate grammage and thickness from this interaction. The progress of basic terahertz research enables compact fiber coupled sensors for an online measurement.

Objectives/Research results

The project objectives are development of an innovative measuring system, development of needed hardware and software components and integration in automation solutions. The measuring system will be able to replace systems with isotopes or x-ray.

Technical aim is the online measurement of paper parameters grammage and thickness.

- Measuring range for grammage: 20 g/m²… 2 kg/m²
- Accuracy of grammage ± 1 % (± 0,5 g/m² at grammage < 50 g/m²)
- Measuring range for thickness: 20 µm… 2 mm
- Accuracy of thickness ± 1 % (± 1 µm at thickness < 100µm)
- Measuring time < 100 ms.

The system will have a degree of protection of enclosure IP65. It will need the EMC requirements of industrial environments and shall cause no safety-related conditions.

The project is a collaboration of several partners from industry and research facilities. PTS is carrying out research in the field of algorithm and software development. Scientific aim is the development of mathematical methods for calculation of grammage and thickness based on physical relations and data based models (calibration). These methods must reference the special composite, structure and surface of paper materials.

Application/Economic benefits

The results of the project can be used in the field of applied engineering, production, measurement, monitoring and automation techniques.

The main focus is aimed at the production of paper and cardboard. It will be also possible to measure grammage and thickness of other materials like plastic foils, textiles and wood products. The project will create a new generation of measuring systems for paper and similar material on fast running production machines. Based on these results producers of automation systems can widen their product range.

The measuring system developed in this project should be of use for any producer of base materials and coated products. These producers are often small and medium sized companies can replace or complement their monitoring devices. The information from the measuring system will allow producers to control product quality and optimise costs for material and energy.

In a long term it is expected that common monitoring systems using radiation (isotopes or x-ray) will be replaced by terahertz systems.

Period of time: 01.01.2011 – 31.12.2012

Remarks

The research project ZIM-VP2037910AB0 is funded by the German Federal Ministry of Economics and Technology BMWi and is carried out in collaboration with Philipps University Marburg, section physics, Menlo Systems GmbH, TEM Messtechnik GmbH, Batop GmbH, iNOEX GmbH, P2T Protagon Process Technologies GmbH.

QUERSCHNITTS-ZIELE

Forschungsgebiet
Energie

Energiegewinnung
Energienutzung

Forschungsstelle:

Albert-Ludwigs-Universität Freiburg
Institut für Forstbenutzung und Forstliche Arbeitswissenschaft
Werthmannstraße 6
79085 Freiburg

Internet: http://www.fobawi.uni-freiburg.de

Leiter der Forschungsstelle:

Prof. Gero Becker

Projektleiter:

Prof. Gero Becker, Wei Xu

Tel: 0761/203-3790
Fax: 0761/203-3763
E-Mail: wei.xu@fobawi.uni-freiburg.de

Forschungsgebiet: Querschnittsziele

Produktionswirtschaft

Schlagworte:

Life cycle analysis (LCA), bleached eucalyptus craft pulp (BEKP), forest-to-pulp supply chain

Subject:
Sustainability Impact Assessment of China's integrated forest-to-pulp supply chain: a case study of wood pulp production based on fast-growing eucalyptus plantations in South China

Starting situation/Statement of the problem

In recent years, China is becoming one of the largest pulp and paper producers in the world. Over the past two decades, China's wood pulp industry has experienced a steady growth. Raw material supply is one of the crucial challenges for the expansion of China's wood pulp industry. Many wood pulp mills have been integrated with large-scale plantations as pulpwood supply base for capacity expansion, particularly with fast-growing eucalyptus plantations in South China, which created the so-called 'forest-to-pulp' supply chain.

Research objective/Research result

With the increasing concerns from different stakeholders regarding the establishment of large-scale eucalyptus plantations and newly-built pulp mill projects, this study aims to get a clear overview of the status quo of China's forest-to-pulp supply chain, and to evaluate the sustainability associated with the examined system from environmental, social and economic perspectives.

Applications/Commercial relevance

Findings of this study set up a sustainability benchmark for plantation operations and wood pulp production in China, which would help the Chinese forest industry and pulp industry for achieving better performance towards sustainable development.

Operating time: Jan. 2009 – Dec.2012

Remarks

This study is sponsored by the graduate school of "Environment, Society and Global change" of Uni-Freiburg, and the STIBET-program offered by DAAD.

Forschungsstelle 1:

Universität Hamburg
Department Biologie
Zentrum Holzwirtschaft
Arbeitsbereich Chemische Holztechnologie
Leuschnerstraße 91
21031 Hamburg

Internet: http://www.holzwirtschaft.org

Leiter der Forschungsstelle 1:

Prof. Dr. Bodo Saake

Projektleiter:

Priv. Doz. Dr. habil. Jürgen Odermatt

Tel: 040/73962-528
Fax: 040/73962-502
E-Mail: j.odermatt@holz.uni-hamburg.de

Forschungsstelle 2:

TU Dresden
Fakultät Maschinenwesen
Institut für Holz- und Papiertechnik
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/pt

Leiter der Forschungsstelle 2:

Prof. Dr.-Ing. H. Großmann

Projektleiter:

Dr.-Ing. R. Zelm
Dipl.-Ing. Ina Greiffenberg

Tel: 0351/363-38033
Fax: 0351/363-38032
E-Mail: roland.zelm@tu-dresden.de
ina.greiffenberg@tu-dresden.de

Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe

Schlagworte:

Z-Gradient,Hilfsstoffverteilung, Festigkeitsverteilung

Thema:

Ermittlung der Z-Gradienten der Konzentrationen an organischen Komponenten und festigkeitsrelevanten Strukturmerkmalen von Papier und Karton und deren Einflüsse auf wesentliche Papiereigenschaften

Ausgangssituation/Problemstellung

Die Einflüsse der Verteilung von Papier- und Kartonkomponenten in Z-Richtung auf die Eigenschaften von Papier- und Kartonsorten sind in vielen Fällen nicht geklärt. Die Kenntnis dieser Einflüsse ist aber ein wichtiger Baustein im generellen Verständnis der Wechselwirkungen zwischen der dreidimensionalen Struktur und den Eigenschaften der verschiedenen Papier- und Kartonsorten. Ohne das Wissen um diese Zusammenhänge bleiben die Entwicklung neuer Produkte, die Wirkung von Prozessänderungen auf die Produkteigenschaften oder eine angestrebte Eigenschaftsverbesserung stark empirisch geprägt. Aktuell fehlen leistungsfähige Verfahren für eine zuverlässige Ermittlung der Gradienten organischer Papierkomponenten. Dies trifft vor allem für die Analyse der verschiedenen Papieradditive zu, wodurch eine gezielte Einstellung der Gradienten für das Erreichen gewünschter Papier- und Kartoneigenschaften nicht möglich ist. Konkrete Beispiele für Fragestellungen, bei denen die Kenntnis der Z-Gradienten hilfreich wäre, sind die Ermittlung des Penetrationsverhaltens von Komponenten zur Oberflächenmodifizierung, die mit verschiedenen Aggregaten wie Leim- oder Filmpressen aufgegeben werden können, das Migrationsverhalten von Papierkomponenten an die Papieroberfläche oder auch das Eindringverhalten von Strichbindemitteln in das jeweilige Basispapier.

Forschungsziel/Forschungsergebnis

In dem Forschungsvorhaben ist es gelungen, eine Methodik zu erarbeiten, die flexibel an die Anforderungen zur Erstellung von Z-Profilen verschiedenster Papierkomponenten und Papiereigenschaften in unterschiedlichen Papier- und Kartonsorten angepasst werden kann. Damit wurde eine breite Anwendung über die gesamte Wertschöpfungskette Papier hinweg ermöglicht. Die Eignung verschiedener Kombinationen an Probenvorbereitung und Quantifizierungs- bzw. Messmethoden wurde ermittelt. Die entwickelten Verfahren wurden und werden weiterhin bis zum Abschluss des Projektes an Fragestellungen und Probenmaterialien aus dem Kreis der Projektbegleiter validiert, indem entsprechende Z-Gradienten für Papierkomponenten und -eigenschaften ermittelt werden.

Anwendungen/Wirtschaftliche Bedeutung

Insbesondere durch die vielfältigen Einsatzmöglichkeiten der zur Quantifizierung verwendeten Py-GC/MS wird die in dem Forschungsvorhaben zu entwickelnde Methodik auf eine große Anzahl von verschiedenen Fragestellungen und Problemen anwendbar sein und kann daher von vielen Beteiligten der Wertschöpfungskette Papier genutzt werden. Die Technik ist besonders gut für Spezialpapiere und Nischenprodukte geeignet, die häufig spezielle Anforderungen an die Papiereigenschaften stellen, die durch einen angepassten Blattaufbau oder auch durch die Verwendung spezifischer Additive erreicht werden. Der Erkenntnisgewinn zu dem Komplex der Struktur-Eigenschaftsbeziehungen und die Möglichkeit den Einfluss von Z-Gradienten direkt messen zu können, kommt deshalb insbesondere den Herstellern von Spezialpapieren, Nischenprodukten, Firmen aus den Bereichen Weiterverarbeitung und Veredelung, aber auch den Zulieferfirmen aus Chemie und Maschinenbau zugute, denen viele KMU der Wertschöpfungskette Papier zuzurechnen sind. Durch das Projekt profitieren auch die KMU der Papierkette von den Möglichkeiten anspruchsvoller Analytik, die mit der Anschaffung und dem Betrieb der Analytik überfordert wären. Da die wirtschaftlichen Effekte der zu entwickelnden Methodik nur mittelbar wirken, ist die wirtschaftliche Bedeutung nur schwer einzuschätzen. Es ist aber gut vorstellbar, dass eine enorme Hebelwirkung erzielt werden kann, wenn z. B. Fehlinvestitionen vermieden, Reklamationen aufgelöst, neue Produkte entwickelt, Qualitätsschwankungen und der Ressourceneinsatz vermindert werden.

Bearbeitungszeitraum: 01.12.2010 – 31.05.2013

Bemerkungen

Gefördert durch:

Bundesministerium für Wirtschaft und Technologie

aufgrund eines Beschlusses des Deutschen Bundestages

Das IGF-Vorhaben 16810 BG der Forschungsvereinigung Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V., Adenauerallee 55, 53113 Bonn wurde über die AiF im Rahmen des Programms zur Förderung der industriellen Gemeinschaftsforschung und -entwicklung (IGF) vom Bundesministerium für Wirtschaft und Technologie aufgrund eines Beschlusses des Deutschen Bundestages gefördert.

Forschungsstelle:

Albert-Ludwigs-Universität Freiburg
Institut für Forstbenutzung und
Forstliche Arbeitswissenschaft
Werthmannstraße 6
79085 Freiburg

Internet: http://www.fobawi.uni-freiburg.de

Leiter der Forschungsstelle:

Prof. Dr. Dr. h.c. Gero Becker

Projektleiter:

Prof. Marie-Pierre Laborie, Ph.D.

Tel: 0761/203-97617
Fax: 0761/203-3763
E-Mail: marie-pierre.laborie@fobawi.uni-freiburg.de

Forschungsgebiet: Querschnitts-Ziele

Energiegewinnung // Reststoffe

Schlagworte:

Rinde, Tannine, Gerbstoffe, Nebenproduktverwertung

Thema:
BioFoamBark: Aufwertung von Nadelholzrinden zu isolierenden Schäumen und Bioenergie

Ausgangssituation/Problemstellung

Sprunghaft ansteigender Energieverbrauch und Treibhausgasemissionen führen zu gesteigerten, gesellschaftlichen Erwartungen an die Biomasse Holz als Rohstoff für Energie und Materialien. Mit zunehmendem Druck auf die Holzbiomasse wird eine effizientere Nutzung dieser Ressource erforderlich. Die Rinde europäischer Baumarten ist ein wichtiger aber derzeit unterschätzter Rohstoff. Rinde wird gegenwärtig in Nischenmärkten wie in der Landwirtschaft und im Gartenbau verwendet oder für die Gewinnung von Bioenergie verbrannt Tatsächlich werden momentan in Europa 12 Mio. m³ Rinde zur Erzeugung von Bioenergie eingesetzt. Mit einem geschätzten Potential von europaweit 38 Mio. m³ Rinde, lediglich aus der Ernte von Fichten- und Kiefernholz, wird deutlich, dass eine Aufwertung der Rinde in hochwertige bio-basierte Materialien und durch eine Umwandlung zu Bioenergie am Ende des Produktlebens dem Cluster Forst und Holz einen Mehrwert und verbesserte Erträge bietet. Gleichzeitig würde der zunehmende Druck auf die Holz-Biomasse abgeschwächt.

Forschungsziel/Forschungsergebnis

Die Forschungsschwerpunkte liegen in der Entwicklung der Chemie und Technologie zur Herstellung vollständig bio-basierter Tanninschäume, um damit auf Petroleum basierende Schäume zu ersetzten. Die Tannine werden aus der Rinde weit verbreiteter Nadelholzarten extrahiert. Weitere Komponenten für die Schaumzubereitung wie Glycerol und Furfural sind Nebenprodukte aus der Biodiesel- sowie Holz- und Papierindustrie. Ein Ziel besteht darin, Schäume mit exzellenten Eigenschaften zur Verwendung in isolierende Baumaterialien und zur Umwandlung in Synthesegas am Ende des Produktlebens zu entwickeln. In diesem Projekt ist ebenfalls geplant, die Auswirkungen auf die Umwelt, die technisch-ökonomische Durchführbarkeit sowie das Marktpotential dieser Produkte zu ermitteln.

Anwendungen/Wirtschaftliche Bedeutung

Das Projekt BioFoamBark untersucht die hochwertige stoffliche und energetische Kaskadenverwertung von Nadelholzrinde, welche bei der Faserstoffherstellung und in Sägewerken in großen Mengen als Nebenprodukt anfällt. Die Erkenntnisse des Projektes ermöglichen daher eine höhere Wertschöpfung aus dem Nebenprodukt Nadelholzrinde zu erzielen.

Bearbeitungszeitraum: Feb. 2012 – Jan. 2015

Bemerkungen

Das Projekt BioFoamBark wird mit Mitteln des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz (BMELV) durch die Fachagentur Nachwachsende Rohstoffe e. V. (FNR) gefördert.

Projektseite: https://www.biofoambark.uni-freiburg.de

Forschungsstelle 1:

Technische Universität Darmstadt
Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. K. Villforth

Tel: 06151/16-3009
Fax: 06151/16-2754
E-Mail: villforth@papier.tu-darmstadt.de

Forschungsstelle 2:

GWT-TUD GmbH
Blasewitzer Str. 43
01307 Dresden

Internet: www.gwtonline.de
http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Prof. Dr.-Ing. H. Großmann

Projektleiter:

Dr.-Ing. R. Zelm

Tel: 0351/463-38027
Fax: 0351/463-3802
E-Mail: roland.zelm@tu-dresden.de

Forschungsgebiet: Querschnitts-Ziele

Energie // Energienutzung

Schlagworte:

Abwärme, Kälteerzeugung, Prozesssimulation, Trockenpartie, Dampf- und Kondensatsystem, Brüden

Thema:
Nutzung von Abwärme aus Brüdenkondensat zur Kälteerzeugung

Ausgangssituation/Problemstellung

Die Papierindustrie benötigt nicht nur Wärme in großen Mengen sondern heute auch Kälte für verschiedene Zwecke, wie z. B. die Kühlung elektrischer Anlagen, die Kühlung von Wasser für Vakuumpumpen oder von Prozesswasser vor einer biologischen Behandlung.

In der Papierindustrie haben Sorptionskältemaschinen keine Bedeutung erlangt, obwohl seit einigen Jahren standardisierte Module für den industriellen Einsatz zur Verfügung stehen. Trotz ihrer ökonomischen und ökologischen Vorteile wird diese Technologie bei Modernisierungen wie auch bei Neuanlagen nicht ernsthaft in Erwägung gezogen.

Wenn es gelänge, thermische Sorptionsmaschinen in der Papierindustrie zu etablieren, um z. B. Abwärme aus den Brüden der Trockenpartie für die Erzeugung von Kälte zu nutzen, würde dies eine beachtliche Energieeinsparung ermöglichen.

Forschungsziel/Forschungsergebnis

Dieses Projekt soll im Rahmen einer Machbarkeitsstudie klären, welche Wärmequellen in Papierfabriken für die Kälteerzeugung mit Adsorptionskältemaschinen genutzt werden können, wie ggf. die Wärme für eine optimale Kältegewinnung vorbehandelt werden muss (z. B. durch Phasentrennung der Brüden), wie eine Einbindung der Kälteerzeugungsprozesse erfolgen kann. Weiterhin sollen die Randbedingungen für einen wirtschaftlichen Betrieb solcher Konzepte ausgearbeitet werden.

Die Möglichkeiten der Abwärmenutzung werden anhand thermodynamischer Modelle im Rahmen einer Simulation der Papierherstellung untersucht. Relevante Stoff- und Energieströme sollen unter verschieden Betriebssituationen, wie An- und Abfahrzustände nachgestellt werden, um technologische und regelungstechnische Aspekte zu beleuchten und die Übertragbarkeit einzelner Konzepte zu bewerten. Im Fokus der Untersuchung stehen der störungsfreie Betrieb und der energetische Wirkungsgrad der Gesamtanlage.

Mit Hilfe des Simulationssystem BALAS wurden Trockenpartien von drei unterschiedlichen Papiermaschinen mit ihren Dampf- und Kondensatsystemen abgebildet. Hierzu wurden Rohrleitungs- und Instrumentenfließbilder ausgewertet und in das Simulationssystem übertragen. BALAS beinhaltet hierzu alle grundlegenden Module. Deren Einstellung erfolgt anhand von aufgezeichneten Prozessdaten bzw. Messungen vor Ort. Validierte Modelle auf der Basis dreier unterschiedlicher Papier-/Kartonmaschinen bilden den Ausgangpunkt für die Simulation der Abwärmenutzung und deren Effekt auf den Wärmehaushalt.

Aus dem BALAS-Modell ergeben sich zwei prinzipielle Wärmesenken, die für den Betrieb einer Absorptionskältemaschine in Frage kommen. Dies sind die Abluftströme und das Kondensat im Rücklauf zum Heizkraftwerk. Das Kondensat muss im Kraftwerk mit Primärenergie wieder aufgeheizt werden, so dass lediglich die Abluft eine echte Abwärmequelle darstellt.

In der Simulation kann eine Absorptionskältemaschine mit Abluft als Wärmequelle betrieben werden. Die Abschätzungen zur Wirtschaftlichkeit zeigen, dass nicht zuletzt wegen der relativ hohen Investitionskosten eine Umrüstung derzeit nicht sinnvoll erscheint. Unter geänderten Randbedingungen wie z. B. steigenden Stromkosten wäre ein wirtschaftlicher Betrieb allerdings denkbar.

Anwendungen/Wirtschaftliche Bedeutung

Die Ergebnisse dieser Machbarkeitsstudie werden für alle Papierfabriken direkt nutzbar sein, um abzuschätzen, unter welchen Randbedingungen die Kälteerzeugung durch Abwärme wirtschaftlich ist.

Bearbeitungszeitraum: 01.01.2010 – 31.12.2011

Bemerkungen

Das Projekt (INFOR 136) wird in Kooperation mit der GWT-TUD GmbH und den Mitarbeitern des Institutes für Holz- und Papiertechnik der TU Dresden durchgeführt und durch das Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Andreas Well
Tel: 089/12146-572
Fax: 089/12146-36
E-Mail: andreas.well@ptspaper.de

Research area: General aims

Energy // Energy use

Key words:

corrugated board, energy, efficiency, concepts, costs

Title:
Developing measures to improve energy efficiency for a corrugated board sector energy concept

Background/Problem area

Manufacturers of corrugated board spend approx. 2% of their turnover for energy procurement. At a production capacity of 50,000 tpa, these costs amount to approx. € 500,000 per annum. These costs have risen drastically in the past few years and are burdening the added value chain which continues to experience tight margins.

In the manufacture of corrugated board, energy is used predominantly in the form of heat (steam). The greatest heat requirements are experienced in shaping the corrugation and in drying the glue as well for heating halls, storage rooms, staff rooms and hot water production. Electricity is consumed primarily to drive the corrugated board facility, in converting the board (cutting to size, etc.) and for ancillary equipment such as the production of compressed air, for example. The production locations usually have their own steam production facilities, whilst the electricity must be bought from outside providers.

A research demand therefore exists regarding the discovery of energy savings potentials in one's own production process. The complex marginal conditions of corrugated board manufacture must of course be taken into consideration. A research demand also exists in the further development of the manufacturing process and of the products themselves far beyond the state of the art with a view to bringing about a drastic savings of energy.

Owing to the fact that the manufacturing structure consists of many small parts, there is a need to conduct developments within the scope of joint research projects aimed at providing all corrugated board manufacturers with access to alternatives and improvements in the area of energy production and savings.

Objectives/Research results

The project objective is to develop measures for reducing the energy requirements in the corrugated board manufacturing process.

Key findings from the project are:

- The use of energy in a box plant is often not transparent
- A valid benchmarking cannot be done for the entire system
- Some areas of technology such as steam generation, compressed air, lighting or hall heating can be assessed very well.
- a general value for energy consumption of corrugator could not be found no general, as the product quality (number and type of wave (s), weights and grades of paper used) has a strong influence on energy demand

Quickly achievable savings are often achieved in the following areas:

- Compressors (leakage, network management, control)
- Daylight-dependent lighting
- insulation
- the replacement of old equipment (press, compressors, dryers)

Large savings can be achieved

- Boiler house: Reduction of exhaust gas temperature (economizer)
- Essential equipment units replace (paste unit, D & K, HZP) - technological leap

Application/Economic benefits

The results will help Bavarian corrugated board converters make their energy production and consumption more efficient, save costs and thus consolidate and extend their leading position both in Germany and in Europe. In this way, a contribution will also be made to ensuring the continued existence of the production locations and working places there as well as to reduce sector-specific CO2 emissions. The innovations that are worked out will serve to ensure long-term competitiveness, thus safeguarding the future of these companies.

Period of time: 01.04.2011 – 31.03.2012

Remarks

Research project BAY 10/01 "Corrugated board sector energy concept" is being funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de
www.cornet-w2pheat.eu

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Christian Bienert
Tel: 089/12146-469
Fax: 089/12146-36
E-Mail: christian.bienert@ptspaper.de

Research area: General aims

Energy // Energy use

Key words:

paper for recycling, pulping, high temperature, heat pump, energy concepts, waste heat

Title:
Upgrading of waste heat to process heat for different industries (From Waste Heat to Process Heat) (W2PHeat)

Background/Problem area

Often a lot of industrial waste heat is dissipated completely or partially into the environment while there is still need for process heat in the form of warm or hot water, low-pressure steam or warm air. By using heat pumps, waste heat can be upgraded to a higher temperature level. Even though heat pumps are long known, they can be rarely found in industrial environment. The maximum output temperature of approximately 80 to 90°C and the unfavourable electricity/fuel price ration are predominant reasons for the lack of heat pump applications in industry.

Objectives/Research results

The overall goal of the project is to show the economical use of heat pumps in industrial environment. A new technology (high temperature heat pump – HT HP) is to be developed, aiming at upgrading process heat by the use of unavoidable waste heat. Making this available, it could be a key-technology to decrease the excess of waste heat into the environment and to reduce the energy demand for energy-intensive industries like pulp and paper, food, brick, chemical and textile.

For the development of the heat pump and suitable processes following steps will be performed: literature research, on-site investigations, simulation works, laboratory tests, and demonstration with the help of test facilities. The project will provide information about the feasibility to reverse the ORC process, achievable output temperatures of high temperature heat pump, economic and environmental aspects of industrial heat pump applications.

Upgrading waste heat to process heat gives industry the opportunity to achieve higher process temperatures at constant or lower production costs. Processes will be developed to create a suitable process environment for integrating the heat pump technology in the paper industry. The aim of that process development is to investigate the influence of higher process temperatures on process optimisation, product quality, and production costs.

Application/Economic benefits

Integrating waste heat into the process by using high temperature heat pump can reduce energy costs and make an important contribution to reduce greenhouse gases. Suppliers of heat pumps, heat exchanger, compressor and driving machines, like gas motors or gas turbines, plant engineers and designers can use the project results to cover new markets if the implementing of heat pumps will increase. Results will be transferred to SMEs from two different European countries/regions in regional SME User Committees, by directly involving industrial partners from targeted sectors, by performing case studies, by website, organizing workshops and seminars.

Period of time: 01.01.2012 – 31.12.2013

Remarks

The research project IGF 63 EN is being funded by the Federal Ministry of Economics and Technology (BMWi).

QUERSCHNITTS-ZIELE

Forschungsgebiet
Umwelttechniken

Wasser
Emissionen
Reststoffe

Forschungsstelle:

Hochschule München
Fakultät 05, Verfahrenstechnik Papier und Verpackung
Studiengang Papiertechnik
Lothstraße 34
80335 München

Internet: www.hm.edu

Leiter der Forschungsstelle:

Prof. Dr. Stephan Kleemann

Projektleiter:

Dipl.-Ing. (FH) Sandra Röber

Tel: 089/1265-1564
Fax: 089/1265-1560
E-Mail: roeber@hm.edu

Forschungsgebiet: Querschnitts-Ziele

Umwelttechniken // Wasser

Schlagworte:

Mikrobiologie, Verfahrenstechnik, Papiermaschine, Biozidersatz, Prozesswasser

Thema:
Entwicklung eines neuen Verfahrens und der geeigneten Anlagentechnik zur Aufbereitung von Prozess- und Abwasser in der Papierindustrie auf Basis eines neuen Funktionsprinzips. Forschungsschwerpunkt Bayern: Papier und Verpackung

Ausgangssituation/Problemstellung

Die Firma Reiflock hat mit einem neuen Prinzip basierenden Aufbereitungsverfahren im Rahmen eines Vorläufer-Projektes erstmals erfolgreich eine Desintegration biologischer Schlämme nachgewiesen.

Auf Basis der dabei gewonnenen Erfahrungen soll nun mit Schlämmen und Wasser aus der Papierproduktion ein unterschiedlicher Anwendungsbereich erforscht werden, der durch andere Stoffströme, Anforderungen an die Medienaufbereitung und die Auslegung der Anlagentechnik gekennzeichnet ist. Die Unterschiede des geplanten Projektes werden hierbei auch durch eine Patentanmeldung deutlich.

Forschungsziel/Forschungsergebnis

Ziel des Vorhabens ist es, ein auf dem Prinzip von Dampfdruck-Impulsen basierendes Verfahren zur Aufbereitung von Prozess- und Abwasser der Papierindustrie zu entwickeln. Hierbei stellen die biologische Schleimbildung und der biologische Abbau von Roh- und Zuschlagstoffen ernstzunehmende Risikofaktoren im Produktionsgeschehen dar. Mit dem neuen Verfahren soll der bisher übliche Einsatz von Bioziden vermieden bzw. deutlich reduziert werden, so dass auch die Belastungen der Prozesswässer und Schlämme mit Bioziden vermieden bzw. deutlich reduziert werden, woraus sowohl Vorteile für Umwelt als auch Gesundheit des Bedienpersonals folgen. Ferner soll eine wissenschaftliche Grundlage zum Verständnis der Wirkungsweise des neuen Verfahrens gelegt, sowie wirtschaftliche Vorteile herausgearbeitet werden.

Im Rahmen des Projekts wurde im November 2011 eine Technikums-Versuchsanlage für die Hochschule München gebaut und in Betrieb genommen. Hier wurden im Rahmen einer Bachelorarbeit Methoden für die Messungen der mikrobiologischen Aktivitäten in verschiedenen Wässern getestet und in Relation zu den Einstellungen an der Anlage gesetzt.

Mit einem eigens entwickelten Messprogramm werden nun mit der Anlage weitere Prozess- und Abwässer in der Hochschule, wie auch mit der mobilen Anlage von der Fa. Reiflock in Papierfabriken analysiert.

Der nächste Schritt wird die Überprüfung der Wechselwirkungen der unterschiedlichsten Bestandteile des Prozess- und Abwassers sein.

Anwendungen/Wirtschaftliche Bedeutung

Der Lösungsweg innerhalb des Projektes sieht vor, eine Versuchsanlage zu konstruieren und aufzubauen, mit der anschließend zunächst unter Laborbedingungen, später im Technikumsmaßstab und schließlich unter Praxisbedingungen Versuche mit verschiedenen Prozesswässern durchgeführt werden können. In diesen Versuchen soll das optimale Verfahren zur Wasseraufbereitung entwickelt und die Anlagentechnik weiterentwickelt werden.

Der zentrale Vorteil des geplanten Verfahrens soll im Vergleich zum aktuellen Stand der Technik (Einsatz von Bioziden) darin bestehen, dass die biologische Aktivität der Prozessmedien nicht durch den Einsatz von Chemikalien sondern überwiegend durch Dampfdruck erfolgt. Hieraus resultieren die bereits oben beschriebenen Vorteile für Umwelt und Gesundheit sowie Reduzierung der Kosten, woraus wiederum erhebliche Wettbewerbsvorteile folgen.

Als Ergebnis des Projektes soll eine neue Verfahrens- und Anlagentechnik entstehen, die vermarktungsreif ist (Prototyp-Status), so dass im Anschluss an das Projekt die Umsetzung in die Serie und eine Vermarktung an Papier- und Zellstofffabriken starten kann. Hieraus sollen Wettbewerbsvorteile, wissenschaftliches und wirtschaftliches Wachstum bei beiden Partnern erzielt werden.

Bearbeitungszeitraum: 1.12.2010 − 31.12.2012

Bemerkungen

Dieses Projekt wird über das zentrale Innovationsprogramm Mittelstand (ZIM) vom Bundesministerium für Wirtschaft und Technologie gefördert.

Forschungsstelle:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

Dipl.-Ing. A. Klose
Dr.-Ing. H.-J. Putz

Tel: 06151/16-2209
Fax: 06151/16-2454
E-Mail: klose@papier.tu-darmstadt.de

Forschungsgebiet: Querschnitts-Ziele

Umwelttechniken // Wasser

Schlagworte:

Entsalzung, mikrobielle Entsalzungszelle, Wasseraufbereitung, Prozesswasser

Theme:
Reduction of Salt Ions in Process Water by Using a Microbial Desalination Cell

Background/Problem Area:

The pulp and paper industry is one of the most water consuming industries today. Nevertheless a remarkable progress was made in the past 35 years by decreasing the average water consumption of 46 litres down to 10 litres per kilogram (average) of produced paper in Europe. Still challenging is the full water cycle closure especially when recovered paper is used as raw material. In contrary to the application of virgin fibres the matrix of process water is much more complex. Critical parameters like e. g. starch, sulphur components and contents of various salt ions create several problems while recycling the process water. The latter is a major obstacle to overcome on the way to zero effluent production. Salt ions like chloride and calcium are not degraded in any biological waste water treatment plant. Therefore the salt content rises up to a high equilibrium in the process water. Chloride is a problem due to its corrosive behaviour. High calcium concentrations can reduce flotation efficiency for removing printing inks from the paper stock.

Due to changes in pH values calcium carbonate which is brought into the process due to high ash content of the recovered paper dissolves partially in the water. The removal of precipitated material from an anaerobic stage due to loss of biomass and expensive cleaning shut offs of the reactors is undesired. Another field of application is given if highly salted water e. g. brackish water is used as fresh water source. The problems caused by salt ions in process water lead to hesitation in the progress of further cycle narrowing and also, in the end, full cycle closure. The available techniques for removal of salts like e. g. reverse osmosis, nanofiltration or electro dialysis are energy intensive and expensive so research groups were looking into new promising technologies.

Therefore a new technology, a so called microbial desalination cell (MDC), seems to offer a very good perspective for removal of several salt ions from process water with a gain of energy during operation.

Objective/Research Results:

Since the MDC is a new technology in the field of industrial water treatment objective is the evaluation of model and real waste water and process water from pulp and paper industry for a possible successful approach of a MDC. Therefore a labscale MDC was developed. In the first set of trials model waste and process water with different levels of COD and salt ion concentrations are tested to gain more knowledge on the MDC principle, possible challenges and problems during running. A first optimisation of the cell will be carried out.

The second part of trials will deal with real process and waste water from the paper industry. The challenge there is the presence of solids like fibres and fillers which can cause e. g. membrane fouling or plugging of the cell. Besides testing for suitability of different water samples also different running parameters (e. g. batch/continuous mode) will be investigated. Furthermore results for the anticipated energy gain and first calculations for an economic efficiency of the MDC will be determined.

Application/Economic Benefits:

With successful completion of this project a highly innovative method for laboratory scale process water desalination is available. The concept includes energy generation via microbial degradation of waste water and therefore concentration driven desalination of process water. With successful reduction of salt ions in process water cycles a big obstacle on the way to zero effluent paper production is taken. Due to determination of energy gain from the waste water degradation an estimation for a possible industrial use is possible.

Project Period: 01.06.2012 – 31.05.2013

Remarks:

The research project (INFOR 157) is being funded by Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.

Research institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Svenja Bierbaum
Tel: 089/12146-144
Fax: 089/12146-36
E-mail: svenja.bierbaum@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

effluent treatment, TNb, organic nitrogen, paper industry

Title:
Derivation, characterisation and development of organic nitrogen compounds in biological waste water treatment plants in paper mills using virgin fibres

Background/Problem area

The current revision of the Waste Water Ordinance may require replacement of the parameter N_{total} by TN_b.TN_b analysis is capable of detecting organic nitrogen compounds which would otherwise not be detected using N_{total} analysis. The replacement has become necessary for economic reasons. Organic N-compounds are available as nutrients and may therefore cause eutrophication in receiving waters.

Paper mill effluents contain organic and inorganic N-compounds. The main source of organic N-compounds is additives, e.g. retention, flocculation and wet strength agents as well as optical brighteners and colouring agents. These compounds are not directly available in most cases, they have to be metabolised beforehand.

Actually, an unknown part of $N_{organic}$ is oxidised during biological effluent treatment. Therefore an unknown concentration of organic N-compounds in the discharged effluent may be oxidised in the receiving water. The future use of TN_b for effluent discharge control may bring about an increase in discharge expenses due to the additional amounts of $N_{organic}$ detected. It is necessary to generate a database for the parameter TN_b to learn more about the composition of TN_b, its sources, development and degradation, especially when passing through the waste water treatment plant (wwtp). This knowledge may then be used to establish measures to reduce organic N-compounds and meet future TN_b limit values.

Objectives/Research results

The project objective is to develop measures for reducing nitrogen compounds in the effluents of paper mills using virgin fibres. This will make it possible to observe future nitrogen limit values on the basis of TNb.

The first step involved was undertaking a data survey to obtain comprehensive nitrogen parameter data from paper mills. 147 paper mills received a questionnaire asking for information about legal guidelines, analysis of N-parameter and N-elimination and problems in wastewater treatment. 41 paper mills sent an answer - which means that 33% of the paper and board production in Germany were covered, but only 14 paper mills using virgin fibres. Data analysis of the survey showed that meeting the limit value may be a problem especially in some paper mills using recovered paper or producing wood free and specialty papers. TNb values of tested effluents amounted to 6 mg/l on average.

In the next step a method had to be established to measure TNb in aerobic and anaerobic sludge, which is necessary for balancing the amount of nitrogen in the wwtp. The final method is based on TKN digestion.

Operational data of the wwtp, production data and additive use of the selected paper mills were evaluated. In six sampling series per paper mill, samples were taken before and after each stage of the wwtp, from fresh water and sludge, and characterised concerning nitrogen parameters and organic load. It was found that the share of Norganic of TNb in the final effluent varied between 25 and 80 % from mill to mill. In some mills considerable fluctuations were found as well. The following amounts of nitrogen were measured: fresh water: about 2 mg TNb/l, raw materials: 1.5 mg N/mg TR and below, aerobic sludge: 30 and 65 mg N/mg TR, measured as TKN, varying from mill to mill.

Application/Economic benefits

The introduction of TNb limit values into waste water legislation may bring about higher discharge costs. Knowledge concerning the origin, development and conversion of TNb-compounds, especially when passing through waste water treatment plant, should allow measures to be taken that will prevent higher TNb-concentrations in paper mill effluents. In the best-case scenario, examination costs could be set off against effluent discharge fees. Discharge costs of more than 100,000 Euros may be saved. Especially paper mills using virgin fibres or producing specialty papers have to worry about great variability in N-loads due to additive application. Plant operators will welcome the knowledge and concepts for preventing or reducing organic nitrogen compounds in order to avoid unplanned costs for significantly higher effluent discharge fees.

Period of time: 01.03.2010 – 31.07.2012

Remarks

The research project IGF 16408 N has been funded by the Federal Ministry of Economics and Technology (BMWi).

Research institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Hans-Jürgen Öller
Tel: 089/12146-465
Fax: 089/12146-36
E-Mail: hans-juergen.oeller@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

waste water treatment, critical trace compounds, reduction

Title:
Studies on reducing organic trace compounds in paper industry effluents with the help of advanced treatment technologies

Background/Problem area

To an ever greater extent, German paper mills must have their effluents examined for organic trace compounds in order to then take measures to reduce them. The reason for this is a large number of regulations, guidelines and set targets whose declared aim it is to reduce or even totally eliminate the discharge of certain organic trace compounds. The most criticised trace substances in paper mill effluents include, among others, complexing agents as DTPA and EDTA, polycyclic aromatic hydrocarbons (PAH) and chlorinated aromatic compounds (CAH), bisphenol A (BPA) as well as per- and polyfluorinated chemicals (PFC). Although as much as 80 % of some of these compounds can be eliminated abiotically or by biological degradation in effluent treatment plants, measurable concentrations are still found in the treated effluents. Previous R&D studies on reducing these compounds have always concentrated on certain species or on other media, e.g. municipal wastewaters. The extent to which advanced treatment methods are capable of reducing several of these substances in paper mill effluents at one and the same time is unknown.

Objectives/Research results

The objectives of the project are to determine the concentration of organic trace compounds relevant to the paper industry and to develop effluent treatment concepts to reduce them economically. The desired research results include:

- A procedural regulation will be created for the species PAH, chlorinated aromatic compounds, chelating agents (EDTA, DTPA), phthalates as well as BPA, so that these trace compounds can be reliably quantified in paper mill effluents.
- Determination of the trace compound concentrations: the concentration levels in the effluents from recovered paper processing paper mills will be cited for the organic trace substances listed above.
- Development of reduction concepts: the efficiency of advanced treatment methods (O_3, UV, UV/H_2O_2, Fenton's reagent (H_2O_2/Fe^{2+}), Photo-Fenton's reagent (H_2O_2/Fe^{2+}, UV), nanofiltration) to simultaneously reduce different kinds of trace compounds will be evaluated by a comparison process, jncluding investment and the working capital costs.

A group of 8 paper mills were selected for investigation within the project. All of them use recovered paper as most important raw material and they produce graphic, packaging or tissue papers (p.). Conventional parameters of the biologically treated effluents covering following ranges: COD = 120 (graphic p.) - 300 mg/l (packaging p.), TOC = 32 - 85 mg/l (both graphic p.), TN_b = 3.4 - 11 mg/l (both graphic p.), $P_{total} < 0.5$ mg/l (one value at a newsprint mill is close to 2 mg/l), AOX $\leq$ 200 µg/l for all mills. The screening of the conventional parameters of all effluents shows normal composition. Identification of critical compounds was performed by stir bar sorptive extraction (SBSE) for a selective accumulation of polar and nonpolar organic compounds. By means of thermodesorption of the stir bar loaded with the absorbed compounds directly to the chromatographic system trace amounts of organic compounds in the range of 10 - 100 ng/l can be determined.

Due to the fact that some trace compounds are only present in low concentrations in paper mill effluents it was decided to add trace compounds in order to better compare different treatment methods. The following levels were selected: chelating agents = 5 mg/l, phthalates = 1 µg/l, BPA = 100 ng/l, PAH and CAH = 200 ng/l. The assessment of overall elimination capacity for the different kinds of trace compounds results in the following semi-quantitative order of decreasing elimination: chelating agents > Pentachlorophenol (PCP) > BPA > PAH. If for example BPA is the primary compound to be eliminated, processes which use H_2O_2 as oxidizing agent work better than O_3 or UV. If PCP is the envisaged target compound in these matrices, processes including UV radiation will be advantageous. To improve economics of the advanced treatment an investigation of combined oxidative and subsequent aerobic degradation will be performed in the final experimental section.

Application/Economic benefits

The complexity of the interdisciplinary issues to be examined makes it virtually impossible for small and medium sized enterprises to develop strategies and concepts designed to reduce trace compounds in effluents at an acceptable expense. Hence, there exists especially in small and medium sized enterprises a great need for central ideas and knowledge transfer which is met by the findings accruing from the project on how to reduce or eliminate trace compounds in biologically treated effluents. It is absolutely necessary to make economical concepts for the advanced treatment available to small and medium sized enterprises. These concepts will not substantially increase the operational costs of existing effluent treatment plants that range from 0.03 to 1.28 (averaging 0.40) €/m^3. Only in this way, an important contribution can be made at an early stage to secure site locations in future in the light of the EU Water Framework Directive and its ambitious goals.

Period of time: 01.12.2010 – 30.11.2012

Remarks

The research project IGF 16552 N is being funded by the German Federal Ministry of Economics and Technology (BMWi) and performed together with IfP-gGmbH, Darmstadt.

Research institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Hans-Jürgen Öller
Tel: 089/12146-465
Fax: 089/12146-36
E-mail: hans-juergen.oeller@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

paper mill effluents, limit value, monitoring, duckweed growth inhibition test

Title:
Assessing the aqua-toxicological impact of paper mill wastewaters by means of the Lemna test, and identifying the causes of increased Dw values

Background/Problem area

At the request of the Federal Ministry for the Environment, the working group (WG) for the revision of Annex 28 Waste Water Ordinance looked for a test assessing the aquatic toxicity that could be included in the new Annex 28. In a project funded by the German Federal Environment Agency, 20 wastewater samples from 13 paper mills were subjected to the following tests: fish egg, daphnia, luminescent bacteria, algae, Lemna and umu tests. Data collected by the agency were examined as well. Based on these investigations, the duck weed growth inhibition test (Lemna test, results expressed as dilution factor Dw) was recommended for inclusion as a requirement in Annex 28 on the grounds of its adequate sensitivity and minimum cross-sensitivity.

Dw values were inconspicuous in the majority of samples, amounting to 1 or 2. However, there were isolated cases with measured Dw values of up to 8, and values of up to 24 were found in more recent data of the agency. These increased values occurred exclusively in paper recycling mills. Their exact causes or further attendant circumstances could not be clarified so far. Against this background, the WG for the revision of Annex 28 is currently unable to define a minimum requirement for the Lemna test to be included in the revised Annex 28. A specified limit value, however, is absolutely necessary for directly discharging paper mills to safely comply with the requirements of the Waste Water Ordinance.

Objectives/Research results

The main goal of this project is to identify the causes and influences of increased Dw values in biologically treated paper mill effluents. Moreover, the variation ranges of Dw were to be determined to propose a scientifically based, practically viable requirement for the new parameter to be included in the revised Annex 28.

A total of 15 paper mills were selected for a multiple Lemna test screening of fully biologically treated effluent samples, comprising 4 recovered paper (rp) mills with deinking line, 9 rp mills without deinking line and 2 virgin fibre processing mills. Two or three mills showing higher Dw values in their effluents will be investigated in detail, by detailed studies of either the effluent treatment plant and/or the papermaking process.

Application/Economic benefits

The inclusion of an aqua-toxicological parameter in Annex 28 of the Waste Water Ordinance is a novelty for the paper, paperboard and board manufacturing industry. It is therefore all the more important to define and stipulate a target value for Dw that can be complied with by means of state-of-the-art technology. This will ensure the safe compliance of directly discharging paper mills with the minimum requirements of the Ordinance. In view of the all-pervasive economic pressure on the paper sector, it is imperative to avoid any costs incurred by the non-compliance with limit values, e.g. penalties for multiple transgressions according to the four-out-of-five rule.

Period of time: 01.05.2012 – 30.04.2014

Remarks

The research project IGF 16844 N is being funded by the German Federal Ministry of Economics and Technology (BMWi).

Research institute:

PTS München
Hess-Str. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Hans-Jürgen Öller
Tel: 089/12146-465
Fax: 089/12146-36
E-Mail: hans-juergen.oeller@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

effluents, paper production, metal converting, AOX

Title:
Improving the AOX measurement of aqueous samples and raw materials to avoid faulty results

Background/Problem area

Organic halogen compounds (AOX) adsorbable on activated carbon are among the parameters for which monitoring is legally required in many industrial wastewaters. Standard measuring methods for the AOX content of aqueous samples have been available for many years, but various disturbances lead to measurement fluctuations in the range of several 100 %. This is the case in sectors like metal production/working/processing, papermaking, textile production and –cleaning etc. Main disturbances include chloride, DOC (dissolved organic carbon), surfactants and hydrocarbons contained in the wastewater, as well as filterable solids and conductivity. Papermaking pulps, for example, can introduce considerable amounts of AOX into the circuit water and, thus, wastewater of paper mills. PTS method RH 11/91 can be used to estimate the amounts of AOX introduced under standard conditions. In balancing applications, however, the method was found to give incorrectly high values. The measuring technique of AOX must therefore be improved to enable safe and reliable wastewater monitoring and more accurate AOX balances.

Objectives/Research results

Prime objective of the research project is to minimize influences distorting the analytical results of AOX measurements in various industrial wastewaters. Reliable and comparable measurements are to be ensured by the development of wastewater-specific analysis methods and definition of a standard measurement procedure.

The AOX determination of aqueous samples will be improved by VDEh-Betriebsforschungsinstitut (BFI), the research institute in charge of the project IGF17207N; the PTS method will be adapted by the co-operating research institute Papiertechnische Stiftung (PTS).

The variation range of samples from the steel- and metalworking sectors was determined, and the influence of dilution on analytical results investigated. The results showed no effect of dilution on analytical results. Synthetic samples were used for first studies into the effects of chloride contents at different initial AOX concentrations and nitrate rinsing volumes, and to compare the methods of DIN 38409-H14 (AOX) and DIN 38409-H22 (AOX-SPE). The tests have shown that for initial AOX concentrations of 250µg/l and 1,000 µg/l as well as chloride concentrations of 100 mg/l and 1,000 mg/l, the results of AOX analyses differed by maximally 4 % and 6 %, respectively. The analytical results were reproducible. The initial findings suggest that recovery rates cannot be improved by using twice as much nitrate for rinsing. Further studies will investigate the influence of DOC levels and combinations of different DOC and chloride levels at different initial AOX concentrations on the AOX quantities absorbed on activated carbon as well as on recovery rates.

PTS scientists used statistical experimental design to develop and implement a screening plan varying the sample preparation conditions of the AOX release method. The following parameters were varied: soaking time t_E = 0 or 120 min, disintegration time t_A measured as total number of revolutions in the laboratory disintegrator = 25,000 and 75,000, disintegration consistency S_A = 0.6 and 4 %, dilution consistency S_V = 0.1, 0.6 and 4 %, stirring time t_R after dilution = 5 or 60 min, and temperature T = 20 or 40 °C. By means of statistical experimental design and by defining two settings for each of the six parameters, the number of tests could be reduced from several thousand to 27. Looked at individually, the parameters S_A and S_V constitute the most important influences. Interactions between S_V*T, S_A*S_V, t_E*S_V and t_E*S_A were identified as further significant influences by multi-factorial analysis, and are currently being investigated in more detail. The envisaged final result is a coefficient model explaining the effects of individual factors (variables) on the target value = AOX release, and forming the basis for defining suitable parameters for the technique.

Application/Economic benefits

Faulty measurements during AOX analysis resulting in levels that seem to exceed the respective limit value must be avoided by all means. Otherwise, the already high cost pressure on small and medium enterprises of the above mentioned sectors could be further increased by unnecessarily high chemical dosing in AOX treatment units, higher (i.e. the loss of reduced) discharge fees for AOX, and extra costs for the dimensioning and operation of treatment stages for AOX reduction. Moreover, the urgency of the subject dealt with in the project was confirmed by the proposed revision of DIN EN ISO 9562 “Determination of adsorbable organically bound halogens (AOX)“ in spring 2012.

Period of time: 01.09.2011 – 31.08.2013

Remarks

The research project IGF 17207N is being funded by the German Federal Ministry of Economics and Technology (BMWi) and performed together with the co-ordinating research institute VDEh-Betriebsforschungsinstitut GmbH in Düsseldorf.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Daniela Römer
Tel: 089/12146-224
Fax: 089/12146-36
E-Mail: daniela.roemer@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

ceramic membranes; waste water

Title:
Nanoporous ceramic membranes for a sustainable recycling of water and solvent

Background/Problem area

11 partner companies from 4 different sectors are involved in this cross-sector project. The production of paper, textiles and chemical products as well as the processing of metal are known to consume vast amounts of water and solvents. A more sustainable use of these resources through a further closure of the cycles is the overall objective of the project. The focus of this study is on membrane technology.

The technological problem involved in membrane use is the fact that common membranes are made of organic polymeric material and are not suitable for all treatment processes. Limitations include high temperature, extreme pH values, aggressive solvents or abrasive particles. Ceramic membranes can be used in a broader variety of applications, due to their more resistant materials. Owing to their high loading capacity and temperature stability, ceramic membranes offer special advantages for applications in the pulp & paper industry. Partial streams such as effluents from chemical pulp bleaching often have temperatures in excess of 70°C. Organic membrane materials cannot be used at these temperature levels, whereas ceramic membranes can – and their still higher investment costs for a given membrane area are frequently compensated for by higher flux and longer service life. Existing ceramic membranes are much more stable under harsh conditions but up to now the lowest cut-off of this membrane type has been 1 nm.

Objectives/Research results

The objective of the project is the development of ceramic membranes with a pore size < 0.9 nm (cut-off < 200 g/mol).The process of material development is supplemented by laboratory and pilot trials using process waters of the partner companies involved.

For the pulp and paper industry four different waste waters were examined in lab trails. With the newly developed 200 Da membrane a significantly higher separation efficiency has been achieved. Noteworthy is the AOX retention of 85 % in the experiments with waste waters from bleachery. The permeability of this waste water was 7 to 12 l/m²h bar with the new membrane. These values are sufficiently high to carry out further experiments with this waste water on a pilot scale.

Application/Economic benefits

The project results can be used in all industries dealing with water and solvents, especially in pulp and paper mills. Objective is the technically mature development of a new membrane material in combination with an approved module design. By using ceramic nanofiltration membranes not only water is being recovered, but soluble substances can be concentrated and recycled into the papermaking process as well. This use of membrane plants as integrated instead of end-of-pipe solutions allows their economical application and cost-effective operation.

For SME of the environmental technology sector, economic benefits will emerge from the broader use of membrane technology in the European paper industry.

Period of time: 01.05.2010 – 30.04.2013

Remarks

The research project BMBF “NanoMembrane” is being funded by the German Federal Ministry of Education and Research BMBF and is being performed together with:

- Fraunhofer Institut für keramische Technologien und Systeme IKTS
- Koehler Kehl GmbH
- Zellstoff Stendal GmbH
- Merck KGaA (Coordinator)
- Rauschert Kloster Veilsdorf GmbH
- Fa. Andreas Junghans
- BENSELER Sachsen GmbH & Co. KG
- Plauener Spinnhütte GmbH
- Color Textil Veredelung Peppermint Holding GmbH
- Universität Stuttgart - Lehrstuhl für Bauphysik LBP

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Benjamin Simstich
Tel: 089/12146-388
Fax: 089/12146-36
E-Mail: benjamin.simstich@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

anaerobic waste water treatment, membrane, biogas

Title:
Further development of anaerobic MBR technology for producing biogas from partial wastewater streams

Background/Problem area

Wastewater from the paper industry inherits chemical energy which could be utilized for the production of biogas in anaerobic treatment processes. However, only 20 % of German paper mills use this technology. State of the art in most mills is still aerobic wastewater treatment (e.g. activated sludge process) or indirect discharge to the municipal sewer system. Compared to aerobic treatment, the advantages of the anaerobic process are a much lower energy demand (only 10 %) and a much reduced production of solid by-products (only 5 %). And the most important difference in terms of sustainability and economic efficiency is the generation of biogas.

The main reason why only some mills use anaerobic water treatment technology is an excessively low COD concentration in the wastewater. Of course, anaerobic reactors could be used process integrated to treat partial streams only, especially those with a higher COD concentration. However, this has not been put into practice until now because the unstable feedwater parameters negatively affect the performance of the anaerobic microbiological system.

The combination of an anaerobic reactor and a membrane (AMBR) is a promising new technology which is currently under development by some companies and researchers. With this combination, a substantially higher proportion of paper mills would be able to use and profit from the anaerobic treatment of their wastewaters. Concerning the application in the paper sector, and also for breweries, PTS revealed some open research questions which are important for the further development of the AMBR.

Objectives/Research results

The main project objective is to expand the number of possible users in the paper industry, who may profit from their wastewater as a biogas source. The research therefore focuses on technical details which are important for the studied industry branches of paper production and breweries. In concrete terms, the project will lead to knowledge on:

- the filterability of the sludge-water mix in the reactor when the system is operated under unstable conditions in terms of COD feed concentration or operated at low COD concentrations < 1000 mg/l.
- the influence of turbulence and shear forces on the microbial activity in a dynamic cross-flow membrane module.
- economically sound concepts for the process integrated use of these AMBR systems.

After more than one-third of the project period, some of the planned anaerobic degradation tests have already been performed. Initial results have shown that a periodic change in the COD concentration of the feedwater lead to an alteration of the shape and particle size distribution of the solids and granules. Compared to reactors fed with a constant load and COD concentration, the particle size is smaller at unstable feed parameters. This also affects filterability, which is reduced when the mean particle size in smaller. This was tested and confirmed in filtration tests after the anaerobic degradation trials. Currently, lab trials are being performed to study the effects of continuously lower COD concentrations in the feed to the anaerobic reactor. For this reason, parallel degradation tests are being conducted with several diluted water samples with a COD between 6000 and 500 mg/l.

FISH analyses with gene probe sampling methods are also planned for the next few months to come to an in-depth understanding of the microbiological processes that took place during the trials.

Application/Economic benefits

The projects results will provide Bavarian paper mills with an opportunity to glean knowledge and obtain information on this new AMBR technology and especially on how to reap its benefits in their own mill. Participating in the project are also several Bavarian companies from the environmental mechanics and plant construction sector (mainly SMEs) that stand to earn direct profits from the project results. The development aims to provide economically viable processes that are intended to offer economic benefits for end-users in the paper industry as well as in breweries.

Period of time: 01.02.2012 – 31.01.2013

Remarks

Research project VIII/7-3621b/211/2-IGF-1112-0003 is being funded by the Bavarian Ministry of Economics, Infrastructure, Transport and Technology.

Research institute:

PTS Munich
Hess-Str. 134
80797 Munich, Germany

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Dieter Pauly
Tel: 089/12146-160
Fax: 089/12146-560
E-mail: dieter.pauly@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

cross-sector approach, water and energy savings, paper, chemistry, food, textile, treatment trains, technologies, less effluent, circuit closure, process stability

Title:

EU-AquaFit4use – Sustainable Water Use in Paper, Chemical, Food and Textile Industries; SubProject SP 5 "pilots in four different sectors" covers work package WP5.1 "paper industry", WP5.2 "chemical industry", WP5.3 "food industry", and WP5.4 "textile industry"

Background/Problem area

By consuming several billion m³ of water per year, industry has a significant impact on available water sources. Legislation, stringent discharge standards as well as process and product demands force industry to ensure higher water quality resulting in increasing costs. In the water consuming industry, water is no longer regarded as a consumable or utility but as a highly valuable asset: and vital element used in close conjunction with the production processes. Industries want to become more independent of public and private parties for the supply of process water and the treatment of wastewater. Furthermore, they want to use water qualities according to their own specifications, fit-for-use.

Securing sufficient quantities of water of good quality and resources for urban, industrial and agricultural uses is a major driving force behind the current EC policy. Although Europe has extensive knowledge and experience of developing solutions in the field of water, the fragmented character of the European water sector strongly limits its potential. A focused European approach on industrial water has enormous potential in fostering technical innovations. Therefore four sectors, i.e. paper (WP5.1), chemistry (WP5.2), food (WP5.3) and textile (WP5.4) have combined their expertises by learning from each other to face this ambitious issue.

Objectives/Research results

This proposal aims to balance industrial supply-side and demand-side approaches to managing scarce water resources. In this context we are aiming to reduce high quality water consumption and fresh water needs, mitigate the environmental impacts of both water treatments and effluent discharge, and to better manage the health and safety risks relating to water use while improving product quality and process stability, reducing water related costs (intake, treatment, re-use, closed loops, discharge), increasing independency and flexibility and creating new jobs in Europe when strengthening competitiveness by ensuring the world market leadership of European water treatment technologies.

To reach these ambitious goals a new management system including new approaches, tools, methods, and technologies needs to be developed. AquaFit4Use aims at these developments focusing at cross-sector issues that concern the major water consuming industries in Europe.

Application/Economic benefits

Simulation studies in four different sectors have been successfully performed at partner factories, elaborating several scenarios for effluent reduction whilst assessing the impact of system closure on system loading. This includes predicting the impact of different integrated water resource management approaches whilst designing principles for ensuring water quality and process stability. Concepts of water circuit narrowing have been discussed, covering measures and partly also several alternatives for reducing specific fresh water consumption.

On-site pre-trials covering separation steps (flocculation, DAF, precipitation, crystallization), AOP (ozone, UV, peroxide), biological treatment (MBR, UASB, denutritor) and pre-filtration/membrane steps (3FM, MF, UV, NF, RO) are being performed. Accompanying on-site meetings of water users, water treatment suppliers and supporting research institutes are being held to prepare alternative pilots.

Thanks to all the results that have been achieved and analysed by considering the partners' specific boundary conditions, a valuable basis has been determined for carrying out SP5's pilots. The details of the pilot trials have been planned and discussed. The layout of pilot plants and corresponding treatment sequences has been fixed. For the paper sector, the following steps have been performed in a timeframe of 8 months covering: anaerobic treatment, calcium elimination & softening, MBR, ozone, evapo-concentration and membrane filtration (NF/RO). Based on the results technological and economical evaluations have been performed suggesting on a modular design tailor-made solutions for specific paper mill's boundary conditions.

Period of time: 01.06.2008 – 31.08.2012

Remarks

The integrated research project AquaFit4use (EU-FP7-ENV-211534) has been funded by the European Commission covering six Subprojects. Subproject SP 5 "Pilots in four different sectors" is coordinated by PTS in cooperation with 27 partners from 11 European countries:
11 industrial partners representing water users as model companies (global player enterprises and SME),
8 industrial partners representing water technology suppliers (global player enterprises and SME),
2 industrial federations (EUCETSA and ISPRIN),
7 institutes, and 2 universities.

Research institute:

PTS Munich
Heßstr. 134
80797 Munich, Germany

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Daniela Römer
Tel: 089/12146-224
Fax: 089/12146-224
E-mail: daniela.roemer@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

cross-sector approach, water and energy savings, paper, wet exhaust air, membranes, technologies, less water less energy

Title:
EU-CapWa – Capture of evaporated water with novel membranes

Background/Problem area

One of the major challenges of this century is the provision of safe drinking water for a growing population. In contrast high quality water is needed for many industrial processes (e.g. steam generating process). In order to achieve this high quality water, raw water needs to be treated and demineralised. This treatment process can be very laborious and costly depending on the raw water source. However, even in water rich countries like Germany, authorities put limits on drinking-water use for industrial purposes. The shortage in water resources, especially in arid areas requires the availability of new, environmental friendly technologies with a high economic and social impact.

In contrast there are large quantities of water vapour present in the air produced and/or liberated in industrial processes and escaped as “waste” water to the atmosphere. Currently, there is no evaporated “waste” water recovery from industrial processes. In principle it is possible to recover water from wet exhaust air (e.g. flue gas, exhaust air of a paper machine) by condensation with a heat exchanger. But cooling the gas stream, or part of it, has a high energy and cooling demand.

Using gas separation membranes, one is able to recover the water and, with a sufficiently selective membrane, produce purified water in a single process step. Because water is removed, the dew point of the exhaust air stream will decrease and energy can be recovered as well, increasing the overall efficiency of an industrial process. This efficiency improvement can be translated to fuel savings and as a consequence reduction of CO_2 emission.

Objectives/Research results

The objective within CapWa is to produce a commercially available membrane modular system suitable for industrial applications. The concept of this membrane is based on a gas separating composite membrane capable of capturing evaporated “waste” water. The objective within this project is to transfer the technology from lab scale to industrial scale.

First step was a lab scale testing of the membrane system in the exhaust air stream of a paper machine hood. The produced water quality from this system is comparable with the quality of demineralised water.

Within the planned pilot plant experiments the behaviour of the membrane system with respect to the thermal/chemically stability under the existing environmental conditions and the resistance to fouling are tested.

Application/Economic benefits

A proof of principle of this concept has been achieved in the flue gas ducts of coal-fired power plants and a waste-to-energy plant. The advantages of the proposed process compared to traditional molecular separation are:

- High energy efficiency: no phase change is required to achieve separation
- Temperature neutral to the source: making heat recirculation in industrial processes very interesting
- Reliability: no moving parts
- Small foot print: it generally easily fits in existing spaces, factories etc.
- Environmental friendly: little to no use of chemicals, no waste streams

Currently on-site pre-trials in the exhaust air of a paper machine hood are being prepared. Simulation studies with different modelling tools will be used to support and speed up the development of the end user system. This includes also predicting the impact of different integration concept by ensuring water quality, product quality and process stability.

Period of time: 01.09.2010 – 31.08.2013

Remarks

The integrated research project CapWa (EU-FP7-SME CP-FP 246074-2) is being funded by the European Commission (FP 7). The project is coordinated by KEMA in cooperation with 13 partners from five European and three African countries:
4 industrial partners representing end users as model companies
4 industrial partners representing membrane technology suppliers (global player enterprises and SME),
3 institutes, and 3 universities.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leaders:

Gabriele Weinberger
Tel: 089/12146-463
Fax: 089/12146-36
E-Mail: gabriele.weinberger@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

algae, mixed algae-bacteria biomass, biological effluent treatment, paper industry

Title:
Combined algal and bacterial waste water treatment for high environmental quality effluents (ALBAQUA)

Background/Problem area

Biological purification is the conventional way of treating effluents in the paper industry. Biological wastewater treatment – meaning purification solely done by bacterial activity – is state of the art and highly sophisticated in the European industry. A lot of different treatment technologies, specialized for several treatment targets, are available on the market. However there are limits to classic biological treatment which could not be overcome by the sole use of bacteria so far. Priority, endocrine substances, residual COD, nutrients, inhibitory or refractory substances, for example, cannot be removed by bacterial activity alone.

Multiple technologies for advanced effluent treatment, e. g. evaporation, membrane filtration, oxidation processes, and precipitation… have been the focus of research for some years. Unfortunately most of theses technologies are quite expensive in investment and operating costs. Therefore the issue of algae is becoming increasingly important worldwide: Algae are seen to have great potential for effluent treatment and the production of energy and biofuels, as raw material or to reduce greenhouse gases – there are a multitude of possible applications.

Within the ”ALBAQUA” (Combined Algal and Bacterial waste water treatment for high environmental Quality effluents) project researchers from four European countries – Germany, Hungary, Belgium and Slovenia – are combining their experiences and capabilities to study the potential of algae for the paper industry and related industrial sectors by an initial exploratory research project. The initial focus will be on effluent treatment due to its operational availability, in order to collect information and gain experience with the use of algae in this field. On the basis of these leadoff results, the further use of algae containing biomass (ALBA-flocs, ALBA-Flocken) is to be investigated to evaluate follow-up beneficial issues for the paper industry. The aim is to establish which of the concepts currently available are suitable for this purpose and have enough potential to be cost-efficient for all grade groups.

Objectives/Research results

The approach taken in this project focuses on effluent treatment first, in order to collect information about and gain experience with the use of algae in this field. The aim is to assess if the use of algae of any kind is suitable for the purposes of the paper industry and its related sectors and has enough potential to be cost-efficient for all tasks planned. These are: cultivation of suitable algae species, testing of suitable kinds of fixation of algae in mixed algae-bacteria biomass, operation of single algae-bioreactor, design of pilot system, degradation performance, utilisation of excess mixed algae-bacteria biomass, pilot plant trial, evaluation of the benefits of effluent treatment by single algae bioreactor or mixed algae-bacteria bioreactor, evaluation of economics.

The ALBA-floc process proofed applicable for purification of paper mill effluents in the range up to COD = 800 mg/l (1000 mg/l) and can be operated stable. Aeration is not necessary, circulation/mixing of the system is required. In total a reduced energy input leading to lower operational costs can be found for the ALBA-floc process compared with the conventional activated sludge process. Earnings from energy containing biomass may support the development of profit driven waste water treatment plants. The operation of the ALBA-floc process for purification of paper mill effluents in pilot scale demonstrate that the first step for successful implementation of this system into industrial scale had been overcome.

Application/Economic benefits

The results of the project may lead to a paradigm shift regarding effluent treatment in the paper industry as well as in related industrial sectors in case the effluent treatment by means of algae proves successful. Entire industrial sectors would change their service and technology portfolios in favour of the new concepts for biological effluent treatment and reuse of excess biomass.

In anticipation of reduced operating costs for effluent treatment (reduced energy supply, lower water discharge costs, prospect of earning money by selling recyclable excess biomass) the outcome of this project will have an impact on SME as well as bigger companies of all industrial divisions related to the set objectives. It would bring new know-how for every SME partner and enable the exchange of experiences, ideas, knowledge, methods and transfer of know-how, all with the aim of efficient problem solutions. The set objectives will be implemented at existing locations and the results will be applied directly in practice. The target market is the entire area of the EU, including the Balkans.

Period of time: 01.09.2009 – 31.12.2011

Remarks

The research project “ALBAQUA” IGF EN 23 has been funded by the German Federal Ministry of Economics and Technology (BMWi) and performed together with other European institutes.

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Carsten Schönfeld
Tel: 03529/551-622
Fax: 03529/551-899
E-Mail: carsten.schoenfeld@ptspaper.de

Research area: General aims

Environmental technology // Emissions

Key words:

nanoparticle, emission, surface modification, coating, light-scattering

Title:
Application of light-scattering methods for the measurement of low-concentration nano-particle emissions of products

Background/Problem area

Nanotechnology is one of the key technologies of the 21st century. However, despite of enormous technical opportunities there are serious risks to be taken into consideration. Questions regarding the release of fine- and ultra-fine dust from nanotech-products are under public debate. An important contribution that science can add to this discussion would be a dependable method for the characterisation of such emissions with respect to quantity and size distribution. A scientifically proven method of nano-particle-characterisation, which could be performed with reasonable effort, however, is currently not available.

Producers of nanotechnology make use of light-scattering methods to characterise particle size distributions. In this case, sufficiently high particle concentrations are available. In the analysis of emissions, however, light-scattering reaches its physical limitations. Lowly concentrated particles of less than 100 nm exhibit such a low scattering intensity that they are hard to detect – especially if larger particles are present. In the analysis of emissions from articles of daily use, in the measurement of ultra-fine dust in working areas or traffic situations as well as in numerous other cases the extremely low scattering intensity of nano-particles is the most prominent challenge for the use of light scattering methods.

Objectives/Research results

When the particle concentration is not arbitrarily adjustable, scattering intensity can still be increased by letting the particles grow in a controlled fashion. According to Rayleigh's law the scattering intensity increases with the sixth power of the particle diameter. Thus, a significant increase of the signal can be achieved very quickly.

The aim of the research project is to supply a method for a controlled growth of nano-particles in the liquid phase such that they can be easily detected by light scattering methods. To accomplish this growth, chemical and physical coating methods are being examined to find out if they are suitable for increasing the scattering intensity of a given model particle ensemble. Knowing the respective reaction conditions an algorithm shall then be derived to trace the result back to the initial particle size and thus provide indirect access to the original size distribution of the ensemble.

First a working environment for sample preparation and the light scattering experiments (photon cross-correlation spectroscopy, PCCS) has been set up in a laminar-flow box. Great care has been taken in working out a contamination-free sampling method which obtained very reproducible PCCS-results for a number of model particle types. A silica-based model system has been chosen due to its narrow and highly reproducible particle size distribution. After this reference system has been characterised and mostly understood, several growth reactions have been tested regarding their ability to render a well defined and reproducible particle growth under controlled conditions.

The growth reactions comprised simple adsorptive processes with a number of medium to higher molecular weight organic molecules, different soluble polymer and polyelectrolyte systems including a system with a suitable lower critical solution temperature. In the latter example a temperature sweep has been used to trigger the coating reaction. Furthermore, reactive coating reactions have been considered among which the Tollens reaction and a sol-gel approach with TEOS (Tetraethyl orthosilicate) have been selected and examined. Up to now, a simple organic compound displaying a rigid anisotropic molecular shape rendered the best results when applied to the reference silica system. A growth of the mean measured particle size from 50 nm to 200 nm depending on the concentration of the compound could be reproducibly proven. First approaches to a statistical-mathematical description of the growth process have been developed.

Application/Economic benefits

In the course of the steadily increasing public discussion of nano-technology risks, politics and society are challenged, to provide clear standards for the use of nano-materials. This is primarily important with respect to occupational health and safety but as well for the sake of a secure use and a harmless disposal of nano-technological products.

The economical relevance of this programme becomes evident in the application of the research results in the determination of potential hazards from nano-technology products. Further to risk assessment and environmental analytics also the biological and medical sector should be able to benefit from the research results.

Applying state of the art surface modification technology, colloid science and chemical kinetics an expansion of the accessible particle size and concentration regime of light scattering methods for the analysis of emissions from nano-technology products can be expected. Thus, the aim of further research should be the development of the project results towards a reference method and its application in standardisation and legislative processes. If this was accomplished, an even larger economical potential could be made accessible.

Period of time: 01.04.2011 – 31.03.2013

Remarks

The research project IK-VF 100023 is being funded by the Federal Ministry of Economics and Technology (BMWi).

QUERSCHNITTS-ZIELE

Forschungsgebiet
Produktionswirtschaft

Managementsysteme
Beschaffung
Logistik
Fabrikationsplanung
Leitsysteme

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Wolfram Dietz
Tel: 089/12146-279
Fax: 089/12146-36
E-Mail: wolfram.dietz@ptspaper.de

Research area: General aims

Production economy // Monitoring and control systems

Key words:

NIR-spectroscopy, recovered paper, substitute fuels

Title:
Development of a method for rapid determination of quality parameters in recovered paper bales based on an NIR measurement system

Background/Problem area

Recovered paper is still the most important raw material in the paper industry. As well there is the tendency to use more recovered paper. With the need to recover more paper, especially from households, the quality of this material will decrease further. On the other hand more and more substitute fuels have to be used to reach European ecological aims. These materials (e.g. rejects of paper production) contain reasonable amounts of recyclable fibres and a high content of water and unwanted plastic material (PVC). Because of this they cause problems when used as fuel.

The quality control of both materials (recovered paper and substitute fuel) is time and cost consuming. In most cases the personal knowledge of the staff is the only way of characterising the quality. Reference methods can only be applied in laboratories on a small part of the materials with a high statistical uncertainty. In some special applications measuring devices have been developed. So it is possible to measure the moisture of the outer layers of paper bales with the AP 500 or the moisture, plastic and ash contend of those bales after drilling a hole into the bale (with PBS, paper bale sensor). Core drilling devices are in use as well, but are very cost intensive. For fast and reliable control and testing of substitute fuel no device is known, that is working without sample preparation.

The use of fast and on-site measurement techniques is a frequently named requirement. NIR spectroscopic measurement methods are in principle able to measure the ingredients in the quality relevant materials, using appropriate mathematical and quantitative methods. On the basis of a prototype of a portable diode array spectrometer PTS has developed a predecessor device, the Paper Bale Sensor (PBS). Ten units are in use worldwide and have delivered valuable information for the concept of a production-ready equipment for industrial applications.

Objectives/Research results

The goal of the PTS was to develop a method for the rapid, quantitative determination of constituents in waste paper bales, based on a new, compact and robust instrument. On the basis of a new device (Sentronic) paper specific mathematical evaluation algorithms and industry-specific user interfaces have been developed.

Priorities had been:

- creating methods for the parameters humidity, plastic, ash, mechanical pulp with improved accuracy
- recording and display of profiles of the parameters (eg humidity) along the test section
- creating methods for new parameters and new applications (whiteness, rejects)
- Industry-specific user interfaces (operation, visualization, communication)
- Industry-specific performance characteristics with regards to ergonomics (weight, handling, life cycle) and durability (outdoor use, safety, wear)

In close coordination with Sentronic and SensoLogic the operating software had been configured. Based on the theoretical insights of the previous work packages, the discussions with factories using RP-bales and specialists of the PTS, which work in RP-treatment, the concept of the use of a measurement device has been finished.

Application/Economic benefits

The project results will provide a tool to the paper industry for quick and easy quality monitoring in the value chain of RP-paper from acquisition to processing. Based on the experience of the predecessor device PBS a functionally significant increased measuring solution has been placed on a solid hardware basis.

This project has used existing skills in the PTS in the area of NIR spectroscopy, the measurement of recovered paper (bulk and bales) and the process and quality management and will continue to expand. The development of technical equipment in a collaborative basis lead to optimal conditions for achieving the objectives of the project.

Through the design and on the basis of prior knowledge, a procedure with unique features has been developed. Since the project also aims to RP-related and completely new applications, new markets can be opened up and existing can be addressed.

Period of time: 01.11.2009 – 31.01.2012

Remarks

The research project ZIM KF 2037907DB9 has been funded by the German Federal Ministry of Economics and Technology BMWi.

Research institute:

PTS Heidenau
Pirnaer Straße 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leaders:

Petra Behnsen
Tel: 03529/551-685
Fax: 03529/551-899
E-Mail: petra.behnsen@ptspaper.de

Research area: General aims

Production economy // Monitoring and control systems

Key words:

direct printing, wood materials, quality

Title:
Investigating the surface structure influence of coated and uncoated wood materials on the quality of direct printing, and developing a methodology for print quality assessment

Background/Problem area

Laminate flooring is a relatively new product with enormous development potential. Global sales have increased from 1,000m m² in 2003 to approx. 1,250m m² in 2007. A new generation of laminate flooring has been on the market since 2006: PDL – Printed Direct Laminate. PDL décor is printed on the primed wood surface by indirect gravure printing, and then sealed with several protective layers. The print quality of PDL is highly dependent on the quality of the high-density fibre boards (HDF) used as the substrate. Up to now, no measuring methods exist to evaluate the suitability of HDF surfaces for printing. To achieve the desired print quality, manufacturers invest relatively large amounts of time and money in pre-press stages (priming – primer, filler, stock).

Nothing is currently known about well-defined relationships between surface quality and the technological parameters of HDF production (material influence – wood species, binder, hydrophobing agent; process influence – SR freeness, residence time in the cooker, pressure in the refiner, compaction parameters). In addition, the influence of refining on the surface quality has not been fully clarified so far.

Objectives/Research results

Main result of the project is the development of two evaluation procedures for the printability of HDF – one based on a predefined method for determining the roughness parameters of untreated HDF, and one based on NIR spectra for primed HDF.

Conclusions about printability can be drawn from differences between the roughness parameters determined before and after moistening. Relationships could be established between roughness parameters, contact angles and selected density profile characteristics. The method can be used offline for final quality inspection in timber production, and for incoming goods inspection in printing.

Application/Economic benefits

Direct printing of wooden flooring has only recently been used in industry. No previous studies are known regarding the influence of material and process parameters on the surface quality and especially the printability of wood materials. Print quality assessments are mostly made empirically by printing tests. No method is currently available which could be used to control the surface quality of HWP structures. These deficits have enormous market potential for achieving economic effects by product optimization and for increasing the output or manufacturing efficiency of production plants. SME (plant manufacturers, metrology producers, supply firms) in particular will benefit from the project work, helping them to

- further improve the production lines for direct printing of wood materials,
- develop and market measuring devices for new applications or open up new markets,
- adapt new wood materials for other application areas, or
- offer improved coating formulations for various materials.

Period of time: 01.08.2009 -- 30.01.2012

Remarks

The research project IGF 16170 BR has been by the German Federal Ministry of Economics and Technology (BMWi) and performed together with the Institut für Holztechnologie Dresden GmbH (IHD).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Björn Zimmermann
Tel: 03529/551-687
Fax: 03529/551-889
E-Mail: bjoern.zimmermann@ptspaper.de

Research area: General aims

Production economy // Monitoring and control systems

Key words:

MuMAS, paper properties, image analysis, spectral analysis, image fusion, formation, dirt specks

Title:
Multi spectral modular analysis system (MuMAS) for the paper industry

Background/Problem area

Since more than 10 years PTS develops and sells the image analysis system DOMAS (Digital Optical Measurement and Analysis System): It has become the standard system for different quality control tasks in the paper industry. DOMAS uses the image information from scanners and cameras. So it is limited to the visual part of the electro-magnetic spectra. New modern imaging sensors acquire also sample information in other parts of the spectra. The analysis of these images can be used to get additional information about the paper samples.

For the sustainability of DOMAS it is necessary to update the software library (OPTIMAS). Thereby it becomes possible to improve the functionality and to assure the ongoing product support.

The use of new additives and components for the effective paper production with new functions rouses the need for new developed quality control tools that require as less as possible time for sample preparation and evaluation.

Objectives/Research results

The research project shall be an important contribution to the quality control in research, development, production and processing of paper products. Starting from the DOMAS functionality PTS is developing a multi spectral measurement and analysis system.

MuMAS will be a product that helps it's users with additional new and objective evaluations from images of paper samples in different spectral intervals. Further possibilities will be the fusion and evaluation of images from different spectral sensors.

MuMAS will be a modular system and has an open concept. Future research projects about paper properties can use MuMAS as a software basis for efficient researching and as a platform to convert research results into products for users from the paper industry.

During the project the system concept has been implemented. The base of the system consists of normal hardware available at the market (PC, image sensors, cameras) and software (Windows®, Matlab®). The main focus of the project is the development of new analysis algorithms and evaluation modules, e.g. XY-Distribution of paper components (Coating, Pigments, Sizing agents) and (optical not visible) unevenness of coatings. This will be realized with example applications. Furthermore the well known DOMAS-Modules will be implemented with improved functionality on a modern platform.

Application/Economic benefits

The system will be used to control the quality (R&D, production control, handling of complaints) in paper mills, printing plants, felt- and wire production and research institutes. Special modules for textiles, fibre composites, coatings and powders can spread the application area.

The economic relevance for end users lays in the enhancement of information variety about paper qualities and production process, in the reduction of sample preparation and in the shortening of evaluation time. Suppliers of modern imaging sensors get a new trade-specific platform for the sale of their products. And last but not least the product MuMAS will result in sales revenue for the PTS.

Period of time: 01.01.2011 – 31.12.2012

Remarks

The research project IK-MF 100044 is being funded by the Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Björn Zimmermann
Tel: 03529/551-687
Fax: 03529/551-889
E-Mail: bjoern.zimmermann@ptspaper.de

Research area: General aims

Production economy // Monitoring and control systems

Key words:

MuMAS, paper properties, image analysis, formation, THz

Title:
Development of a measurement device for the determination of the formation of papers with higher grammage levels

Background/Problem area

Since more than 10 years PTS develops and sells the image analysis system DOMAS (Digital Optical Measurement and Analysis System): It has become the standard system for different quality control tasks in the paper industry. DOMAS uses the image information from scanners and cameras. So it is limited to the visual part of the electro-magnetic spectra. New modern imaging sensors acquire also sample information in other parts of the spectra. The analysis of these images can be used to get additional information about the paper samples.

A high evenness of the paper mass distribution (fibres and other paper components) defined on small areas is one of the most important paper quality properties during the production process. The technicians name this evenness as formation or cloudiness of the paper.

The formation influences the optical and mechanical properties of the paper. So the paper formation determines important properties for the further processing as stability or printability.

During a former project PTS established a measurement standard for online formation measurement with optical devices. This standard is described in a Zellcheming technical leaflet. This method is also available as a DOMAS modul but it is limited to papers with normal grammage levels. Papers with high grammage levels can only be measured with devices based on radioactive sources.

Objectives/Research results

The research project shall be an important contribution to the quality control in research, development, production and processing of paper products. Starting from the DOMAS functionality PTS is developing a new measurement and analysis system.

The objective of this project is the development of a new measurement device for the formation of papers with a higher grammage level or for mass coloured papers without the problems and restrictions of devices with radioactive sources. The system will acquire the paper information with a THz-sensor. The new system shall do the evaluation faster and with a better resolution than the systems actually available on the market.

Application/Economic benefits

The system will be used to control the paper quality (R&D, production control, handling of complaints) in paper mills, printing plants and research institutes. Because of the avoidance of radio active sources the use of the new system will be easier.

The economic relevance for end users lays in the enhancement of information variety about paper qualities and production process and in the shortening of evaluation time. Suppliers of modern imaging sensors get a new trade-specific platform for the sale of their products. And last but not least the product MuMAS will result in sales revenue for the PTS.

Period of time: 01.01.2012 – 31.12.2013

Remarks

The research project IK-MF 110069 is being funded by the Federal Ministry of Economics and Technology (BMWi).

Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Enrico Pigorsch
Tel: 03529/551-678
Fax: 03529/551-889
E-Mail: enrico.pigorsch@ptspaper.de

Research area: Genaral aims

Production economy // Monitoring and control systems

Key words:

near infrared spectroscopy, chemical imaging, paper analysis

Title:
Application of Near Infrared Chemical Imaging Techniques to Paper Analysis

Background/Problem area

Spectral Imaging, also called Chemical Imaging, is a new emerging analytical technique that integrates conventional imaging and spectroscopy. By combining the chemical selectivity of vibrational spectroscopy with the spatial information of image visualisation, spectral imaging enables a more complete evaluation and description of the composition of material samples. Using this technique the commonly asked analytical questions: what chemical substances are in a sample, how much of each is present and most importantly where are they located, can be answered by only one measurement.

Near infrared (NIR) spectral imaging is especially suited for the analysis of paper and paper board samples. The NIR measurements in reflectance mode are fast, they need no or minimal sample preparation and they are non-destructive. Modern NIR cameras with a broad spectral range (up to 2300 nm) are able to measure large areas of paper samples with high speed and with a high spatial resolution at the range of microns. Thus, this new spectroscopic method meets the two important demands on analytical measurements for the analysis and quality control of large surfaces on paper and board products: 1. direct and fast measurements and 2. selective analysis in high spatial or lateral resolution.

Objectives/Research results

The NIR measurements will be performed by means of a NIR camera KUSTA2.2MSI (LLA Instruments GmbH) having a spectral range from 1229 to 2157 nm. The InGaAs detector of the camera has 320 spatial pixels and 256 spectral pixels resulting in a spectral resolution of about 4 nm. The used frame frequency is 100 Hz. The resulting spatial resolution can be up to 150 µm.

The following subjects will be investigated:

- Determination of resolution and detection limits of NIR Imaging on paper systems
- Development of measurement methods for precise, reproducible and representative analysis results
- Development of two standard analysis methods for
  - Detection, identification and quantification of particles in paper
  - Coating analysis and evaluation (spatial distribution of coating components)
- Development of other chemometric analysis software tools for classification and quantification of components in paper

Application/Economic benefits

The use of the NIR imaging technique for the micro analysis of paper offers new promising possibilities to investigate the distribution of chemical particles and components in paper and to evaluate coatings. Until now, NIR imaging has mostly been used for product and process control in the pharmaceutical industry. Applications in the paper industry still have to be explored and developed.

The imaging technique represents a major enhancement to the capabilities of conventional NIR spectroscopy through the introduction of lateral dimensions with a high density of spectral and chemical information. The use of these information will be the key to the understanding of the bulk chemical and physical properties of paper products and consequently how these parameters influence their intended functionality.

Period of time: 01.01.2012 – 31.12.2013

Remarks

The research project IK-MF 110 110 is being funded by the Federal Ministry of Economics and Technology (BMWi).

QUERSCHNITTS-ZIELE

Forschungsgebiet
Ressourceneinsparung

Forschungsstelle 1:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle 1:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

M. Sc. H. Kröling

Tel: 06151/16-4053
Fax: 06151/16-2454
E-Mail: kroeling@papier.tu-darmstadt.de

Forschungsstelle 2:

Papiertechnische Stiftung (PTS)
Heßstraße 134
80797 München

Internet: www.ptspaper.de

Leiter der Forschungsstelle 2:

Dr. F. Miletzky

Projektleiter:

Dr.-Ing. J. Kappen
Tel: 089/12146-495
Fax: 089/12146-36
E-Mail: J.kappen@ptspaper.de

Forschungsgebiet: Querschnitts-Ziele

Ressourceneinsparung

Schlagworte:

Energieeinsparung, Ressourcen, Altpapierkreislauf

Theme:
Product Design According to Energetic Needs

Background/Problem Area

Paper production is one of the biggest industrial consumer of energy and the natural resources water and wood fibers. Environmental restrictions, prices for biomass and energy impose pressure on the paper industry to reduce the consumption of energy, water and fibers. Since the beginning of papermaking recycling of paper is one measure to reduce fiber consumption. Also recycled fibers consume less energy compared to virgin fibers. Today's highly closed paper recycling circulation with a recovered paper utilization rate of over 70 % results in a wide distribution of fiber properties in RCF pulps.

Objective/Research Results

The aim of this study is to reduce energy and resource consumption in an innovative way, looking at papermaking not as a singular process but as a circulation of fibres between paper production and recycling. A model was developed to compare energy consumption of a fibre during the lifetime in the papermaking process from the chemical/mechanical pulping over paper production to recycling. Fibres were equipped with an energy backpack containing all the energy that was applied to the fibre from pulping till the end of its life in papermaking (reject). An existing model describing the composition of recycled pulp (virgin and recycled fibres of different generations) in the papermaking-recycling circulation was extended with the energy backpack concept.

Fractionation was used to identify the value of single fibre fractions of mechanical pulp, chemical pulp, graphic recycled paper and packaging recycled paper. The fibre fractions were evaluated by their water retention value (WRV), as an indication for the energy required to dry them in the dryer section. The middle fraction in these pulps had a high WRV and was therefore selected to be removed. When the middle fraction of packaging recovered paper or mechanical pulp was removed completely, strength properties (tensile strength, strain, tear index, SCT) improved. The removal of the middle fraction from graphic recovered paper reduced the brightness, while the tensile index was unchanged. The tensile strength of chemical pulp did not change with the removal of the middle fraction, either. Based on this data it might be useful to separate the middle fraction. With a removed middle fraction the basis weight can be reduced without losing strength. Alternative possibilities for a utilization of the biomass of the middle fraction were evaluated.

Multiply packaging paper was formed at the PTS pilot paper machine and a model was developed to describe the tensile index, SCT index and burst index of multiply papers. This model was used to identify optimum fibre recipes for packaging papers. With these optimized recipes, two scenarios for packaging papers were designed. In these scenarios the unwanted middle fibre fraction was removed in A) a single paper mill B) in all paper mills. Earlier described models for paper recycling circulation was used to estimate the impact, if all paper mills remove this fraction. Two equivalent models for graphic recovered paper were evaluated in the same way. The possible reduction in basis weight was sometimes nullified by higher reject amounts, but lower basis weight ensured less energy consumption for drying.

Application / Economic Benefits

The pulp composition can be optimised with the simulation of paper properties according to the requirements in order to lower the basis weight. Looking at paper production and recycling as a circulation savings of fibres and energy can be estimated for the whole paper industry. A combination of paper quality aspects and modelling of the paper material flows can be used for strategic planning and development of paper recycling.

Project Period: 01.01.2010 – 31.03.2012

Remarks

The research project (INFOR 143 R) has been funded by Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.

Forschungsstelle 1:

Fachgebiet Papierfabrikation und
Mechanische Verfahrenstechnik (PMV)
Technische Universität Darmstadt
Alexanderstraße 8
64283 Darmstadt

Internet: www.pmv.tu-darmstadt.de

Leiter der Forschungsstelle 1:

Prof. Dr.-Ing. S. Schabel

Projektleiter:

M.Sc. H. Kröling

Tel: 06151/16-4053
Fax: 06151/16-2454
E-Mail: kroeling@papier.tu-darmstadt.de

Forschungsstelle 2:

Papiertechnische Stiftung (PTS)
Heßstraße 134
80797 München

Internet: www.ptspaper.de

Leiter der Forschungsstelle 2:

Dr. Frank Miletzky

Projektleiter:

Dr.-Ing. J. Kappen
Tel: 089/12146-495
Fax: 089/12146-36
E-Mail: j.kappen@ptspaper.de

Forschungsgebiet: Querschnitts-Ziele

Ressourceneinsparung

Schlagworte:

Energieeinsparung, Ressourcen, Altpapierkreislauf

Theme:
Sustainable Product Design for Packaging Paper

Background/Problem Area

Paper production is one of the biggest industrial consumer of energy and the natural resources water and wood fibers. Environmental restrictions, prices for biomass and energy impose pressure on the paper industry to reduce the consumption of energy, water and fibers. The predecessor project “Product Design According to Energetic Needs” showed that it is possible to identify fibre fractions with a low contribution to the desired paper properties. Removing these fractions can lead to a significant decrease in basis weight, energy consumption and overall fiber consumption. However these results are based on a limited data basis (only one graphical and one packaging recycled paper).

Objective/Research Results

Since the biggest improvements in the predecessor project were achieved with packaging recycled paper this study is focussing on packaging recovered papers. The improvements in paper properties have even bigger impact on packaging material performance when multilayer sheet forming is used.

First step of this study is to expand the finding regarding the low value of the middle fraction to a wider basis and more recovered paper grades that are in use for different packaging grades. Both energetic and quality aspects are considered. As soon as the data are available design principals are developed. These new developed design principals are compared with conventional packaging paper.

The models developed in the preceding project are used to simulate the effects of the removal of specific fractions in both single paper mills and the whole paper industry. Alternative usages for the removed fibre fractions are investigated. The energy backpack concept is applied to the new design principals and conventional packaging paper. From these simulations a strategic optimum for virgin fibre usage, removal of rejects and fibre fractions for alternative use, filler usage an unbleached fibres will be characterized. This optimum will be evaluated in terms of energy and raw material saving, sustainability and carbon food print in agreement with the CEPI Roadmap 2050.

Application/Economic Benefits

Under certain circumstances the removal of specific fibre fractions can lead to a decreased fibre consumption, lower energy consumption, lower basis weight, better paper properties and can supply wooden biomass to thermal or material utilisation. This savings could be even higher if not only a single mill but the whole paper industry is complying to the new developed product designs. In addition to that the implementation of the product design principal can help the paper industry to achieve the sustainability goals of the CEPI Roadmap 2050.

Project Period: 01.05.2012 – 30.04.2013

Remarks

The research project (INFOR. 162 R) is being funded by Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.

Forschungsstelle:

TU Dresden
Professur für Papiertechnik
01069 Dresden

Internet: http://tu-dresden.de/pt

Leiter der Forschungsstelle:

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Dipl.-Ing. Paul-Gerhard Weber
Tel: 0351/463-38025
Fax: 0351/463-38032
E-Mail: paul-gerhard.weber@tu-dresden.de

Forschungsgebiet: Querschnitts-Ziele

Ressourceneinsparung

Schlagworte:

Altpapier, Faserstoffbehandlung, Polymer, Rejekte, stoffliche Verwertung, Reststoffe

Thema:
Entwicklung eines Recyclingverfahrens für Reststoffe aus der Papiererzeugung zur Herstellung von Bioverbundwerkstoffen

Ausgangssituation/Problemstellung

Die deutsche Papierindustrie setzte 2007 bei der Produktion von Papier, Karton und Pappe ca. 16 Mio. t Altpapier ein. Bei der Aufbereitung dieser Menge entstanden 3 Mio. t Rejekte, Deinking- und Bioschlämme. Im Leistungsbericht 2010 des Verbandes der deutschen Papierindustrie sind 1 Mio. t Reststoffe aus Sortier- und Deinking-Prozessen angezeigt.

Dabei handelt es sich überwiegend um papiertechnisch nicht erwünschte oder nicht verwertbare, meist anorganische Komponenten, sowie prozessbedingt um unvermeidliche Verluste an Faserstoffen, also biogene Komponenten. An die Stelle der über viele Jahrzehnte hinweg praktizierten Deponierung solcher Reststoffe ist nach Änderung der Gesetzeslage in jüngerer Zeit überwiegend die thermische Verwertung getreten. Sie stellt jedoch unwiderruflich das Ende des „life-cycle“ solcher, also auch der biogenen Komponenten des Altpapiers dar. Die für die thermische Behandlung anfallenden Entsorgungskosten werden alleine von der Papierindustrie getragen. Aus dieser Situation resultiert das Bestreben der Branche, für eine zusätzliche Wertschöpfung neue Verwertungswege für diese Reststoffe zu erschließen.

Bei der Herstellung der Bioverbundwerkstoffe in der Holzwerkstoff- und Kunststoffindustrie werden die Holzfasern mit den Kunststoffen und weiteren Additiven gemischt und compoundiert. Dabei werden die vorteilhaften Werkstoffeigenschaften von Holzfaserwerkstoffen (hohe Steifigkeit, leichte Bearbeitbarkeit, relativ preiswerter und nachwachsender Rohstoff) mit denen der Kunststoffe (effiziente Formgebungsverfahren, hohe Feuchtigkeitsresistenz) kombiniert. Die dabei entstehenden Granulate oder Pellets haben den Vorteil, dass sie bei der Weiterverarbeitung in Extrusions- und Spritzgießmaschinen leicht förder- und dosierbar sind.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsvorhabens ist die Entwicklung von Aufbereitungs- und Verarbeitungsverfahren, die es zulassen, faserhaltige Reststoffe der Papiererzeugung für die Herstellung leistungsfähiger, faserverstärkter Kunststoffverbundwerkstoffe zu nutzen. Sie sollen dabei als Substitut für Holz eingesetzt werden, das zu diesem Zweck mit erheblichem Energieaufwand zerkleinert werden muss.

Diese Reststoffe der Papiererzeugung könnten eine preiswerte und in jedem Fall energetisch attraktive Alternative zu den derzeit eingesetzten Holzmehl bzw. den Holzfasern für WPC darstellen. Die möglichen Kosteneinsparungen sind jedoch lediglich ein Aspekt der Ausgangsbetrachtung. Im Rahmen des Projektes sollen darüber hinaus auch umfassend mögliche Reststoffe als Ausgangsmaterial charakterisiert werden. Neben diesen Reststoffeigenschaften sind deren Verarbeitbarkeit mit Polymeren und die Eigenschaften des neuen Werkstoffes zu prüfen und zu bewerten.

Um die oben definierten Forschungsziele zu erreichen, werden folgende wissenschaftlich-technologischen Forschungsergebnisse angestrebt:

- Bestimmung des Verwertungspotenzials von Reststoffen aus der Papiererzeugung
- Entwicklung eines Aufbereitungsverfahrens für die Reststoffe aus der Papierzeugung
- Entwicklung eines Verarbeitungsverfahrens für die Herstellung von Bioverbundwerkstoffen auf der Basis der aufbereiteten Reststoffe
- Charakterisierung des Eigenschaftspotenzials der erzeugten Bioverbundwerkstoffe
- Bewertung der Nachhaltigkeit der aus den oben genannten Bioverbundwerkstoffen erzeugten Produkte und der entwickelten Aufbereitungsverfahren

Anwendungen/Wirtschaftliche Bedeutung

Der wirtschaftliche Effekt der angestrebten Forschungsergebnisse wird branchenübergreifend bei kleinen und mittelständischen Unternehmen der Papier- und Kunststoffindustrie, im Bauwesen und der Möbelindustrie sowie bei Herstellern von Packmitteln und Büroartikeln erwartet. Es werden durch Erweiterung des Produktportfolios neue Märkte geschaffen.

Durch Materialsubstitutionen können Reststoffe aus der Papierindustrie als Wertstoff genutzt werden, wobei die erwartete Wertschöpfung 10-mal höher ist als bei der energetischen Nutzung. Durch die Bindung von CO2 wird die Umwelt entlastet.

Bearbeitungszeitraum: 01.04.2012 − 31.03.2014

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Das IGF-Vorhaben 17434 BR der Forschungsvereinigung Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V., Adenauerallee 55, 53113 Bonn wurde über die AiF im Rahmen des Programms zur Förderung der industriellen Gemeinschaftsforschung und -entwicklung (IGF) vom Bundesministerium für Wirtschaft und Technologie aufgrund eines Beschlusses des Deutschen Bundestages gefördert. Das Projekt wird in Kooperation mit der Professur für Holz- und Faserwerkstofftechnik der TU Dresden sowie der Professur Strukturleichtbau und Kunststoffverarbeitung der TU Chemnitz bearbeitet.

Forschungsstelle:

Technische Universität Dresden
Fakultät Maschinenwesen
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/ihp

Leiter der Forschungsstelle (Fst.):

Prof. Dr.-Ing. Harald Großmann

Projektleiter:

Prof. Dr.-Ing. Harald Großmann (Fst. TUD)

Tel: 0351/463-38033
Fax: 0351/463-38032
E-Mail: harald.grossmann@tu-dresden.de

Forschungsgebiet: Produkt-Ziele

Querschnittsziele // Ressourceneinsparung

Schlagworte:

Altpapiererfassung, Altpapierkreislauf

Thema:
Eco Design for the Enhancement of Central Europe Paper Based Products Recycling Loop – EcoPaperLoop

Ausgangssituation/Problemstellung

Papier stammt aus natürlichen, erneuerbaren Quellen. Damit ist Altpapier ein kostbarer Rohstoff – und sollte weder als Abfall betrachtet noch behandelt, sondern gesammelt und recycelt werden. Ungeeignete Sammelsysteme können die für das Recycling erfassten Mengen jedoch drastisch reduzieren; und durch ungeeignete Gestaltung eines Druckerzeugnisses oder einer Verpackung können diese nutzlos oder sogar schädlich für den Recyclingprozess werden.

In Zentraleuropa ist Altpapier bereits ein wichtiger Rohstoff. Die Recyclingquoten sind jedoch sehr unterschiedlich in den einzelnen Regionen. In vielen Mitgliedstaaten werden riesige Abfallmengen noch immer auf Deponien abgelagert, und dies, obwohl durchaus bessere Alternativen existieren. Wertvolle Ressourcen werden vergraben, potenzielle wirtschaftliche Chancen werden vertan. Da Altpapier nicht nur lokal in dem Land recycelt wird, in dem es auch produziert wurde, müssen grundlegende Voraussetzungen wie Ökodesign und ökologisch sinnvolle Sammelkonzepte auch über die Staatsgrenzen hinaus entwickelt werden, um die Nachhaltigkeit des Papierkreislaufs zu verbessern.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist die Verbesserung der Qualität des gesammelten Altpapiers. Dabei ist es von besonderer Bedeutung, dass alle Mitgliedern der Papierkette – Verleger, Drucker, Designer, Anwender von Verpackungen und Kunden von Druckereien genauso wie die Weiterverarbeiter von Papier und Pappe oder die lokalen Behörden und Institutionen – in den Prozess einbezogen werden und gemeinsam an der Optimierung der Altpapiersammelsysteme arbeiten.

Einige Mitgliedstaaten waren beim Ausstieg aus der Abfalldeponierung bereits sehr erfolgreich und haben diese praktisch abgeschafft. Trotzdem bleibt die Verbesserung der Abfallvermeidung und die Lösung des Problems der Überkapazität von Müllverbrennungsanlagen eine Herausforderung, die die Abfallverwertung behindern und Abfalleinfuhren zur Beschaffung von Verbrennungsmaterial für die Feuerungsanlagen erforderlich machen können.

Das Projekt beinhaltet u. a. folgende Teilziele: die Bewertung der Rezyklierbarkeit von Papierprodukten, die Verbesserung der Sammelstrategien und die Evaluierung der Nachhaltigkeit des Designs von Papierprodukten.

Anwendungen/Wirtschaftliche Bedeutung

Durch die Verbesserung der Wiederverwertungsmöglichkeiten der Papierprodukte nach ihrem Gebrauch leistet das Projekt EcoPaperLoop einen Beitrag, die Ziele der Lissabon-Strategie für nachhaltige Produktion und Verbrauch (SCP/SIP) zu erreichen. Dies beinhaltet einen schonenderen Umgang mit natürlichen Ressourcen durch eine Senkung des Verbrauches von Energie und Wasser bei der Herstellung neuer Papierprodukte. Gleichzeitig wird organischer Kohlenstoff durch das Recycling eines erneuerbaren Rohstoffs dauerhaft in den Papierprodukten gespeichert. Ziel der im Sommer 2001 beschlossenen EU-Strategie für nachhaltige Entwicklung ist die Verbesserung der Lebensqualität für alle, das heißt sowohl für die heutige als auch für künftige Generationen. Es soll damit sichergestellt werden, dass Wirtschaftswachstum, Umweltschutz und soziale Integration als Einheit behandelt werden.

Bearbeitungszeitraum: 01.09.2012 – 31.12.2014

Bemerkungen

Das Central Europe Projekt EcoPaperLoop wird vom Europäischen Fonds für regionale Entwicklung der Europäischen Union (ERDF) und den jeweiligen lokalen Projektpartnern finanziert. Das Projekt wird zusammen mit Innovhub-Stazioni Sperimentali per l'Industria (Innovhub-SSI, Projektleitung), der Paper Technology Consulting GmbH (PTC), der TU Darmstadt (PMV), dem Polish Packaging Research and Development Centre (COBRO), dem Pulp and Paper Institute Ljubljana (ICP), der University of Ljubljana (UL), der University of West Hungary, der Faculty of Wood Sciences, Paper Research Institute (UWH/FWS/PRI), dem National Consortium for the Recovery and Recycling of Cellulose-based Packaging (COMIECO) und der Lombardy Region (Regione Lombardia, Italy) bearbeitet. Das Projekt wird weiterhin von folgenden Organisationen unterstützt: Municipality of Dunaújváros, Hungary; Milano Chamber of Commerce, Italy; Confederation of European Paper Industry (CEPI), Europe; Assocarta, Italy; Intergraf, Europe; Università di Milano Bicocca, Italy; VDP, Germany; Austria Papier Recycling, Austria; und der International Association of the Deinking Industry (INGEDE).

Forschungsstelle 1:

TU Dresden
Fakultät Maschinenwesen
Institut für Holz- und Papiertechnik
Professur für Papiertechnik
01062 Dresden

Internet: http://tu-dresden.de/ihp

Leiter der Forschungsstelle:

Prof. Dr.-Ing. H. Großmann

Projektleiter:

Prof. Dr.-Ing. Harald Großmann

Tel: 0351/463-38033
Fax: 0351/463-38032
E-Mail: harald.grossmann@tu-dresden.de

Forschungsstelle 2:

TU Dresden
Fakultät Forst-, Geo- und Hydrowissenschaften
Institut für Pflanzen- und Holzchemie
Pienner Strasse
1901737 Tharandt

Internet: http://forst.tu-dresden.de/Chemie

Leiter der Forschungsstelle:

Prof. Dr. rer. nat. habil. Steffen Fischer

Projektleiter:

Prof. Dr. rer. nat. habil. Steffen Fischer
Dr.-Ing. Christian Bäurich

Tel: 035203/38-31243
Fax: 035203/38-31201
E-Mail: fischerk@forst.tu-dresden.de

Forschungsgebiet: Querschnitts-Ziele

Ressourceneinsparung

Schlagworte:

Innovatives Herstellungsverfahren; Ressourcenschonung Energieeffizienz; Elektronenbestrahlung

Thema:
Elektronenbestrahlung von Holzhackschnitzeln zur energieeffizienten Herstellung von Holzstoff in der Papierproduktion

Ausgangssituation/Problemstellung

Holzstoffe mit vergleichsweise hohen Festigkeiten und guten optischen Eigenschaften sind vor allem für Dünndruckpapiere geeignet. Diese Vorteile, verbunden mit der hohen Ausbeute von Holzstoffen machen Holzstoffe zu attraktiven Primärrohstoffen vor allem für Zeitungs- und Magazinpapiere. Der Einsparung von Holzressourcen durch die Nutzung Hochausbeutefaserstoffe steht jedoch sowohl der hohe Energiebedarf als auch der hohe und steigende Energiepreis entgegen. Für stark fibrillierte Holzstoffe wird ein spezifischer Energiebedarf von mindestens 2 MWh/t benötigt. Mit dem hier untersuchten ETMP-Verfahren wird eine Netto-Energieeinsparung von 30 % bis 50 % angestrebt. Dies wird durch eine Bestrahlungsbehandlung der Holzhackschnitzel in Kombination mit einer Imprägnierung erreicht. Mit der Imprägnierung vor der Hackschnitzelbestrahlung soll zusätzlich eine gleichbleibende oder verbesserte Faserqualität erzielt werden.

Forschungsziel/Forschungsergebnis

Das Projekt beweist sehr gut die Möglichkeit einer Implementierung von ETMP in eine bestehende TMP-Anlage. Mit einer Energieeinsparung von 30 % bei der TMP-Erzeugung würde die Papierindustrie einen wichtigen Schritt für die von der Politik geforderten ehrgeizigen Energieziele beitragen.

Vorbereitung zur batchweisen Bestrahlung

Die Eigenschaften des Holzstoffs nach dem Großversuch sind mit unbehandelten Stoffen vergleichbar. Das hergestellte Papier konnte ohne Verlust in der Produktionsqualität verarbeitet und verkauft werden. Der Drucker konnte das Zeitungspapier erfolgreich bedrucken und seinerseits auf den Markt bringen.

Wirtschaftliche Bedeutung

Durch den Einsatz des Verfahrens mit dem um ca. 100 GWh geringeren Energiebedarf in einer Papierfabrik werden die Emissionen von CO_2, das als Treibhausgas zur Erderwärmung beiträgt, um jährlich ca. 51.000 Tonnen reduziert. Der Betreiber eine TMP-Anlage erhält mit dem Bau eines Bestrahlers die Möglichkeit bei einer durchschnittlichen TMP-Anlage ca. 7 Mill. €/a an Betriebskosten zu sparen. Bei einer Investition von 10 Mill. € für den Bau einer solchen Anlage ergibt sich ein sehr günstige Investitionsgrundlage. Weitere Einsparungen sind darüber hinaus bei der Bleiche möglich, da während der Bestrahlung Ozon produziert wird, welches ein hervorragendes Bleichmittel darstellt und auch die Abwärme aus dem Kühlkreislauf des Bestrahlers kann zur Aufheizung des Prozesskreislaufes einer Papierfabrik genutzt werden. Die Bezifferung solcher weiteren Einsparungen ist allerdings erst in weiteren angestrebten Langzeitversuchen möglich.

Das Ziel ist es, ETMP in die Praxis einzuführen und dafür werden Mut und Investitionen seitens der Industrie dringend benötigt. Erste Verhandlungen verlaufen positiv, es fehlt aber noch ein großer Schritt zur Realisierung einer ersten Demonstratoranlage direkt in der Papierindustrie.

Bearbeitungszeitraum: 02.02.2011 − 31.05.2012

Bemerkungen

Das Forschungsprojekt DBU Nr. 28721 wird aus Mitteln der Deutschen Bundesstiftung Umwelt finanziert und in Kooperation mit der Gamma-Service Produktbestrahlung GmbH (Synergy Health) durchgeführt.

Research Institute:

PTS München
Heßstr. 134
80797Müchen

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr. Wolfram Dietz
Tel: 089/12146-279
Fax: 089/12146-36
E-Mail: wolfram.dietz@ptspaper.de

Research area: General aims

Resource saving

Key words:

Deinking sludge, waste recovery, integrated production concepts, calcium carbonate

Title:
DIP-RCC – Experimental development of a new production process for calcium carbonate and metakaolin as raw materials for the paper and cement industry by recovery of deinking sludge combustion residues

Background/Problem area

Papermills produce large quantities of sludge containing organic matter and minerals such as calcium carbonate and kaolin. This sludge is usually incinerated to produce energy and to reduce the quantity of waste to be disposed of. The resulting ash contains a mixture of calcium oxide, calcium carbonate and other inorganic substances.

Objectives/Research results

Objective of the project is a new process for the coupled production of recovered calcium carbonate (RCC) and a by-product. RCC will serve as mineral for the paper production, the by-product as cement constituent. Base materials are combustion residues (ashes) from paper industry deinking sludges. By chemically binding CO_2 in the RCC product the process contributes to the efficient use of resources.

The process chain comprises calcination, precipitation and purification steps. The concept was confirmed on a laboratory scale. Incineration and calcination conditions were investigated to maximize the conversion of calcium carbonate while safeguarding product quality. Further investigations focus on process development for various qualities of paper sludge ashes, experimental production on a pilot scale, use of RCC as paper filler and as coating pigment and use of the by-product.

Application/Economic benefits

The production of a raw material from a material currently classed as waste and its reuse within paper industry will improve the resource and economic efficiency of the paper industry, just as external marketing of RCC and the by-product offers an additional source of income.

Period of time: 01.09.2010 – 31.10.2013

Remarks

The research project ZIM-KF 2037909WZ0 is being funded by the German Federal Ministry of Economics and Technology BMWi and is carried out by CalciTech Synthetic Minerals Europe Ltd. in collaboration with PTS, Verein Deutscher Zementwerke e.V. and Stora Enso Maxau GmbH & Co.KG.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Reinhard Sangl
Tel: 089/12146-496
Fax: 089/12146-36
E-Mail: reinhard.sangl@ptspaper.de

Research area: General aims

Resource savings

Key words:

SC, LWC, construction products, efficiency, fractionation and layering

Title:
Boosting raw material and energy efficiency using advanced sheet structure design and fibre modifications, BOOSTEFF

Background/Problem area

The vision of BoostEff is to develop new innovative manufacturing concepts for wood-fibre based products giving a significant reduction in environmental footprint. The targeted products, coated and uncoated printing paper as well as construction board, are important commodities that fulfil a lot of needs for the European society. Consumption of energy and other natural resources for the manufacturing processes need to be reduced considerably.

Objectives/Research results

The objective of the project is to demonstrate significant reductions in energy and raw material consumption in pilot- and mill-scale. In order to achieve this, the project is based on the focused development of three demonstrator platforms. These platforms will, at the end of the project, describe the future manufacturing processes for the selected products, from wood raw material to final product. The manufacturing concepts developed with a strong industrial focus will in detail describe the whole production chain as well as the environmental and economic impact. Based on the principles of fractionation and layering, it is planned to develop new tailor-made products.

In order to clearly demonstrate the impact and industrial applicability the Future Manufacturing Concepts are based on existing production units of the industrial partners and deal with the production of three commodities in European society:

- Uncoated magazine paper. Supercalendered (SC) paper made primarily by virgin fibres is the focus in this platform. By using the new process concepts, tailor-made paper can be manufactured with the desired mechanical, optical and printing proper-ties but with a lower use of fibres. This will allow production using significantly less energy and fibre input but also the possibility to compete with higher-quality paper grades.
- Coated magazine paper. In focus are light-weight coated (LWC) paper made by primarily recycled fibres. The concept is to replace the energy demanding virgin fibres that are currently used, with recycled fibres. By using the process concept of layering applied to recycled deinked pulp the coating strategy can be changed in order to reduce the environmental footprint in this paper grade. The layering concept will also be applied for the coating process, where curtain coating provides ample opportunities.
- Construction products. The focus will be to develop the manufacturing concepts primarily in the field of construction board. As a difference to the to the paper industry the technologies available for implementing the targeted process concepts are less developed. Thus one of the objectives is to feed process concepts and technology from the paper industry into the construction board industry, which will allow a reduction in energy consumption and environmental footprint. Another objective is to utilise excess material coming from the manufacturing of recycled paper products in construction products, mainly construction board but also other construction products.

The manufacturing concepts are approved in lab- and pilot scale and will be demonstrated in practical scale.

Application/Economic benefits

The individual goal for each Future Manufacturing Concept is to demonstrate that it is possible to reduce the environmental footprint and increase the competitiveness by achieving a significant

- energy efficiency increase;
- reduction of emissions of CO2 and other Green House Gases (GHG);
- raw material savings;
- operating cost reduction or productivity increase.

Period of time: 01.06.2010 – 30.05.2013

Remarks

The integrated research project BOOSTEFF (EU-FP7-NMP-246049) is being funded by the European Commission covering ten Subprojects. PTS tasks concentrate on target monitoring and optimisation (WP3), SC-Paper (WP 4 and 5), LWC Paper (WP 6 and 7) and environmental impact and recyclability (WP 10). Industrial partners: Stora Enso (SE and DE), Holmen (ES), Kadant (FR), Noss (SE) and Tdp (FR). Bangor University (UK) is performing research as a university partner and Innventia (SE), CTP (FR), Itene (ES) and FCBA (FR) participate as research institutions.

Research Institute:

PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Svenja Bierbaum
Tel: 089/12146-144
Fax: 089/12146-36
E-Mail: Svenja.bierbaum@ptspaper.de

Research area: General aims

Resource saving

Key words:

AOP, ozone, UV, ultrasound, peroxide, reuse, water saving

Title:
Reducing fresh water consumption in high water volume consuming industries by recycling AOP-treated effluents

Background/Problem area

Advanced waste water treatment (WWT) by ozone has a lot of advantages compared to other technologies and very good results and experiences were and are achieved. Reducing the organic load by up to 90 % by combining with subsequent biological low load stage is possible, reduction of 50 % and below is economically worthwhile. To make the advantages of advanced WWT by ozone attractive to SMEs, further cost cutting is needed. This could be achieved by combination of ozone with H2O2, UV or ultrasound (US). In regions with a lack of fresh water new water sources are required. Up to now no proper solution is available. The (re-)use of AOP-treated effluents instead of (only) fresh water could solve this problem and would lead to considerable cost reductions.

Objectives/Research results

The project aims are making available new water sources for high water volume consuming industries like pulp and paper and textile by (re-)using treated effluents of pulp and paper, textile and food industry as well as municipal waste water. Key to the (re-)use is to improve the efficiency of AOP-treatment to ensure optimum water quality and to show the possible use of the treated water. With waste water from two selected paper mills the following suitable combinations of AOP-technologies have been chosen to perform laboratory trials: O3, UV, US, O3 + H2O2, O3 + UV, UV + H2O2, US + UV, UV + O3 + H2O2. Selected combinations of AOP treatments were chosen to perform biodegradability trials (Zahn-Wellens-Test) to find out, which overall treatment efficiency can be achieved. Furthermore design and development of simulation models of both mills is in progress to be able to predict quality of process water by using AOP treated effluents from other industries.

O3 could reduce COD-concentration from 160 mg/l down to 60 mg/l (64% reduction) by 1.2 g O3/g CSB0. Furthermore O3 had a very strong decolourisation effect and reduced the colour at 436 nm from 11 m-1 to 1.0 m-1. The BOD5/COD ratio of the effluent prior to ozone treatment was about 0.01 and was increased by ozone treatment to 0.28. Additional H2O2 input could not improve COD degradation in comparison to O3 alone. By 1.0 g O3/g CSB0 and 0.2 g H2O2/ g CSB0 41% COD degradation could be achieved. Colour at 436 nm was reduced from 14 m-1 to 2.3 m-1 and BOD5/COD ratio raised to 0.23. UV radiation had a small effect on COD elimination: UV energy input of 120 kWh/m³ reduced the COD by 7%. Additional input of 0.02 g H2O2/g CSB0 showed a small increase of COD degradation up to 15%. Increasing the amount of H2O2 up to 0.2 g H2O2/g CSB0 the ratio of BOD5/COD could be doubled in comparison to UV alone. Triple combination of 1.0 g O3/g CSB0, 0.75 g H2O2/ g CSB0 and 120 kWh/m³ UV energy reached 45% COD reduction and a maximum BOD5/COD ratio of 0.23.

Toxicity tests (fish egg, algae, daphnia and luminous bacteria) have been performed with untreated and AOP-treated waste water; no toxic effects of the waste water and of the selected AOP-techniques were detected. Based on achieved COD degradation rates specific operation costs were calculated (excl. costs for machine investment, depreciation, maintenance etc.). From all tested combinations O3-treatment was the most cost effective technique.

Based on results gained from AOP laboratory trials for selected combinations further aerobic treatment tests (Zahn-Wellens-Test) were performed. The highest achieved values for the first set of tested treatment combinations showed for 0.8 g O3/g CSB0 + 0.2 g H2O2/g CSB0 DOC elimination of 59% after 5 test days which is the reachable performance for industrial scale plants.

Application/Economic benefits

The project expects to have the following direct economic effects for high water-demand industry. Firstly, application of new solutions for advanced effluent treatment will decrease the costs of direct abstraction of fresh water or water from public water supply and will reduce the costs for discharging of untreated effluent. As the project also aims to increase the efficiency of the treatment, considerable energy savings are expected. Use of treated effluent will also lower the risk of unexpected cut-downs in supply of drinking water due to failures in the distribution system and will also lower the pressure on drinking water withdrawals from public water supply. The technology aims to find end-users among enterprises in the target group especially in water-stressed countries and in countries with stricter environmental legislation. Many European companies including SMEs are involved in the industrial sector related to water. These activities follow the Directive concerning integrated pollution and prevention control that addresses industrial installations with high pollution potential. In industry, the total environmental expenditures (as % of the total expenditures) within manufacturing to all domains (air, wastewater, waste and non-core domains) vary from 0.1 to 1.5%; for the target industry (food, pulp & paper and textile) between 0.2 and 0.4%. In this respect, there is a considerable market for companies to provide services and applications for wastewater treatment in industry considering the fact that pollution treatment investments still prevail to pollution prevention investments in most EU countries

Period of time: 01.01.2011 – 31.12.2012

Remarks

The research project IGF CORNET 46 is being funded by the Federal Ministry of Economics and Technology (BMWi).

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