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

Forschungsprojekte 2011
im Überblick

AiF Mitglied

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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 2011 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 (AiF-Projekte).

Folgende Institute stellen Beiträge aus ihrer Forschungsarbeit vor:

- Papiertechnische Stiftung (PTS)
    - Papiertechnisches Institut (PTI), München
    - Institut für Zellstoff und Papier (IZP), Heidenau
- Technische Universität Darmstadt
    - Fachgebiet Papierfabrikation und Mechanische Verfahrenstechnik
- Technische Universität Dresden
    - Professur für Papiertechnik
    - Institut für Holz- und Pflanzenchemie, Technische Universität Dresden
    - Professur für Holz- und Faserwerkstofftechnik
    - GWT-TUD GmbH
- Universität Hamburg
    - Zentrum Holzwirtschaft
        - Chemische Holztechnologie
- Hochschule München
  Verfahrenstechnik Papier und Verpackung
- FH Osnabrück
  Fakultät Ingenieurwissenschaft und Informatik

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 2011 wurden Kurzbeschreibungen von insgesamt 104 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 2011 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

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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

Wood is a material of very wide use in Europe; it is actually used in large quantities in many different sectors and is a part of our everyday lives. Therefore, in the waste amounts coming from end of life products, there is a significant amount of wood based materials. Recovered wood includes all kinds of wooden material available at the end of its use as a wooden product. The main sources of 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. The fluctuation of the prices of fossil fuels, the European and member states policies in favour of the development of renewable energies and namely of biomass energy are strongly supporting the development of numerous large energy production equipments, either based on the usual combustion of solid wood fuel or producing liquid biomass fuels by bio-technical conversion. 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.

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

Project period: 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.

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Forschungsgebiet: Produkt-Ziele

Rohstoffe // Landwirtschaftliche Nutzpflanzen

Schlagworte:

Additive, Pektin, CMC, Festigkeit

Thema:
Neue Faser-Pektin-Compounds als Additiv-Koppler und zur Festigkeitssteigerung von Papier

Ausgangssituation/Problemstellung

Die Bereitstellung eines kostengünstigen, nachwachsenden und nachhaltig verfügbaren Additivs auf Basis von Zuckerrübenpektin, welches die Eigenschaften verschiedener Additive zur Erhöhung der Papierfestigkeit kombiniert, bietet Wettbewerbsvorteile für alle an der Wertschöpfungskette beteiligten, zuliefernden und verarbeitenden Industrien, die meist mittelständisch geprägt sind. Wenn es gelingt, Rübenpektin so zu isolieren, dass damit die Trockenfestigkeit von Papier gesteigert wird und es gleichzeitig als Additivkoppler zur Verfügung steht, sollten Effekte und Preise ermöglicht werden, wie sie durch Kombination von klassischen Trockenfestmitteln, wie Stärke und CMC kaum erreichbar sind.

Forschungsziel/Forschungsergebnis

Das Projekt verfolgte das Ziel, Pektine der pflanzlichen Zellwand so aus Rückständen der Zuckererzeugung zu gewinnen, dass diese im Verbund mit cellulosischen Papierfaserstoffen zur Festigkeitssteigerung im Papier und als Additiv-Koppler nutzbar sind (Faser-Pektin-Compounds).

In ersten Versuchen wurden kommerziell zur Verfügung stehende Pektine (Apfel-, Citrus- und Zuckerrübenpektine) sowie am IHPC extrahiertes Zuckerrübenpektin (sauer, basisch und neutral extrahiert) untersucht. Es zeigte sich, dass durch die Zugabe von 1,5 % Pektin und verschiedenen Retentionsmitteln keine signifikanten Festigkeitssteigerungen erreicht werden konnten. Auch eine Anlagerung analog wie bei CMC durch Zugabe von Ca2+ - Ionen konnte keine Erhöhung erzielen.

Deshalb erfolgte eine Beschichtung der Fasern mit kationischer Stärke (Polyelektrolyt-Beschichtung) um die Abstoßungskräfte zwischen anionischer Faser und Pektin zu überwinden. Anschließend wurde blattweise Pektin und Retentionsmittel zugegeben. Hier zeigte sich, dass bereits durch die Stärkebeschichtung eine Festigkeitssteigerung von 10 Nm/g erreicht wurde. Durch die Zugabe von Pektin konnte der Tensile-Index um weitere 3 bis 15 % erhöht werden.

Am IHPC wurden weitere Pektine (kommerziell erzeugte Pektine) unter Integration von Modifizierungsschritten (Amidierung, Kationisierung) erzeugt. Durch die Amidierung der Pektine konnten bisher die größten Festigkeitssteigerungen von ca. 37 % erzielt werden. Diese Vorgehensweise wurde auf die am IHPC sauer extrahierten Pektine und anschließender Amidierung übertragen.

Es erfolgten Vergleichsuntersuchungen zu kationischer Stärke und der Aplikation von amidierten Pektin an verschiedenen Faserstoffen. Stärke wirkt bekanntermaßen als Trockenfestmittel und verklebt die Faserberührungspunkte. Durch die Einführung zusätzlicher funktionellen Gruppen wurde die Anzahl und Stärke der Faser-Faser-Bindungen erhöht, was sich positiv auf die Zugfestigkeit auswirkte. Durch die Polyelektrolytbeschichtung wurde die Faseroberfläche mit kationischen Ladungen versehen, was die coulombschen Abstoßungskräfte gegenüber Pektin senkte und so die Anlagerungsbedingungen verbesserte. Durch die Kombination aus Stärkebeschichtung und Applikation des Pektins in die Faserstruktur konnte eine Steigerung der Festigkeit um bis zu 20 % erzielt werden. Diese Steigerung konnte aber nicht die Festigkeiten durch 1,5 % Stärkezugabe in der Masse erreichen.

Anwendung/Wirtschaftliche Bedeutung

Folgende wirtschaftliche Ergebnisse werden angestrebt: Kostengünstige Isolierung von technischen Pektinen aus Zuckerrübenrückständen mit Integration des Modifizierungsschrittes in den Gewinnungsprozess. Nutzung der Zuckerrüben-Restcellulose (des Zuckerrübenparenchyms) in der Papiererzeugung, eventuell in Kombination mit dem Pektin als Faserstoffkomponente. Effektivere Methode der Festigkeitssteigerung in der Papierherstellung, die einem Vergleich mit eingeführten Additiven standhält und Kostenvorteile (gegenüber CMC-Stärke-Kombinationen) bietet. Als Koppelprodukt zum Zucker sollten Kostenvorteile erschlossen werden. Bereitstellen eines effektiven, nachhaltig verfügbaren und Festigkeit steigernden Additivs, das vom Rohölpreis abgekoppelt ist. Sicherung des Bestandes funktionierender Wertschöpfungsketten hinsichtlich des Standort- und Arbeitsplatzerhaltes: Komplette, wertschöpfende, stoffliche Verwertung der Zuckerrübe, branchenübergreifend vom Zuckerrübenbauer bis zum Papierhersteller, Verbesserung der Wettbewerbsfähigkeit erzeugter Papiersortimente durch Einsparung teurer Faserrohstoffe und von Energie, Realisierung hoher Füllstoffgehalte und Einsatzsteigerung rezyklierter Faserstoffe. Sicherung von Papier erzeugenden Standorten durch wettbewerbsfähige Papiersortimente, Beitrag zur Absicherung von Nachfrage bei den zuliefernden Wertschöpfungsketten des Maschinenbaus und der chemischen Industrie sowie der Papier verarbeitenden, insbesondere der Druckindustrie.

Bearbeitungszeitraum: 01.07.2009 – 30.06.2011

Bemerkungen

Das Forschungsvorhaben IGF 16137 wurde im Rahmen des ZUTECH-Programms aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert und in Zusammenarbeit mit TU Dresden, Institut für Holz- und Pflanzenchemie, durchgeführt.

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Forschungsgebiet: Produkt-Ziele

Rohstoffe // Altpapier

Schlagworte:

Rezyklierbarkeit, Inhaltsstoffe, Lackierung, Lebensmittel-kontaktpapier

Thema:
Recyclinggerechte und gesundheitsverträgliche Gestaltung von lackierten Papier- und Verpackungsprodukten zur gesicherten Altpapier-Nutzung für Lebensmittel-Kontaktpapiere

Ausgangssituation/Problemstellung

Papier und Karton sind aufgrund ihrer vielfältigen technischen Eigenschaften aus der Lebensmittelverpackung nicht wegzudenken. An die erzeugten Papiere, Karton und Pappen auf Recyclingbasis für den Lebensmittelbereich werden besondere Anforderungen gestellt. Neben den funktionellen Eigenschaften müssen diese auch sicher für die Lebensmittel und Verbraucher sein.

Da Altpapier die wichtigste Rohstoffquelle der Papierindustrie, auch für Lebensmittelkontaktpapiere ist, ist neben einer recyclinggerechten auch die umweltverträgliche Gestaltung von Papier/Kartonprodukten unter dem Gesichtspunkt der Nachhaltigkeit und des Recyclingkreislaufs von großer Bedeutung.

Um Entwicklungen in nachhaltige Produkte zu initiieren, ist es erforderlich, ein Verfahren zur Prüfung und Bewertung zur Verfügung zu haben. Nur mit Hilfe eines Bewertungskonzeptes können Entwicklungen von recyclinggerechten und umweltverträglichen Papierprodukten verfolgt und bewertet werden.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist die Erarbeitung von Vorgaben für die recyclinggerechte und umweltverträgliche Gestaltung von Papier- und Verpackungsprodukten unter besonderer Berücksichtigung der Lackierungen (UV-Lacke, Dispersionslacke, Öldrucklacke).

Weiteres Ziel ist die Festlegung und Erweiterung der Rezyklierbarkeitsbewertung von Papier- und Verpackungsprodukten unter Berücksichtigung kritischer Inhaltsstoffe.

Anwendung/Wirtschaftliche Bedeutung

Das Forschungsprojekt verfolgt den prinzipiellen Ansatz, die Methode zur Rezyklierbarkeitsbewertung von Papier- und Verpackungsprodukten um kritische Inhaltsstoffe zu erweitern. Dies wird zu einer signifikanten Ausweitung grundlegender Erkenntnisse über die recyclinggerechte und gesundheitsverträgliche Gestaltung von Papier- und Verpackungsprodukten führen. Auf diese Weise wird die nachhaltige Gestaltung von Papier- und Verpackungsprodukten voran getrieben, um so den Herstellern von Lebensmittelverpackungen bestehende Märkte zu sichern.

Bearbeitungszeitraum: 01.07.2011 – 30.06.2013

Bemerkungen

Das Forschungsvorhaben IK-MF 110029 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Forschungsgebiet: Produkt-Ziele

Rohstoffe // Altpapier

Schlagworte:

Altpapier, Sortierung, Bewertung, NIR Spectral Imaging

Thema:
Entwicklung NIR-basierter Klassifikationsalgorithmen und quantitativer Bestimmungsmethoden für die Sortierung und Bewertung von Altpapier

Ausgangssituation/Problemstellung

Der steigende Altpapierbedarf und die damit einhergehende umfassendere Erfassung stellen immer wieder neue Anforderungen an die Altpapierqualität. So zeigen Untersuchungen, dass mit der gesteigerten Erfassung von Altpapier, insbesondere aus dem haushaltsnahen Bereich, eine Qualitätsverschlechterung einhergeht. Zum anderen bedingen steigende Qualitätsansprüche an das fertige Produkt Papier auch hohe Qualitätsansprüche an das Altpapier, vor allem wenn das Altpapier für immer hochwertigere Papiersorten, wie z. B. graphische Papiere, eingesetzt werden soll.

Die erhöhten Qualitätsansprüche stellen eine große Herausforderung für die Recyclingwirtschaft dar, sortiertes Altpapier in einer hohen Qualität an die Papierfabriken zu liefern. Besonders durch die Entwicklung von sensorgestützten Sortieranlagen (NIR, Farbsensoren und Bildverarbeitung) konnten dabei in den letzten Jahren Fortschritte erzielt werden. Es bestehen aber weiterhin erhebliche Verbesserungsanforderungen, wie verschiedene Untersuchungen zur derzeitigen Qualität, der für die Hersteller grafischer Papiere wichtigen Altpapiersorte Deinkingware (1.11) zeigten.

Forschungsziel/Forschungsergebnis

Das Projekt wurde in Kooperation mit dem Spektrometerhersteller LLA Instruments GmbH (Berlin) realisiert. Ziel des Projektes war die Entwicklung eines neuen NIR-Messverfahrens zur analytischen Bewertung von Altpapierströmen. Das neue Messverfahren soll eine wesentliche Verbesserung der Klassifikation von Komponenten im Altpapier bei der Sortierung und damit der Qualität des sortierten Altpapiers ermöglichen. Des Weiteren soll das Verfahren genutzt werden, um den Papierfabriken eine messtechnische Lösung für die Qualitätsbewertung von loser Deinkingware in der Eingangskontrolle anzubieten. Das Gesamtprojekt unterteilt sich in zwei Teilprojekte, die jeweils von den beiden Projektpartnern bearbeitet werden: **LLA** - Entwicklung einer SWIR-2D-Spektralkamera mit Objektbildung und 2D-Präsentation für die Bewertung sich schnell bewegenden Objekten, **PTS** - Entwicklung NIR-basierter Klassifikationsalgorithmen und quantitativer Bestimmungsmethoden für die Sortierung und Bewertung von Altpapier.

Vom Projektpartner LLA wurde die NIR-Kamera mit einem erweiterten Messbereich bis 2200 nm entwickelt und getestet. Von PTS wurden die Altpapiersorten NIR-spektroskopisch charakterisiert. Insbesondere wurden zur Erkennung von Druckfarben, Offset- und Flexodruckfarben spektroskopisch untersucht.

Auf der Grundlage dieser Ergebnisse wurden die Klassifizierungs- und Quantifizierungsmethoden entwickelt und getestet, die für die Sortierung und Qualitätsbewertung von Altpapier genutzt werden können.

Klassifizierungsmethoden teilen die Komponenten aus einem Altpapiergemisch in folgende Klassen ein:

- Deinkingpapiere
- unerwünschte Papiere,
- Flexodruckpapiere und
- papierfremde Bestandteile

Für jede Klasse wird eine Erkennungsgenauigkeit von > 90 % angestrebt. Die Klassifizierungsmethoden sollen so robust gestaltet werden, dass die Erkennungsgenauigkeit auch bei einer Altpapierfeuchte von bis zu 15 % erhalten bleibt.

Quantifizierungsmethoden	bestimmen folgende Parameter:
	absolute Genauigkeit
Aschegehalt (525 °C)	+/- 3 %
Feuchte	+/- 2 %

Anwendung/Wirtschaftliche Bedeutung

Das Ergebnis der Entwicklungsarbeiten im Forschungsprojekt sind Klassifikationsalgorithmen für die Sortierung von Altpapier. Diese Algorithmen und die ebenfalls entwickelten quantitativen Bestimmungsmethoden für die Asche und die Feuchte können für die Bestimmung der Zusammensetzung bzw. der Qualität von losem Altpapier verwendet werden. Des Weiteren kann das Messsystem mit den entwickelten Identifikationsmethoden für die verschieden Altpapierkomponenten für die Sortierung von Altpapier genutzt werden.

Bearbeitungszeitraum: 01.01.2009 – 31.03.2011

Bemerkungen

Das Forschungsvorhaben ZIM-KF2037902FK8 wurde aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert und in Zusammenarbeit mit LLA Instruments GmbH durchgeführt.

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Forschungsgebiet: Produkt-Ziele

Rohstoffe // Altpapier

Schlagworte:

Altpapier, Altpapierqualität, Altpapierzusammensetzung, Deinkingware

Theme:
Investigation on Recovered Paper Quality in the INGEDE Member Countries

Background/Problem Area:

The last investigation on recovered paper (RCP) quality was performed between 1997 and 2000 and included RCP from German collection systems, only. The public funded research project contained the recovered paper grades 1.01, 1.02, 1.04, 1.11 and 4.03. Between 01.11.2007 and 30.04.2010 a new public financed project (AiF 15408 financed by the German Ministry of Economics and Technology) evaluated the same recovered paper grades in Germany.

An international survey of the recovered paper quality did not exist. By comparison of the recovered paper quality in various European countries with INGEDE member mills differences in paper composition, content of impurities, dewatering behaviour, deinkability, sheet properties and harmful substances could be detected and correlated with recovered paper collection systems. This gave significant more information than comparison of the recovered paper entrance control performed by each individual INGEDE member mill.

Objective/Research Results:

The proposed project delivered for the first time an international data base on recovered paper quality for grade 1.11 used in paper mills of the European INGEDE members. Information was provided on the composition and the fibre quality of recovered paper and quality parameters were correlated to collection and sorting systems of the investigated countries. Since the same test procedures and test methods were used for all samples analyzed, these results afford the basis for discussing differences between European countries regarding typical collection and sorting behaviours. The public funded and at PMV realized AiF project provided the basis work and the data acquisition and analysis for Germany. With this additional INGEDE project synergies could be utilized in order to get a European picture of recovered paper quality.

In addition to the AiF project investigations on recovered paper grade 1.11 in Germany the investigations were extended to INGEDE members mills from Austria, Belgium, Finland, France, Italy, Netherlands, Norway, Sweden, Switzerland and United Kingdom. Sampling was performed only for unbaled recovered paper according to INGEDE Method 7. Each sample investigation was performed in accordance to the analysis concept of the AiF project. Each sample to be investigated came from one delivery of unbaled recovered paper (about 30 kg).

The composition of the investigated recovered paper grade 1.11 showed big differences for the eleven probed countries. The share of unwanted material (packaging material and board, unsuited paper and non-paper components) was between 1.5 and 13.5 %. In average to recovered paper utilization a content of 6.5 % was calculated. The lowest contents could be found for Scandinavian countries which have the lowest recovered paper utilization rate followed by Switzerland which uses bundle collection. Italy had the highest share of unwanted materials as well as the highest moisture and sticky content. The average moisture content according to recovered paper utilization was 9 %. The sticky content could be correlated to the content of packaging material and board and varied between 2 900 and 23 000 mm²/kg. For the suspension properties like dewatering behaviour only small deviations (values between 50 and 60 SR (Schopper-Riegler-Value)) were measured, whereas the ash content was found to vary between 15 and 27 % according to differences in recovered paper utilization rate between the probed countries. The deinkability was tested according to INGEDE Method 11. After lab flotation (with PTS cell) an average brightness of almost 57 % could be achieved. Sheet properties like tear reached average values of 1 120 mN*m/m, burst 141 kPa and breaking length approx. 3.6 km. For the content of harmful substances like chemical oxygen demand (COD), organic halogen compounds (OX) no significant differences could be found for different European countries. Other organic substances like Diisopropylnaphthalene (DIPN), Pentachlorophenol (PCP) and various phthalates varied according to national regulations and differences in recovered paper composition.

Application/Economic Benefits:

For the first time comparable recovered paper data between various European countries were investigated for the recovered paper grade 1.11. The quality of recovered paper and its composition was determined and differences from country to country became evident. The results could be correlated to different collection systems and recovered paper utilization rates.

Project Period: 01.06.2008 – 31.12.2010

Remarks:

The research project INGEDE 12608 is being funded by INGEDE.

PRODUKT-ZIELE

Forschungsgebiet
Faserstoffe

Altpapierstoff
Holzstoff
Zellstoff

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Forschungsgebiet: Produkt-Ziele

Faserstoffe // Altpapierstoff

Schlagworte:

Altpapier, Festigkeitseigenschaften, Stoffaufbereitung, Flotation

Thema:
Sicherstellung der Festigkeit von Wellpappenrohpapieren durch selektive Flotation von anorganischen Bestandteilen (Entaschung)

Ausgangssituation/Problemstellung

Die Erzeugung von Wellpappenrohpapier ist im starken maße durch folgende Rahmenbedingungen geprägt.

- steigende Kosten für Energie und Hilfsstoffe,
- abnehmende Flächengewichte im erzeugten Papierprodukt,
- steigende Maschinengeschwindigkeiten,
- definierte Anforderungen an die Produkteigenschaften (Festigkeit),
- steigende Anforderungen an die Bedruckbarkeit.

Ständig erhöhende Anteile anorganischer Bestandteile im Altpapier wirken sich negativ auf die Festigkeitseigenschaften der Rohpapiere aus. Besonders betroffen sind hiervon Wellpappenrohpapierhersteller.

Bestehende Technologien sind nur noch in begrenztem Umfang geeignet, den Anforderungen an die Prozessbedingungen und die Produktqualität gerecht zu werden. Ein Instrument, um diesen Entwicklungstrends zu begegnen, ist die Verbesserung der Fertigkeiten durch Reduzierung anorganischer Bestandteile. Ein innovativer Ansatz ist dabei die Anwendung, der für die Erzeugung brauner Wellpappenrohpapiere unüblichen, Flotationsverfahren sowie die Low-Intensity Mahlung.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist es, ein Verfahrenskonzept in der Stoffaufbereitung zu entwickeln, das die Festigkeit von Altpapierfaserstoff um mehr als 20 % erhöht. Dies soll durch die Implementierung einer Flotationsstufe zur Entaschung des Altpapierstoffs sowie einer Low-Intensity Mahlung in den Stoffaufbereitungsprozess von Wellpappenrohpapieren erreicht werden. Durch die Anwendung chemischen Additiven soll der Betrieb der Flotationsstufe sehr selektiv gestaltet werden.

Dieses Forschungsprojekt strebt die folgenden Ergebnisse an:

- Bestimmung von Art und Menge der Flotationschemikalien zur Steigerung der Selektivität und des Wirkungsgrades beim Flotationsprozess
- Prüfung der Möglichkeiten der Oberflächenspannungsmessung zur Erhöhung der Abtrenneffizienz des Flotationsprozesses für anorganische Stoffe
- Bewertung der Eignung des Flotationsverfahrens zur Erhöhung der Festigkeitseigenschaften im Produkt WP-Rohpapier
- Bewertung der Eignung der Low-Intensity Mahlung zur Erhöhung der Festigkeitseigenschaften im Produkt WP-Rohpapier
- Auslegungs- und Betriebsdaten für Stoffaufbereitungsanlagen mit integrierter Flotationsstufe und Low-Intensity Mahlung für die Erzeugung von Wellpappenrohpapieren
- Wirtschaftl. und techn. Bewertung für unterschiedl. Verfahrenskonzepte zur Sicherung der Festigkeitseigenschaften von WPR

Erste positive Ergebnisse von Laborflotationen mit kationischen Sammlerchemikalien konnten im Technikumsmaßstab, unter Verwendung der verkleinerten EcoCell, bisher nicht in dieser Breite bestätigt werden. Ursachen werden hier in der Art der Dosierungen, im heterogenen Partikelgrößenspektrum der Mineralien, im abweichenden Flotationskonzept der verkleinerten EcoCell von der Laborflotationszelle und den abweichenden pH- Wert- und Ladungsverhältnissen der Praxisstoffe zu den im Labormaßstab verwendeten Stoffen gesehen.

In weiteren Grundlagenuntersuchungen konnte die Abhängigkeit der Flotationseffektivität von der Partikelgröße der Mineralien deutlich gemacht werden. Mit Hilfe von Silikonderivaten gelang es den Austrag mineralischer Bestandteile mit dem Flotat zu steigern bei geringeren Faserverlusten. Ursachen werden hier bei der Verschiebung des Partikelgrößenspektrums durch Agglomerationen mineralischer Bestandteile in ein für die Flotation begünstigendes Spektrum gesehen. Derzeit wird die Umsetzung im Pilotmaßstab an der verkleinerten EcoCell geprüft.

Anwendung/Wirtschaftliche Bedeutung

Die Ergebnisse des Projektes sind den Fachgebieten Rohstoffe, Produktion und Verfahrenstechnik zuzuordnen. Primärer Nutzungsbereich ist das Papiergewerbe Durch die Kombination des selektiven Flotationsverfahrens und der Low-Intensity Mahlung wird sowohl die Einsparung von Kosten für die Oberflächenstärke als auch der Einsatz kostengünstiger Faserrohstoffe ermöglicht. Die Entfernung mineralischer und anderer Störstoffe steigert die Runnability der Papiermaschine, die darüber hinaus durch die Eliminierung des Stärkeauftrages in der Trockenpartie eine Steigerung der Produktivität ermöglicht.

Bearbeitungszeitraum: 01.02.2010 – 31.07.2012

Bemerkungen

Das Forschungsvorhaben IGF 16358 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Forschungsgebiet: Produkt-Ziele

Rohstoffe // Holz; Faserstoffe // Holzstoff

Schlagworte:

Innovatives Herstellungsverfahren; Ressourcenschonung; Energieeffizienz; Elektronenbestrahlung

Thema:
Elektronenbestrahlung von Holzhackschnitzeln zur energieeffizienten Herstellung von Holzstoff in der Papierproduktion

Ausgangssituation/Problemstellung

Die Verfügbarkeit und die Kosten der Rohstoffe für die Papierindustrie haben sich innerhalb weniger Jahre in einem bisher nicht gekannten Ausmaß verschlechtert. Der aus ökologischen Gründen anzustrebenden verstärkten Nutzung von Hochausbeute-Faserstoffen (Holzstoffe) stehen die hohen Energiekosten im Wege. Die klassischen Prozesse der Holzstofferzeugung gehören seit jeher zu den energieintensivsten Teilprozessen der Papierherstellung. Mit einem an der Technischen Universität Dresden entwickelten neuen Verfahren zur Herstellung thermo-mechanischer Holzstoffe konnten die positiven Ergebnisse bezüglich Faserqualität und Energieeffizienz bisheriger, überwiegend auf den Labormaßstab beschränkter Forschungsarbeiten (INFOR Nr. 64 R 2005 und 77 R 2006; AiF-Nr.15623 BR 2008) in einem industriellen Großversuch auch in der Praxis eindrucksvoll bestätigt werden. Dabei gelang es, einen entsprechend dem neuen Verfahren vorbehandelten TMP-Holzstoff mit einem um 30 % reduzierten Energieeinsatz zu erzeugen und zusammen mit deinktem Faserstoff (DIP) zur Herstellung von Zeitungsdruckpapier einzusetzen. Wegen seiner hohen Energieeffizienz wird der neue Holzstoff als ETMP (Energy-efficient TMP) bezeichnet.

Forschungsziel/Forschungsergebnis

Als innovativer Ansatz für das energieeffizientere Verfahren wird die Schwächung der Faser-Faser-Bindungen im Holz durch die Behandlung der Hackschnitzel mit energiereicher Strahlung (Elektronenstrahl) vor dem Mahlprozess gesehen. Zu diesem Zweck muss die klassische Hackschnitzelverarbeitung vor der Zerfaserung um zwei Prozessstufen erweitert werden, und zwar um eine Vorimprägnierung der Hackschnitzel und einer sich daran anschließenden Elektronenbestrahlung.

Ein Energieeinsparpotenzial > 30 % stellt für die TMP-Erzeugung eine seit Einführung dieser Technologie nie erreichte energetische Optimierung dar. Damit können auch in Zeiten sehr hoher Energiepreise Ressourcen schonende Hochausbeute-Holzstoffe wirtschaftlich hergestellt werden.

Anwendungen/Wirtschaftliche Bedeutung

In weiteren Arbeiten soll das ETMP-Verfahren weiter entwickelt und in vollem Umfang für die Papierindustrie nutzbar gemacht werden. Um den Wissenstransfer in die Papierindustrie vollständig abschließen zu können, müssen die zusätzlichen Prozessstufen in die kontinuierliche Holzstofftechnologie integriert werden. Für dieses Vorhaben sind starke, innovative Partner notwendig, mit deren Hilfe ETMP energie- und ressourcenschonend hergestellt werden kann.

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 durchgeführt.

PRODUKT-ZIELE

Forschungsgebiet
Papier, Karton und Pappe

Graphische Papiere
Verpackungspapiere und -karton
Technische Spezialpapiere

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Graphische Papiere

Schlagworte:

SC-Papier, Füllstoffgehalt, Festigkeitsverlust, Steifigkeit, Latex, Polymer-Pigment-Hybride

Thema:
Vermeidung des Steifigkeitsverlustes bei der Erhöhung des Füllstoffgehalts von grafischen Massenpapieren

Ausgangssituation/Problemstellung

Grafische Massendruckpapiere, wie z. B. SC-Papiere, sind hinsichtlich ihres Füllstoffgehalts begrenzt. So wird SC-Papier als ein hochgefülltes, ungestrichenes Papier mit einem Füllstoffgehalt bis etwa 35 % erzeugt. Der Bereich der flächenbezogenen Masse liegt bei SC-Papier meist zwischen 50 und 60 g/m². Dies macht deutlich, dass an diese Papiere erhebliche Festigkeitsanforderungen in der Papiererzeugung und Verarbeitung gestellt werden. Eine weitere Steigerung des Füllstoffgehaltes wäre aus Kostengründen und wegen der besseren Bedruckbarkeit wünschenswert, führt jedoch zu einer Abnahme der für die Verarbeitung erforderlichen Festigkeitseigenschaften sowie der Steifigkeit.

Forschungsziel/Forschungsergebnis

Die Ziele des Forschungsvorhabens sind die Vermeidung des Festigkeits- bzw. Steifigkeitsverlusts von grafischen Massenpapieren bei der Erhöhung des Füllstoffgehalts, eine Verbesserung der Druckqualität und eine Kostensenkung vor allem bei der Herstellung von SC-Papieren.

Als Ansätze für eine Vermeidung von Festigkeitsverlusten sind im Rahmen des Vorhabens der Einsatz von Latices als Bindemittel und die Verwendung von Polymer-Pigment-Hybriden (PPH) in der Masse vorgesehen.

In einem ersten Schritt erfolgen Untersuchungen im Labormaßstab unter Nutzung des Retention-and-Drainage-Analyzers (RDA) für die Laborblattherstellung. Ausgehend von heute üblichen Rezepturen für die SC-Papierherstellung (35 % Füllstoffgehalt) werden Laborversuche zur Herstellung hochgefüllter Papiere (Ziel: 45 % Füllstoffgehalt) durchgeführt und die Veränderungen der Festigkeitseigenschaften untersucht. Weiterführende Laborversuche zur Verbesserung der Festigkeit hochgefüllter Papiere beinhalten die Nutzung der o. a. Additive. Die Effizienz der einzelnen Optionen zur Steigerung der Papierfestigkeit bzw. -steifigkeit wird durch vergleichende Bewertung der erzeugten Papiere ermittelt. Anhand der Versuchsergebnisse werden in einem zweiten Schritte Versuche zur Bahnbildung auf Basis von optimierten Stoff-Additiv-Rezepturen an einem dynamischen Blattbildner (Simulation der industriellen Papierherstellung) durchgeführt. Die Kosteneffizienz der verschiedenen Ansätze wird geprüft.

Das erste Treffen mit den Projektbegleitern wurde veranstaltet. Dabei wurden das Vorgehen im Labor und die erforderlichen Parameter zur Blattbildung und Papierprüfung festgelegt. Daran anschließend wurde im Labor am „Retention and Drainage Analyzer“ (RDA) eine Einstellung gefunden, die hinsichtlich SC-Papier-Rezeptur als Standardeinstellung im weiteren Projektverlauf genutzt werden kann. Die Nachstellung der Industriemuster von den beteiligten Partnern inklusive Kalandrierung wurde im Labor erfolgreich fertig gestellt. Nach einer Recherche wurden erste Versuche mit zwei unterschiedlichen Latices durchgeführt.

Anwendung/Wirtschaftliche Bedeutung

Die Ergebnisse ermöglichen es, die Abnahme der Festigkeit bzw. der Steifigkeit von Massendruckpapieren bei der Steigerung des Füllstoffgehalts zu vermeiden. Dies ist eine wesentliche Voraussetzung für die weitere Reduzierung der Rohstoffkosten bei gleichbleibender oder zunehmender Produktqualität. Damit werden die Voraussetzungen geschaffen, grafische Massenpapiere kostengünstiger herstellen zu können.

Bearbeitungszeitraum: 01.01.2011 – 31.12.2011

Bemerkungen

Das Projekt (INFOR Nr. 153) wird aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. finanziert und in Zusammenarbeit mit der Papiertechnischen Stiftung (PTS), München, durchgeführt.

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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 fast 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. Unknown are coating formulations and coating structures which can lead to improvements and can guarantee high printing qualities with all three types of printing methods.

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 or three different printing methods especially offset, flexo and 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 tailor-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 papers in offset, flexo and inkjet printing.
- Coating layers with different porosities were applied to two base papers and one plastic foil. The layers were investigated by microscopy and tested in respect of surface tension, porosity and ink penetration.
- 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.

Project period: 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.

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Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

chemical ghosting, coated paper, sheet-fed offset

Title:
Chemical ghosting in sheet-fed offset printing: substrate effects, reaction kinetics and measurement description

Background/Problem area

The term chemical ghosting in sheet-fed offset printing describes contact phenomena occurring particularly during printing on coated papers. Reverse side yellowing and matt/glossy effects are typical signs of chemical ghosting.

This project dealt in detail with matt/glossy effects. These occur in uniformly dark coloured illustrations on the reverse side sheet image as matt or shiny areas having the shape and size of the print image. The term “ghosting” has been coined because of the slight but clearly visible effect on the one hand, and because of the mysterious non-occurrence of the effect under apparently identical conditions on the other hand. The Fogra research institute has completed a project on this topic (IGF 14366N) and has established an analytical understanding of the occurrence of chemical ghosting, whereas the present project realized jointly by Fogra and PTS intends to further close the gap between phenomenological description and the systematic avoidance of chemical ghosting.

Objectives/Research results

According to the research results of Fogra (IGF 14366N), chemical ghosting effects develop in the following way: After an induction period, the front side print emits aldehydes while its printing ink is drying. These aldehydes are absorbed by the reverse side of the opposite sheet. During reverse-side printing, the aldehydes speed up the drying of freshly applied printing ink on the reverse side from below, depending on the print image. This early dried bottom layer can prevent levelling processes of the ink film later on. At the same time, further aldehyde emitted from the front side can accelerate the drying process of the ink surface, leading to faster film formation in the area of later ghost images.

Moreover, the sealing of paper in the image areas of front side prints leads to longer dwell times of the aldehydes released from the reverse side ink layer, causing the surface of this ink layer to dry faster as well. Faster dried sections in a larger ink film area have smoother surfaces than the rest, causing incident light to be strongly reflected so that ghosting areas appear darker. Chemical ghosting effects in sheet-fed offset printing are thus the result of local differences in drying speed of the printing ink.

Coated papers systematically prepared on laboratory and pilot scale with recipes and properties showing the influence of coated paper on the occurrence of ghosting effects were investigated. Additionally, it was determined whether the use of additives in the coating colour can reduce the activity of aldehydes formed during ink drying.

The lab scale results indicated that coarser GCC pigments promoted ghosting especially in single coating or, in the case of multiple coated papers, in the top coating layer. This is why pigment screening was performed as a next project step. Pigment type (GCC, PCC, clay, talcum), pigment shape (aragonite, scalenohedral, rhombohedral) and particle size distribution were evaluated.

Binder type and chemical composition have an influence on chemical ghosting as well. Among the binders investigated, a tendency for chemical ghosting was observed. The worst chemical ghosting was observed with casein, followed by polyurethane, styrene-acrylate, starch dextrin and styrene-butadiene.

In order to prevent chemical ghosting, aldehyde absorbers were added to the coating colours. Depending on the chemical composition and reactivity, stabilized copolymers based on polyamide performed best. On lab scale, the polyamide additives reduced chemical ghosting significantly and reproducibly by up to 5 units in the visual ranking performed by Fogra.

To transfer these lab results to a level more relevant to production, pilot coating trials and sheet-fed offset printing trials were performed as a last project step.

It can be concluded that coated and uncoated papers can have an effect on chemical ghosting, but compared to the influences of the printing inks used and of the interval between face and reverse printing, their influence is rather low.

Application/Economic benefits

The project deals with a presently not fully understood problem of the printing industry. Deeper knowledge of the influences of paper and ink ingredients on ghosting effects will enable ink and paper manufacturers to use materials which are less likely to cause chemical ghosting and have the potential to increase the quality of production and lower the number of complaints.

This has a positive impact on their competitiveness. The possibility to forgo time-consuming preliminary experiments will lead to faster job throughputs in the printing industry and higher flexibility of production - with a positive impact on their currently tight revenue situation.

Period of time: 01.12.2008 – 31.05.2011

Remarks:

The research project IGF 15882 N was funded by the German Federal Ministry of Economics and Technology BMWi and was performed together with the printing research institute Fogra.

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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 significantly 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 scale. The formulations are applied in 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.

At the moment small scale pilot trials are planed using the best formations from the laboratory trials. Trials and paper testing will be performed in the near future.

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.

Project period: 01.03.2010 – 30.06.2012

Remarks:

The research project IGF 16357 is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with TU Dresden.

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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. For the preparation of filler-fines-slurries containing also a coupling agent much stronger effect are expected. The introduction of cellulosic fines particles and cationic polymers into a typical filler slurries was possible without strong detrimental its viscosity.

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.

Project period: 01.02.2010 – 30.07.2012

Remarks:

Research project IGF 16359 BR is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: Product aims

Paper, paperboard and board // graphic papers

Key words:

bimodal grain size distribution, coating, offset paper

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 22.8bn 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 now to be reproduced on the pilot coater in a next step.

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.

Project period: 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).

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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. This will significantly reduce the development effort in its many stages. The development of the necessary modeling methods and tools should be made stepwise in individual modules.

The current project aims at the development of the first module for the simulation-based optimization of a coating design with a defined ink penetration characteristic. The modeling method should improve ink penetration of coating formulations and should for instance be applied also to combined printing so as to secure throughput and print quality. It will focus on offset printing with small amounts of ink in the scope of personalized printing.

The parameter range of relevant coating formulations and print colours will be investigated in a complex experimental schedule (5-10 variants of pigment and mixing ratio, 2-3 variants binder, 2- and 3-layer coating) and will subsequently be made available to the simulation tool. Thereby, basic materials have been chosen that widely differ in their influence on porosity, absorptive capacity and pore size of the coating.

A concept for the structural design of the simulation software has been developed. It was designed as a structurally open, modular system base that can be extended easily by other modules. For the modeling of ink penetration, three fundamentally different approaches were chosen:

- Analytical computations
- Simulations of porous structural models
- FEM-simulations

The modeling should be attended by comparative measurements of the ink penetrated coating based on three different measuring procedures:

- Analysis of cross-sectional images with light-optical microscope
- Analysis of change of color intensity with high-speed camera
- Determination of changes in weight over time after application of ink

Application/Economic benefits

The expected 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

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Research area: Product aims

Paper, paperboard and board // graphic papers

Key words:

nanotechnology, hybrid pigments, coating colour

Title:
The use of nanoscale pigments in the form of hybrid pigments to control the sorption properties of coated graphic paper

Background/Problem area

The sorption properties of coated paper are one important factor that considerably influences the print quality. They are strongly influenced by the structure of the coating. By adding nanoparticles as hybrid pigments (nanoparticles fixed on conventional coating pigments) to the paper coating colours, paper coatings with a variable pore structure compared to conventional coating colours can be obtained. In a best-case scenario, the porosity and thus the sorption behaviour of the paper will vary significantly and may even be very selectively adjusted.

The use of nanoscale pigments in inorganic-inorganic hybrid pigments is intended to employ the nanoparticles as effectively as possible, while avoiding possible problems that may occur when conventional (non-fixed) nanoscale pigment slurries are used.

Objectives/Research results

The objective of the project was to control the porosity of paper coatings by incorporating nanoparticles as hybrid pigments in the coating colour formulation and this optimising the printability of the papers.

In order to take into account the special properties of nanoparticles when used in water-based coating colours, the nanoparticles were firmly anchored to the surface of conventional coating pigments. The resulting hybrid pigments were then added to the coating colour formulations. This improved the retention behaviour of the nanoparticles, achieved cost reduction as a result of a more efficient use of the nanoparticles and also avoided the common and strong tendency of unfixed nanoparticles to form undesirable re-agglomerates.

A large number of nanoparticle and coating pigment combinations was tested to yield hybrid pigments. Heterocoagulation was used for fixing the nanoparticles on the conventional coating pigments. Therefore it was possible to yield hybrid pigment dispersions by mixing nanoparticle and coating pigment dispersions in different ratios. Using a scanning electron microscope it was clearly documented that the nanoparticles were fixed on the surface of the conventional coating pigment particles. And, as assumed, the nanoparticles were effectively hindered from forming undesirable re-agglomerates.

The hybrid pigment dispersions were added to coating colour formulations used for offset papers and gravure printing papers respectively: Different amounts of a conventional coating pigment in the coating colour formulation were replaced by the hybrid pigments.

Because of the low solids content of the hybrid pigment dispersions the solids content of the resulting coating colours decreased with increasing amounts of hybrid pigment. The strongly varying solids content allowed only to predict a trend but no absolute value of the influence of the used amounts of hybrid pigments on the resulting pore structure of the coated papers.

So, subsequent research is necessary to develop hybrid pigments as slurries with higher solids content or in solid form. In addition, it is necessary to explore other processes to yield cost effective hybrid pigments with well defined composition suitable for conventional coating techniques.

Application/Economic benefits

As a part of the producing sector, the paper industry is closely linked to suppliers from the mechanical engineering and chemical sectors that frequently have a small- and medium-sized business structure in these sectors. In the graphic paper product sector, the customer segment is also dominated by a printing industry that has a pronounced small- and medium-sized business structure.

Coated graphic paper is a market segment of enormous importance in the German paper industry. This explains why it is absolutely essential to keep this important product sector at a high-quality level by constant further developments and innovations, thus strengthening it in competition with other markets. Only in this way can the existence of the many small- and medium-sized enterprises be ultimately guaranteed in the long term.

The innovative developments for coated graphic paper resulting from this research project can be used to optimise printing processes. Such optimisation can have an impact on cost reduction for existing processes, technologies and products. It can also result in innovative or cost-saving new developments in the sector of printing inks and processes from which the domestic printing industry with its pronounced small- and medium-sized business structure will ultimately profit.

Period of time: 01.07.2009 – 30.06.2011

Remarks:

The research project IK-VF 090009 was funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words

folding, fibre treatment, base paper composition, fibre types

Title:
Development of fibre-based concepts to control folding properties of coated graphic papers

Background/Problem area

Coated graphic papers usually are subjected to an intensive converting process after printing. Especially the folding properties of the papers are important to guarantee an immaculate converting process and therefore to supply a product with high practical value.

The printability of graphic paper was and is further optimised during the last years. This is primarily achieved by increasing the amount of mineral pigments on the paper. These stiff and incompressible coatings cause additional forces to occur on the surface of the papers during folding that may lead to cracks in the paper surface due to – amongst others – insufficient energy uptake of the base paper.

The physical processes during folding in the composite “graphic paper” are very complex. Experience shows that the mechanical strength and compressibility properties of papers highly differ over the paper cross section and exceedingly depend on the fibre type. These complex interactions are until now not extensively examined and are only handled empirical.

Objectives/Research results

The project aims to investigate the correlation of fibre selection, fibre treatment and resulting structural strength for optimised folding properties of the base papers and therefore of coated papers by derivation of the treatment methods in stock preparation and sheet formation.

For the precise understanding of the correlation of base paper composition/properties and its folding properties different fibre types (long/short, sulphate/sulphite/BCTMP) are to be examined. The fibres will be impinged with different refining intensities (e.g. different plate design). The thus prepared fibres are to be examined regarding their fibre flexibility, fibre elasticity and resulting structural strength and energy uptake of the sheet. Furthermore the parameters due to different fibre mixtures and compositions (base paper formulations) influencing the folding properties will be determined. In the field of sheet formation high attention will be paid to the process control. This should help to determine the influence on folding and creasing properties due to sheet formation and fibre orientation as well as fines and filler distribution.

The exact design of experiments and the selection of the fibres, fillers, additives and process parameters (sheet formation) as well as the parameters and physical properties to be determined are carried out in close coordination with the members of the project committee.

Application/Economic benefits

The project results will help to produce cost effective products by using the mill-specific facilities regarding the selection of raw materials, fibre treatment and process control (sheet formation) for a cost effective base paper with good folding and creasing properties.

Project period: 01.01.2011 – 31.12.2011

Remarks:

The project (INFOR Nr. 152) is being funded by the curatorship of research and technique of the pulp and paper industry within VDP e. V.

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Graphische Papiere

Schlagworte:

Markierungsresistenz, Nanopartikel

Thema:
Strichoberflächen von Mattpapieren mit hoher Markierungsresistenz

Ausgangssituation/Problemstellung

Aufgrund ihrer besonderen Oberflächeneigenschaften sind matt gestrichene Papiersorten hinsichtlich der Verarbeitung anspruchsvoller als glänzend gestrichene. Insbesondere die irreversible Qualitätsminderung durch die Ausbildung von Glanzmarkierungen als Folge mehr oder weniger aggressiver Oberflächenkontakte mit Transportelementen von Maschinen oder während des Gebrauchs beim Endkunden ist nach wie vor eines der größten Probleme. Neue, erfolgversprechende Lösungen hierfür können jedoch mit Hilfe nanotechnologischer Ansätze und einer verbesserten Prüftechnik erarbeitet werden. Diese stehen im Mittelpunkt dieses Forschungsprojekts.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist eine deutliche Steigerung der Markierungsresistenz von matt und halbmatt gestrichenen Papieren. Dazu sollen zusätzliche dünne Schutzschichten im Nanomaßstab auf die gestrichenen Oberflächen appliziert werden, die die Widerstandsfähigkeit der Papieroberfläche gegenüber mechanischer Beanspruchung bei vernachlässigbarer Beeinträchtigung des Mattcharakters bewirken. Insbesondere sollen beim Papiertransport in der Ausrüstung sowie später in Druck- und Verarbeitungsmaschinen ähnliche Geschwindigkeiten und ein ähnliches Handling wie bei glänzenden Papieren erreicht werden. Zudem soll die Markierungsbildung beim Endkunden verringert werden. Zusätzlich dazu sollen bisherige Bewertungsverfahren dahingehend optimiert werden, dass auch kleine Veränderungen in der Markierungsempfindlichkeit noch gut detektiert werden können.

Anwendungen/Wirtschaftliche Bedeutung

Eine Nutzung der Forschungsergebnisse ist entlang der gesamten Wertschöpfungskette graphischer Papiere von der Herstellung bis zum fertigen Druckereiprodukt möglich. Dazu gehören Hersteller von gestrichenen Offsetdruckpapieren, Hersteller chemischer Rohstoffe und Additive, Druckereien und Hersteller von hoch spezialisierter Messtechnik. Insbesondere die von kleinen und mittelständischen Unternehmen dominierte Druckbranche erlangt dadurch folgende wirtschaftlichen Vorteile:

- höhere Produktionsgeschwindigkeiten,
- Verringerung der Makulatur,
- weniger Reklamationen,
- höhere Druckqualität und
- höhere Qualitätskonstanz.

Darüber hinaus können in der Papier- und Druckindustrie tätige Messgerätehersteller ihr Produktportfolio erweitern.

Bearbeitungszeitraum: 01.03.2010–30.06.2012

Bemerkungen

Das IGF-Forschungsvorhaben Nr. 16357 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Product aims

Paper paperboard and board //
Packaging papers and paperboard

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 the analysis of the reasons of striping and existing solutions from literature. It could be deduced that probably to a great extent quick absorption of rather high amounts of ink on the liner coating would be beneficial to reduce striping. The first results showed that it's possible to get high absorptivity by using certain pigments. PCC and NPSD GCC are more absorbent than BPSD GCC and SiO_2. Nano PCC's show good absorptivity as well, of which one is the most absorbent pigment within all pigments tested. The coating structure also influences the absorptivity. Calendered papers are less absorbent than uncalendered ones due to reduced porosity and sealed surface of the coating layer. Blending a GCC pigment with a PCC pigment increases the absorptivity of coating by increased PCC amount. From first laboratory printing (IGT F1) samples no significant dot size variations could be observed. However the formation of "print donuts" occurred with the samples coated with high surface energy pigments.

Therefore a selection was made for future transfer from the laboratory bar coating to laboratory curtain coating. These results then should give a more precise idea of print quality since the curtain coating samples should be much more uniform. With the most promising combinations the research will be continued and in a further step laboratory corrugated board samples will be prepared, also with coated samples from the pilot coater. Finally the best formulations will be coated on industry scale with following industry scale flexo post 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.

Project period: 01.09.2010 – 31.08.2012

Remarks:

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

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Verpackungspapiere und -karton

Schlagworte:

Maschinenkarton, Faltschachtelkarton, spezifisches Volumen, Steifigkeit, Getreidemehl, Kleie

Thema:
Entwicklung eines Kartons mit verbesserten Produkteigenschaften

Ausgangssituation/Problemstellung

Das in den letzten Jahrzehnten zu verzeichnende erhöhte Umweltbewusstsein sowie ökonomische Erwägungen haben in der Papierindustrie zu wesentlichen Änderungen in der Produktionstechnologie geführt.

Gleichzeitig hat sich die Altpapierqualität immer weiter verschlechtert. Aufgrund der z. T. ungenügenden Verfügbarkeit einzelner Sorten muss ebenfalls häufig auf schlechtere Sorten ausgewichen werden.

Die gleichzeitige Steigerung der Anforderungen an Produktqualität und Produktivität einerseits und die schlechtere Rohstoffqualität andererseits erfordern unter diesen Randbedingungen die Entwicklung neuer Verfahren zur Sicherung der Funktionalität der Endprodukte.

Forschungsziel/Forschungsergebnis

Das Vorhaben zielt auf die Entwicklung eines Kartons mit optimierten Produkteigenschaften, insbesondere verbessertem spezifischem Volumen und Spannungs-Dehnungs-Verhalten (E-Modul), zur Ausbildung höherer Steifigkeiten ab.

Dazu soll eine Aufwertung des Sekundärfaserstoffeinsatzes in der Karton-Einlage durch den Zusatz von kostengünstigen Additiven erfolgen sowie die Verwendung von Kleiefraktionen als Abstandshalter zur Erhöhung des spezifischen Volumens und zur Material- und Kosteneinsparung getestet werden. Die Hochkonsistenztechnologie (HC-) zur Optimierung der Wirkeffizienz der Additive soll ebenfalls zur Anwendung kommen.

Die Zielstellung des Vorhabens soll umgesetzt werden, indem modifizierte (trocken derivatisierte bzw. extrudierte) Getreidemehle der Faserstoffmatrix der Einzellagen zugesetzt werden. Es ist davon auszugehen, dass die in den Mehlen enthaltene Stärke einen positiven Beitrag zur Festigkeitserhöhung und das ebenfalls enthaltene Protein die Gesamtsteifigkeit des Faltschachtelkartons steigert. Das zusätzliche Einbringen von Getreidekleie in der Einlage bewirkt eine Anhebung des spezifischen Volumens dieser anteilmäßig größten Kartonlage und steigert darüber die Biegesteifigkeit.

Gemeinsam mit den Projektinteressenten der Mühlen, des Modifizierungsunternehmens sowie des die Kleiemahlung realisierenden Unternehmens wurde eine funktionsorientierte Auswahl der im Rahmen des Projekts einzusetzenden Rohstoffe vorgenommen. Es wurde deutlich, dass teilweise rohstoff- und verfahrensbedingte Alternativen zu den im Antrag vorgesehenen Variationen gefunden werden mussten. Um vergleichbare Bedingungen bei den Untersuchungen sowohl im Labor als auch im Technikum zu schaffen, wurde mit Modellfaserstoffen und -wässern auf praxisorientierter Grundlage für die Einlage bzw. Schonlage gearbeitet.

Im Labormaßstab wurden unterschiedliche Getreidemehle in der Schonlage und der Einlage eingesetzt, woraus die jeweils beste Variante für die weiteren Arbeiten ausgewählt wurde. Es zeigte sich, dass für das verwendete Stoffsystem ein Kationisierungsgrad von DS = 0,05 zu hoch ist und dieses teilweise schon umgeladen wurde. Bezüglich des Einsatzes nativer Kleiefraktionen konnte keine Erhöhung des spezifischen Volumens festgestellt werden.

Anwendung/Wirtschaftliche Bedeutung

In Deutschland wurden im Jahr 2008 etwa 2,5 Mio. Tonnen Maschinenkarton hergestellt, wobei die bedeutendsten Sorten durch Faltschachtelkarton (ca. 62 %) und Graukarton (ca. 16%) gebildet wurden. In den neuen Bundesländern wurden davon 73,5 kt produziert. Der Produktionsanteil von Maschinenkarton in den neuen Bundesländern ist gegenwärtig als eher unbedeutend einzustufen, obwohl der Anteil von Papier, Karton und Pappe für Verpackungszwecke 45 % der Gesamterzeugungsmenge in Ostdeutschland ausmacht. Mit der Bearbeitung des Projekts sollen Möglichkeiten aufgezeigt werden, eine Aufwertung der Produktpalette durch spezielle Ausstattungen der Kartone vornehmen zu können, um neue Märkte zu bedienen.

Sowohl bei den ausschließlich in den alten Bundesländern produzierten Faltschachtelkartonen als auch bei den Graukartonen ist eine Erweiterung des Produktportfolios vorgesehen, die durch teilweise Substitution oder zusätzliche Kapazitäten realisiert werden soll.

Bearbeitungszeitraum: 01.10.2009 – 31.12.2011

Bemerkungen

Das Forschungsvorhaben IK-MF 090072 wird im Rahmen des INNO-KOMM-Ost-Programms aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Product aims

Paper, paperboard and board // packaging paper and board

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

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:

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Verpackungspapiere und -karton

Schlagworte:

Viskoelastizität, Faserstoffmahlung, PEM-Beschichtung, PEC-Beschichtung

Thema:
Polyelektrolyte als viskoelastische Bindungsschichten an der Faserwand als innovatives Konzept zur Rohstoff- und Energieeinsparung in der Papiererzeugung

Ausgangssituation/Problemstellung

Mehr als die Hälfte des Energiebedarfs der Stoffaufbereitung bei der Papierherstellung entfällt auf die Mahlung der Faserstoffe. Durch diesen Verfahrensschritt werden die Eigenschaften der aus den Faserstoffen hergestellten Papiere nachhaltig beeinflusst, wobei den auf dem Faser-Faser-Kontakt basierenden Festigkeitseigenschaften eine besondere Bedeutung zukommt. Mit zunehmender Mahlung steigt jedoch auch die Rohdichte der Papiere und die Luftdurchlässigkeit nimmt ab.

In der letzten Zeit wurden deshalb Arbeiten durchgeführt, die Alternativen zur Mahlung zum Inhalt hatten, um eine Reduzierung der Energiekosten sowie eine Entkopplung der Festigkeitssteuerung im Papier von der mechanischen Mahlbehandlung und deren negativen Einflüssen auf E-Modul der Faser und Trocknung zu forcieren. Ein Weg hierzu eröffnet sich durch eine alternierende Anlagerung von kationischen und anionischen Polyelektrolyten auf den Fasern im Zuge einer Mehrfachbeschichtung. Erste Ergebnisse liegen in der PTS vor.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist die Erarbeitung von optimalen Prozessbedingungen zur technischen Umsetzung der verbesserten Polyelektrolytbeschichtung von Papierfasern. Damit soll die Faserwand in ihren viskoelastischen Eigenschaften selektiv so verändert werden, dass Grenzflächenwechselwirkungen von Fasern verstärkt werden und so eine verbesserte Faser-Faser-Bindung erreicht wird. Es soll eine Entkopplung der Festigkeitssteuerung im Papier von der mechanischen Mahlung und deren negativen Einflüssen auf E-Modul der Faser und Trocknung realisiert werden.

Durch die Implementierung dieses energiesparenden Prozesses soll eine Reduzierung der Herstellungskosten von Papier erreicht werden, da zukünftig auf den Prozessschritt der Mahlung zumindest teilweise verzichtet werden kann.

Neben dem Effekt der Einsparung von Strom für Mahlung und Trocknung steht auch die Ziel gerichtete Eigenschaftssteuerung des Papierproduktes über polyelektrolytinduzierte Grenzflächeneffekte unter Erhaltung der Einzelfaserfestigkeit im Vordergrund. Das Verfahren soll die in der Mahlung unvorteilhaft beeinflussten Papiereigenschaften wie Durchreißfestigkeit, Steifigkeit, Dimensionsstabilität und spezifisches Volumen zielgerichtet einstellbar machen. Damit wird eine Entkopplung von statischen und dynamischen Festigkeiten erreicht.

Anwendung/Wirtschaftliche Bedeutung

Die Anwendbarkeit der Polyelektrolytbeschichtung von Papierfasern besteht vorrangig in denjenigen Papiersorten, die komplett oder anteilig aus gemahlenen Zellstofffasern bestehen, wie z. B. Kopierpapier, Fotorohpapier und Dekorpapier, aber auch SC- und LWC-Papiere, weiß gedeckter Liner und Tissue.

Neben der Energieeinsparung durch zumindest teilweisen Ersatz der Faserstoffmahlung kommt auch der Verfahrens- und Produktentwicklung insbesondere für kleine und mittlere Unternehmen eine große Bedeutung zu. Die Einführung innovativer Produkte am Markt, wie z. B. eines Druckpapiers mit hoher Steifigkeit bei reduziertem Zellstoffverbrauch kann den vom Projekt unterstützten kmU die Chance auf zusätzliche Umsätze eröffnen.

Bearbeitungszeitraum: 01.01.2011 – 31.12.2012

Bemerkungen

Das Forschungsvorhaben IW MF 100047 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Product aims

Paper, paperboard and board //
Packaging papers and paperboard

Key words

printing inks, migration, 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 in tho 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.

Already 15 sorption materials have been examined regarding their mineral oil sorption properties. Depending on the type of the sorption pigments up to 25 mg mineral oil (vapour) per 1g pigment can be sorbed. Especially zeolites and silica show a high sorption potential.

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.

Project period: 01.02.2011 – 31.01.2013

Remarks:

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Forschungsgebiet: Prozess-Ziele

Papier, Karton und Pappe // Verpackungspapiere und -karton

Schlagworte:

Altpapier, Wellpappenrohpapierherstellung, Koppelnutzung, Fraktionierung, Plattformchemikalien

Thema:
Entwicklung eines Verfahrenskonzeptes zur erstmaligen Koppelnutzung von Altpapier zur Verpackungspapier- und Lävulinsäureherstellung

Ausgangssituation/Problemstellung

Die Herstellung von Verpackungspapieren und -kartone erfolgt überwiegend auf der Basis von Altpapier. Eine weitere Charakteristik dieses Produktsegmentes sind die verhältnismäßig geringen Verlustraten. Dieser eng geschlossene Faserstoffkreislauf bedingt eine Anreicherung von Verunreinigungen sowie mineralischen Stoffen und damit eine Verringerung der papiertechnologischen Gebrauchswerteigenschaften des Faserrohstoffes. Für die Papierhersteller ergibt sich daraus die Notwendigkeit, zusätzliche technische und/oder technologische Maßnahmen anzuwenden, welche zunehmend kostenmäßig wirksam werden.

Eine weitere entscheidende Entwicklung ist die verstärkte Ausrichtung der Energieerzeugung auf nachwachsende Rohstoffe, in deren Zusammenhang auch die energetische Verwertung von Altpapier immer wieder ins Gespräch kommt.

Aufgrund der sich daraus ergebenden Zuspitzung der wirtschaftlichen und technologischen Rahmenbedingungen für die Papierherstellung, wie z. B. steigende Kosten für Energie und Hilfsstoffe und erhöhtem Preisdruck wird in der Branche die Bedeutung unterschiedlicher Wertschöpfungsketten für Altpapier verstärkt diskutiert. Eine Möglichkeit hierfür ist die parallele, gewinnbringende Herstellung eines hochwertigen Produktes aus einem Faserstoffteilstrom der Stoffaufbereitung der Papierherstellungsanlagen.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsvorhabens ist die Entwicklung eines Verfahrenskonzeptes zur Koppelnutzung von Altpapier in Produktionsanlagen für Verpackungspapiere durch eine gezielte Abtrennung eines Teilstromes aus der Faserstoffaufbereitung und dessen Nutzung im Rahmen einer Bioraffinerie-Prozesskette zur Herstellung von Lävulinsäure. Die Herstellung für Lävulinsäure steht dabei exemplarisch für andere Bioraffinerieprozesse. Das entwickelte Konzept soll für die Industrie praktische Entscheidungshilfen über die Umsetzung eines solchen Konzeptes liefern. Die technologische und wirtschaftliche Tragfähigkeit dieses Konzeptes wird anhand der realen logistischen und strukturellen Daten der Region Ostdeutschland entwickelt und bewertet. Ein wesentlicher Aspekt der Konzepterstellung und der Machbarkeitsbewertung ist die maximale Ausschöpfung des Synergiepotentials der Koppelnutzung durch die im veränderten Papiererzeugungsprozess zu erwartende Produkteigenschaftsverbesserung einerseits und die stoffliche und energetische Kopplung durch Nutzung von Rejekten als Rohstoffe sowie Abwärme als Prozessenergie für den Bioraffinerieprozess.

Die Projektarbeiten beinhalteten die Aufnahme der derzeit angewandten Verfahren zur Herstellung von Lävulinsäure und deren technologische und wirtschaftliche Bewertung. In diesem Zusammenhang wurden unterschiedliche Altpapierfaserstoffe in Bezug auf ihre Eignung als Rohstoff für chemische Umwandlungsverfahren geprüft.

Einen weiteren Schwerpunkt der Arbeit bildeten Untersuchungen zur Bestimmung eines geeigneten Faserstoffstromes, welcher aus dem Papierherstellungsprozess ausgeschleust und der Lävulinsäureproduktion als Rohstoff zugeführt wird. Hierzu wurden im Labor- und Technikumsmaßstab eine Reihe von Faserstofffraktionen erzeugt und hinsichtlich ihrer papiertechnischen Eigenschaften und der bei Einsatz in chemischen Umwandlungsverfahren zu erzielenden Ausbeute bewertet. Dabei wurde deutlich, dass ein Schlüssel für die Wirtschaftlichkeit des gesamten Verfahrenskonzeptes in der effizienten Abtrennung und gewinnbringenden Nutzung der in dem abgetrennten Teilstrom vorhandenen mineralischen Bestandteile liegt.

Anwendung/Wirtschaftliche Bedeutung

Die Koppelnutzung von Altpapier durch Papierfabriken stellt ein neues technologisches und wirtschaftliches Konzept dar. Speziell unter dem Aspekt einer zukünftig weiter steigenden Nachfrage nach lignocellulosehaltigen Stoffen eröffnet das Koppelnutzungskonzept durch eine erhöhte Wertschöpfung die Möglichkeit, die Finanzierung des Faserrohstoffes auch unter erhöhtem Konkurrenzdruck zu ermöglichen. Insbesondere für kleine Papierfabriken stellen zusätzliche wertschöpfende Prozesse eine Option zur Standortsicherung dar.

Das neue Konzept zur parallelen Produktion von Verpackungspapier bzw. -karton und Plattformchemikalien ermöglicht den Papierfabriken die Einstellung erhöhter Verlustraten im Produktionsprozess und damit eine Verbesserung der Faserstoffeigenschaften. Zudem weist das Konzept auch einen Ausweg aus den Qualitätsproblemen, welche sich aus der weiteren Schließung der Papier-Recyclingkreisläufe ergeben. Dieser Weg war für das Produktionssegment der Verpackungspapiere und -kartone unter den derzeitigen Produktionsstrukturen durch ein ungünstiges Kosten-/Nutzen-Verhältnis verschlossen.

Bearbeitungszeitraum: 01.10.2010 – 30.09. 2012

Bemerkungen

Das Forschungsvorhaben IK-MF 100014 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Product aims

Paper, paperboard and board // packaging papers and paperboard

Key words:

packaging paper, nanoparticles, health, environment

Title:
Impacts of nano particles from paper and packaging products on health and environment

Background/Problem area

"Nanotechnology" (NT) - as in other industries - is an important factor for further technological advancement in the paper industry. Among other planned innovations, NT products have been in use for many years, e.g. nanoscale pigments for enhancing the printability or NT-based systems to improve retention.

Despite the clear benefit offered by NT, the discussion about the risks of NT is going to be capture the attention of the public to an ever greater extent, particularly non-governmental-organisations (NGOs) like environmental or consumer protection associations expressing their concerns about possible NT risks in public discussions.

Driven by the NGO concerns and the increasing public discussion, consumer questions about the application of nanoparticles in paper & board and related packaging products are rising as well. As a result, if nanoparticles are in use, there are follow-up questions to be answered: Are there adverse health or environmental effects which can be caused by the use of nanoparticles in paper products? Are there possible negative impacts if nanoparticles enter the environment or the recycling loop?

In addition to these questions, a regulatory framework of the NT in the European Union (EU) is still non-existent. In April 2009 the EU Parliament decided that there is a need for action in view of the fact that the existing acts to regulate NT are insufficient.

It is necessary to point out that obtaining information about NT and especially in combination with corporate data is a challenging task. This is due to the fact that there are numerous literary/internet sources and the problem about the legal grey area, which brings additional problems to find or identify nanotechnological paper industry products.

Objectives/Research results

The most important objectives within this project are to describe and observe the current development of NT in paper products and to identify the nanoparticles which might be used in German paper mills. In this context, it is necessary to consider the use of nanoparticles during paper production as well as the impact of nanoparticles on human health and their environmental effects.

It can be said first of all that nanoparticles are used mostly as part of retention systems or as nano-scale products in paper coatings. Graphic paper and photographic paper are currently providing the greatest input of nanomaterials. So far it has not been possible to find examples of tissue paper or packaging paper in which nanoparticles are being used, although there are nanoparticle-based coating products for packaging products on the market, e.g. an anti-slip coating for paper bags.

A standard statement concerning the risks of NT is not possible. Several hundred research projects are currently in progress to gather more information about the toxicology and ecotoxicology of nanoparticles. Up to now, NT research has been concerned primarily with commercial performance goals rather than risk matters. Therefore, the actual state of nanoparticle risk knowledge can only be summarized and combined with paper industry interests.

Furthermore, it is necessary to obtain more information about nanoparticle emissions during the life cycle of paper products. In particular, this has to include emissions at the workplace, to the consumer and during paper recycling. Referring to the recycling loop, a special focus will be to identify which particles might get returned to the production process, still with nanoscale properties.

Another goal is the identification and evaluation of existing and potential future acts which can affect the German paper industry. In this context, several European and German acts have been considered, e.g. the European Cosmetic Regulation 1223/2009 which includes a first NT definition but only for cosmetics, and European Regulation No 10/2011 for plastic packaging materials intended to come into contact with food which also regulates NT products in several points.

So far, the literature study has not yet reached completion and the recommended follow-up action has to be further elaborated and ultimately will be added in the completed project report.

Application/Economic benefits

The expected results of this study can be used directly by all paper mills. Referring the superior topic of this study "impacts of nanoparticles" a broad knowledge base will be provided. This knowledge base can be used to assess on-going or scheduled nanoparticle based paper and packaging products. The recommended follow-up actions include research proposals designed to close knowledge gaps and to avoid possible negative impacts on human health or environmental media due to the use of nanoparticle in paper und paper-based packaging products.

Project period: 01.01.2011 – 31.12.2011

Remarks:

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Papier, Karton und Pappe // Verpackungspapiere und -karton

Schlagworte:

Faltschachtel, Kleben, Klebemaschine, Karton

Thema:
Spezifizierung von Karton- und Klebstoffeigenschaften für eine optimale Verklebbarkeit von Faltschachteln auf Faltschachtelklebemaschinen

Ausgangssituation/Problemstellung

Faltschachteln aus Karton sind ein gängiges und viel verwendetes Packmittel. Wesentliche Vorteile gegenüber anderen Packstoffen sind ihre Formstabilität und Stapelbarkeit sowie die guten Schutzfunktionen bei günstigen ökologischen Eigenschaften. Sie bieten ausreichend Fläche und Oberflächenqualität für das Aufbringen von Werbebotschaften und Kundeninformationen.

Ein wesentliches Qualitätskriterium von Faltschachteln ist die Güte der Längsnahtverklebung. Da das Verkleben der Nähte den letzten Schritt in der Produktionskette darstellt, kann eine fehlerhafte Verklebung zu einem Schaden führen, der den Materialwert um ein Vielfaches übersteigt. Ein seit kurzem von der Forschungsstelle entwickeltes Prüfverfahren ermöglicht erstmals die Quantifizierung der Klebenahtfestigkeit unter praxisgerechten Belastungen. Dieses Instrument eignet sich auch dazu, die Haupteinflussfaktoren auf die Klebenahtfestigkeit zu ermitteln und optimale Eigenschaftsprofile und Prozessparameter zu spezifizieren.

Forschungsziel/Forschungsergebnis

Ziel des Projektes war die Ermittlung der karton- und klebstoffspezifischen Einflussfaktoren auf die Klebenahtfestigkeit von Faltschachteln bei ihrer Herstellung. Die ermittelten Einflussfaktoren wurden anschließend dazu benutzt, die optimalen Karton- und Klebstoffeigenschaften zu spezifizieren. Einen Schwerpunkt der Untersuchungen bildeten mit Lacken und Folien veredelte Kartonoberflächen.

Zusammenfassend lässt sich eine Vorgehensweise beschreiben, mit der die Spezifizierung einer optimalen Verklebung von Faltschachteln auf Faltschachtelklebemaschinen möglich ist. Die Herstellung der Faltschachteln erfolgte ausschließlich an Faltschachtelklebemaschinen unter praxisrelevanten Bedingungen bei den Industriepartnern. Damit der mögliche Einfluss der Faltschachtelklebemaschine ermittelt werden konnte, wurden jeweils die gleichen Falt-schachtelnutzen auf den unterschiedlichen Maschinen geklebt.

Zur Identifizierung der Klebenahtfestigkeit wurden die geklebten Faltschachteln entsprechend der PTS-Methode PTS-PR 301/2008 geprüft und das Bruchverhalten in Trennfläche bewertet. Aus Gründen der Vergleichbarkeit wurde ein genaues Zeitintervall zwischen dem Verkleben der Schachteln und der Klebenahtprüfung eingehalten. Die Auswertung der Messergebnisse erfolgte u.a. mit Hilfe statistischer Korrelationsanalysen, insbesondere wurden die Einflussstärken der einzelnen Einflussfaktoren auf die Klebenahtfestigkeit durch die Berechnung mittels Faktorenanalyse ermittelt und quantifiziert.

Je nach Art der Einflussfaktoren wurden für die einzelnen Bereiche Optimierungsvorschläge erarbeitet.

Anwendung/Wirtschaftliche Bedeutung

Bayern stellt einen bedeutenden Standort für die Faltschachtelindustrie dar. Zusätzlich dazu sind in Bayern wichtige Zulieferer der Faltschachtelindustrie, wie beispielsweise die Klebstoffindustrie, präsent.

Die Wettbewerbsfähigkeit der überwiegend kleinen und mittelständischen bayerischen Faltschachtelbetriebe hängt wesentlich davon ab, ob Produkte mit hoher Qualität kostengünstig hergestellt werden können. Ein wichtiges Kriterium stellt hierbei die Güte der Klebenähte dar. Die vorbeugende Qualitätssicherung durch die sichere Beurteilung der zur Verklebung eingesetzten Materialien vermeidet die Produktion von Makulatur, spätere Reklamationen oder Produktivitätsverluste durch Maschinenstillstandszeiten bzw. Reduktion der Maschinengeschwindigkeiten.

Das Vorhaben wird deshalb einen wesentlichen Beitrag zur Sicherung der Produktion von kleinformatigen Faltschachteln leisten und somit die Wettbewerbsfähigkeit der bayerischen Faltschachtelindustrie verbessern.

Bearbeitungszeitraum: 01.02.2010 – 31.01.2011

Bemerkungen

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Forschungsgebiet: Produkt-Ziele

Papier, Karton u. Pappe // Verpackungspapiere und -karton

Schlagworte:

Mineralöl, Migration, Verpackungen, Lebensmittel

Theme:
Migration of Mineral Oils from Packaging Materials into Foodstuffs as a Function of Storage Time and Storage Conditions

Background/Problem Area:

Mineral oil components in foodstuffs and in food packaging materials are strongly discussed since the end of 2009 as Grob et al. have published their results concerning the amount of mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) in foodstuffs and in recycling cartonboard. Since that time scientists from the Federal Institute for Risk Assessment, the Federal Ministry for Food, Agriculture and Consumer Protection and especially representatives of involved industrial associations and paper mills discuss the situation, the possible strategies to overcome the problems and the effects for the German paper industry. In the meantime, the quite extensive investigations in the Kantonales Labor Zürich and other laboratories demonstrate that certain cartonboard packagings contain high mineral oil amounts. The most important source is the recycling of offset printed papers (newspapers, advertising supplements and other). Unprinted recycling cartonboard usually contain 300 – 1 000 mg/kg mineral oil compounds with a share of 15 – 20 % aromatic compounds. The aromatic compounds, most of them highly alkylated polycyclic compounds, may show a risk for human health. Due to the relative low molecular weight, the highly vapour pressure and the low boiling points the compounds with 10 to 25 carbon atoms in the molecule may migrate via the gas phase from the packaging material to the packed foodstuffs. According to Grob nearly 70 – 80 % of the mineral oil components in the cartonboard may be released within 8 months. But on the basis of the undirected spread of mineral oils in the gas phase and of the design of the packages and the differences in the composition of the foodstuffs the amounts of mineral oils in the stored foodstuffs vary in a wide range. A certified analytical method for the determination of MOSH and MOAH in the different matter and a model for the calculation of the transfer from the packagings into the different foodstuffs under consideration of storage time and the various designs of packagings do not exist.

Objective/Research Results:

The extent of transfer of mineral oil compounds from the packaging depends on the following factors:

- Design of packaging and outer packaging (e. g. ratio of mass of packaging matter to packed foodstuff, size and
- matter of outer packaging and number of packaging units in one outer packaging),
- Barrier coatings of packaging material or inner bag,
- Type of packed foodstuff (amount of fat and moisture, particle size, porosity, density etc.),
- Conditions of storage (period, open or closed storage, ambient conditions (temperature, moisture content etc.)).

Therefore the forecast of the migration behaviour is very difficult. Usually for determination of transfer of contaminants from the packaging via the gas phase into dry foodstuffs the migration test with modified polyphenylene oxide (Tenax®) according to DIN EN 14338 is carried out. In the current research project different foodstuffs will be tested under standardised conditions concerning their MOSH and MOAH amount in relation to the MOSH and MOAH amount of the packaging matter and the storage time. The results will be compared to the result of the Tenax® migration test of the packaging before filling of packaging with foodstuff. Additionally specific applications, e. g. for short time storage of fruits and vegetables and for take away packagings will be investigated, too.

Application/Economic Benefits:

Against the background of the current discussion about mineral oils which may migrate from recycling packagings into the packed foodstuffs detailed investigations of migration process as a function of storage time are urgently necessary. On the basis of the experimental results a real estimation of quantity and period of mineral oil migration from packaging into foodstuffs is possible. Additionally conclusions about the safely use of food packaging made from recycling paper and board could be drawn. To provide evidence for uncritically usage of recycling packagings for special use, e. g. short time open packaging and storage of vegetables, fruits, eggs and pizza will be a significant sales argument.

By means of the planned investigations data should be generated to support the producers of recycling packagings in their product responsibility according to EU regulation 1935/2004. Currently, the guarantee that recycling packagings do not release compounds in such quantities to the foodstuffs which might be suitable to affect the human health is the most important prerequisite for the acceptance of these products as food packagings. The expected results will be useful for the cooperation with the authorities for consumer protection.

Project Period: 01.01.2011 – 31.03.2012

Remarks::

The research project (INFOR 148) is being funded by INFOR.

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Verpackungspapiere und -karton

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 is 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 IGF project AiF 8243/16344 of the research association "Forschungsgesellschaft Kunststoffe e.V." was 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) on basis of a decision of the German Federal Parliament and is performed in cooperation with "Deutsches Kunststoffinstitut" (DKI) and "Hochschule Darmstadt, Fachgebiet Mikrobiologie".

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Verpackungspapiere und -karton

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

Trotz der unbestrittenen und erheblichen Bedeutung für die Eigenschaften von Papier und Karton ist der konkrete Einfluss der räumlichen Verteilung der verschiedenen Produktkomponenten insbesondere in Z-Richtung in vielen Fällen unbekannt. 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 Abschätzung der Wirkung von Prozessänderungen auf die Produkteigenschaften oder eine angestrebte Eigenschaftsverbesserung stark empirisch geprägt. Aktuell fehlen jedoch leistungsfähige Verfahren für eine zuverlässige Ermittlung der Z-Gradienten nicht nur organischer Papierkomponenten. Dies trifft vielmehr grundsätzlich für die verschiedensten Papieradditive zu, wodurch eine gezielte Einstellung entsprechender Gradienten, die für das Erreichen gewünschter Papier- und Kartoneigenschaften außerordentlich wünschenswert wäre, nicht möglich ist. Konkrete Beispiele für Fragestellungen, bei denen die Kenntnis der Z-Gradienten hilfreich wären, 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 soll eine Methodik erarbeitet werden, die flexibel an die Anforderungen zur Erstellung von Z-Profilen verschiedenster Papierkomponenten und Papiereigenschaften in unterschiedlichen Papier- und Kartonsorten angepasst werden kann, um eine möglichst breite Anwendung über die gesamte Wertschöpfungskette Papier hinweg zu ermöglichen. Die Eignung verschiedener Kombinationen an Probenvorbereitung und Quantifizierungs- bzw. Messmethoden soll ermittelt werden. Die entwickelten Verfahren werden 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 zu beantragende Projekt würden auch die KMU der Papierkette von den Möglichkeiten anspruchsvoller Analytik profitieren, 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

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.

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Verpackungspapiere und - karton

Schlagworte:

Versuchspapiermaschine, Laborstreichgerät, Haftklebstoff, Elektronenstrahlhärtung, UV-Härtung

Thema:
Forschungsschwerpunkt Bayern: Papier und Verpackung

Ausgangssituation/Problemstellung

Die Forschungskompetenz im Papierbereich liegt an der Hochschule München unter anderem auf dem Gebiet der chemischen Verfahrenstechnik bei der Papierherstellung und -modifikation. Hierbei dreht es sich insbesondere um den Bereich der chemischen Additive, welche sowohl als Prozesschemikalien als auch als funktionale Additive zur Papierqualitätsoptimierung Anwendung finden. Hiermit ist die Papierindustrie in der Lage, die Ausbeuten zu erhöhen und damit ressourcenschonender zu produzieren. Die Forschungskompetenzen auf dem Gebiet der Verpackung liegen im Bereich der Elektronenstrahl-und UV-Härtung, der Schmelzklebstoffe und der Etikettenverarbeitung sowie beim Beschichten, Streichen und Verkleben von Papieren. In den einzelnen Themenbereichen wurden Projekte gestartet, Vorträge gehalten und Patente eingereicht. Die Hochschule München bietet deutschlandweit die einzige Fachhochschulausbildung im Bereich Papier und Verpackung. Mit über 350 Studierenden ist diese europaweit eines der drei größten Ausbildungszentren im tertiären Bereich. In den letzten Jahren konnten acht kooperative Promotionen in oben genannten Themengebieten durchgeführt werden.

Forschungsziel/Forschungsergebnis

Die übergreifenden Forschungsgebiete, die die gesamte Prozesskette, vom Faserstoffhersteller über die Papier- und Kartonerzeugung, den Druckfarbenlieferanten, den Haftklebstoffhersteller und -beschichter bis zum Drucker abdecken, gestatten ein besseres Verständnis der Zusammenhänge in diesem Themenkomplex. Es wird damit möglich, prozesskettenübergreifende Forschungsprojekte zu starten, in die mehrere Firmen aus verschiedenen Bereichen eingebunden sind. Ziel ist es daher, diejenigen Bereiche der oben angeführten Prozesskette stärker zu entwickeln, die aufgrund fehlender Ressourcen bisher noch nicht in der notwendigen Tiefe bearbeitet werden konnten. Im Rahmen der beantragten Kapazitätsausweitung ist vorgesehen, die seit vielen Jahren vorhandene aber mangels personeller Ausstattung noch nicht eingesetzte Papiermaschine (VPM) sowie die vorhandenen Streichaggregate in die Forschung und Ausbildung einzubeziehen.

Im Laufe des Berichtzeitraums konnte die VPM in der neu eingerichteten Maschinenhalle in Betrieb genommen werden. Erste Untersuchungen im Bereich der Forschung wurden erfolgreich durchgeführt und mit dem Aufbau einer individuell auf die Bedürfnisse der Versuchspapiermaschine angepassten Stoffaufbereitung begonnen. Im Bereich der Streichtechnik wurden umfangreiche Untersuchungen, auch im Rahmen von Masterprojekts und Bachelorarbeiten, durchgeführt, um die Performance der Streichaggregate auszuloten und zu verbessern. Im Bereich Verpackung wird in Kooperation mit der TU München eine Promotion zum Thema Stanz- und Kriechverhalten von Haftklebstoffen durchgeführt. Es wurden verschiedene neue Messverfahren entwickelt, die es ermöglichen, die einzelnen beim Stanzen stattfindenden Schritte zu separieren und zu verstehen. Als weiteres wurde ein Verfahren zum Nachweis des Aushärtungsgrades von strahlungshärtenden Druckfarben so weiterentwickelt, dass in Kooperation mit einer Firma die Übertragbarkeit in den Produktionsprozess geprüft wird. Im Bereich Wechselwirkungen wässriger Systeme mit Papier wurde eine Methode entwickelt, die das Eindringverhalten von wässerigen Beschichtungsmassen in Zeiträumen unter drei Sekunden detektieren kann.

Anwendungen/Wirtschaftliche Bedeutung

In halbjährlichen Treffen werden die jeweiligen Forschungsergebnisse Firmen aus der Industrie vorgestellt. Damit entwickelt sich der Forschungsschwerpunkt als wichtiger Kooperationspartner für FuE-Projekte. Aus den laufenden Forschungsarbeiten sollen nach dem Förderungszeitraum weitere Projekte im Anschluss gestartet werden. Neben der Stärkung der Forschungsschwerpunkte soll die Förderung des Bereich „Papier und Verpackung“ dazu genutzt werden, weiteren hochtalentierten AbsolventInnen die Chance auf eine erfolgreiche Promotion zu ermöglichen.

Bearbeitungszeitraum: 01.07.2008 - 30.06.2011

Bemerkungen

Der Forschungsschwerpunkt Papier und Verpackung wird aus Mitteln des Bayerischen Staatsministeriums für Wissenschaft, Forschung und Kunst, München, gefördert.

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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

composite; paper; sheet; resin; lightweight construction

Title:
Development of a paper-sheet metal composite of a high-strength, thin-walled body panel in automotive engineering

Background/Problem area

The demand for multifunctional, light-weight composite materials which at the same time exhibit high mechanical load carrying capacity continues to grow and is even set to intensify in view of the continued shortage of natural resources and the rise in global demand for light-weight materials. The use of high-strength, thin-walled sheet metal in automotive engineering holds great potential for a significant savings of material as a result of mass reduction and thus higher energy efficiency. It has, however, not yet been possible to tap the full potential of the thin-walled body panels owing to their poor vibration behaviour and their poor sound deadening.

Initial preliminary studies showed that the acoustic behaviour of such panels can be improved significantly by applying a layer of paper to them. To be used in automotive engineering, however, such paper-sheet metal composites must meet a large number of requirements. In addition to guaranteeing the mechanical and acoustic properties, the composites must also ensure good workability and durability, for example.

Objectives/Research results

The objective of the project is to develop a multifunctional paper-sheet metal composite designed to improve the vibration behaviour and acoustic deadening of high-strength, thin-walled body panels for car body construction with a view to reducing the mass and save energy in car manufacturing.

Investigations have been started defining the particular requirements of the composite. Based on these results, different possibilities for the assembly have been discussed. They indicated that glue layer, fibre-additive formulation, binder and impregnation should be developed in such a way, that the composite shows strong viscoelastic properties and viscous internal frictional losses of particles as high as possible, thus significantly reducing its acoustic emission properties.

Considering the results for sound propagation and -absorption, several two-dimensional paperboards differing in their particular fibre composition as well as in the pre-treatment of the fibres and the area related mass were produced in pilot scale at PTS. Furthermore, using the same fibre formulations as in the pilot trials, three-dimensional fibre bodies were developed in a pulp moulding process.

In parallel, a binder especially optimised for the impregnation of the fibre samples was developed. Afterwards, trials on the impregnation behaviour and stickiness of the two- and three-dimensional samples were carried out. In addition, the resin uptake and the influence of a pre-treatment with paraffin were analysed. This held true for the mechanical properties.

Based on these results, a first development of paper-sheet metal composites has been started. The determination of the particular sample properties and the comparison with already existing materials is currently being accomplished.

Application/Economic benefits

The material is to be designed in such a way that a wide variety of different sectors can benefit from it. The properties are to be combined much like a modular system so that a cost-effective solution can be provided depending on the application or construction concept. The group of users includes companies in the following sectors:

- The sheet metal working industry, construction industry and mechanical engineering
- Automotive engineering (cars, railway technology, airplane, ship, container construction)
- Housings, switch cabinets for industry and home electronics as well as household appliance technology
- Manufacturers of fibres and adhesives, paper composites and additives.

The benefits derive from the use of high-strength, thin-walled and thus mass-savings pieces of sheet metal in car manufacturing by developing novel paper composites with multifunctional product properties. The novelty also includes the use of regenerative raw materials (a lasting source of cellulose fibres) which will replace synthetic, petrochemically based man-made fibres, thus resulting in a significant savings of energy during production. This in turn will enhance the environmental compatibility / recyclability of the composite. Similarly, the (partial) use of virgin materials for adhesive and impregnating resin system will also make a contribution. Additionally integrated functions such as printed circuits will serve to reinforce the benefits of the composite as well.

Project period: 01.07.2010 - 30.06.2012

Remarks:

The research project IGF 362 ZBR is being funded by the Federal Ministry of Economics and Technology BMWi within the framework of the ZUTECH programme and is being performed together with Brandenburgische Technische Universität Cottbus, Lehrstuhl für Polymermaterialien (BTU-LSPM) and with the Technische Universität Dresden, Lehrstuhl für Umform- und Urformtechnik (TUD-LUT).

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Technische Spezialpapiere

Schlagworte:

Präkeramische Papiere, Porenbrenner, hochtemperaturbeständige Werkstoffe

Thema:
„HÖCKER“ - Höchsttemperatur- und korrosionsbeständige hochporöse (Faser-)keramiken für energieeffiziente Verbrennungsprozesse

Ausgangssituation/Problemstellung

Porenbrenner weisen ein hohes Potenzial für Energie- und Emissionseinsparungen auf. Die Schadstoffemissionen können halbiert werden und liegen weit unter den gesetzlich vorgeschriebenen Grenzwerten. Probleme herkömmlicher Verbrennungstechnologien durch hohe Strömungsgeschwindigkeiten werden vermieden. Kernkomponenten des Porenbrenners sind die Brennzone aus einem keramischen porösen Material und eine vorgelagerte Flammensperrzone. Für den zuverlässigen Langzeitbetrieb der Porenbrenner werden verbesserte thermoschockbeständige Materialien benötigt, die möglichst Temperaturen bis zu 1600 °C und aggressiven Atmosphären standhalten.

Papierabgeleitete keramische Wellpappenstrukturen bieten eine elegante Möglichkeit für die Herstellung dünnwandiger, komplex geformter Strukturkeramik. Papiere können bereits beim Papierherstellungsprozess mit präkeramischen Füllstoffen so hoch angereichert werden, dass sie sinterfähig sind. Sie können mittels klassischer papiertechnologischer Formgebungsverfahren zu Papierbauteilen (z. B. Wellpappenstrukturen) geformt und thermisch in Keramik überführt werden. Präkeramische Papiere lassen sich stanzen und zu papiertypischen Wellpappenstrukturen umformen, so dass nach Schichtung von Wellpappenelementen und einer thermischen Umsetzung hochporöse Keramiken mit definierter Porosität und Porengeometrie sowie definierten Steggeometrien realisierbar sind, die zum Aufbau von Porenbrennern geeignet sind.

Forschungsziel/Forschungsergebnis

Gesamtziel des Vorhabens ist die Entwicklung poröser Keramikwerkstoffe für den Einsatz in energieeffizienteren Gasverbrennungsanlagen, wie z. B. Porenbrenner und Brennkammerauskleidungen. Sie sollen für Einsatztemperaturen bis 1600 °C in oxidierender und reduzierender Atmosphäre geeignet sein.

Die Aufgabe der PTS besteht in der Entwicklung papierbasierter Werkstoffe („präkeramische Papiere“) als Vorstufen für gesinterte Werkstoffe zur Porenbrennerentwicklung. Dazu sind folgende Arbeitsschritte vorgesehen: Entwicklung und Herstellung von mit SiC und ZrO2 hochgefüllten Papieren im Labormaßstab zur Umwandlung in keramische Werkstoffe, Hochskalierung vom Labor- auf den Technikumsmaßstab, Entwicklung von Formgebungs- und Fügetechnologien, Bereitstellung erster Bauteile und Herstellung optimierter Funktionsmuster.

In Kooperation mit den Projektpartnern wurden zunächst die Anforderungen an die neuen Werkstoffe hinsichtlich mechanischer, thermischer und chemischer Stabilität definiert und geeignete Basiswerkstoffe ausgewählt. Ausgehend von bei der PTS vorliegenden Erfahrungen wurden hochgefüllte Papiere auf der Basis von Siliciumcarbid und Zirkoniumdioxid im Labormaßstab hergestellt. An diesen wurden von den Projektpartnern Sinterungsversuche durchgeführt. Die im Labormaßstab gefertigten Blätter wurden mittels Laborkalander satiniert und Formgebungsversuche auf der Labor-Wellpappenmaschine durchgeführt. Anschließend wurden Versuche zur Optimierung der Fügetechnologie durchgeführt. Aus den im Labormaßstab gefertigten Papieren wurden verschiedene Porenbrenner-Modelle hergestellt und bei den Projektpartnern auf ihre Eignung untersucht. Die ersten Versuche ergaben eine gute Eignung der Werkstoffe, jedoch eine Neigung zur langfristigen Bildung von Mikrorissen. Die Papierrezepturen wurden hinsichtlich der Vermeidung der Mikrorisse weiterentwickelt und die Geometrie der Modelle anhand der Ergebnisse der Brennertests modifiziert. Die optimierten Labormodelle wurden bei den Projektpartnern Sinterungsversuchen unterzogen und auf ihre Eignung als Porenbrenner untersucht.

Anwendung/Wirtschaftliche Bedeutung

Es besteht ein Bedarf nach energieeffizienteren, flexiblen und hochmodulierbaren Heizmethoden, der für eine Vielzahl von Anwendungen durch den Einsatz von Porenbrennern abgedeckt werden kann. Als Voraussetzung hierfür müssen Einsatztemperatur, Lebensdauer und Zuverlässigkeit der Porenbrennersysteme erhöht werden. Daraus werden ein zunehmender Einsatz von Porenbrennern in Verbrennungs- und Hochtemperaturanlagen und Energieeinsparungen durch höhere Wirkungsgrade sowie Schadstoffreduktionen erreicht werden können. Mit dem Porenbrennersystem werden Ziele und Lösungen auf einem weltweit brisanten energie- und umweltpolitischen Gebiet angestrebt.

Im Erfolgsfall können die für die Porenbrennertechnik entwickelten Materialien und die verbesserten Oxidationsschutzschichten auch für andere Höchsttempertaturanwendungen genutzt werden, z. B. Gasturbinen, industrielle Wärmebehandlungsanlagen, Filter sowie Teile im Abgasstrang von Fahrzeugen oder in der Luft- und Raumfahrt.

Bearbeitungszeitraum: 01.10.2009 – 30.09.2012

Bemerkungen

Das Forschungsvorhaben BMBF 03X3543 HÖCKER wird im Rahmen des Programms „Höchstleistungswerkstoffe für mehr Energieeffizienz und CO_2-Einsparung: Leistungssprünge in energetischen Umwandlungsprozessen“ aus Mitteln des Bundesministerium für Bildung und Forschung (BMBF) gefördert. Es wird in Zusammenarbeit mit der Schunk Kohlenstofftechnik GmbH, der Evonik Degussa GmbH, der Firma Walter E. C. Pritzkow Spezialkeramik, der Drache Umwelttechnik GmbH, dem Ingenieurbüro Issendorf, der Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (IWM) und der Friedrich-Alexander-Universität Erlangen-Nürnberg (LSTM) durchgeführt.

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Forschungsgebiet: Produkt-Ziele

Papier,Karton und Pappe // Technische Spezialpapiere

Schlagworte:

organische Elektronik, Glätte

Thema:
Optimierte papierbasierende Substrate mit höchstglatter, folienähnlicher Oberfläche für organische Elektronik

Ausgangssituation/Problemstellung

Organische Elektronik gilt als Hauptentwicklungsbereich mit stetig und massiv anwachsender Bedeutung. Die Herstellung von beispielsweise einfacher gedruckten Leiterbahnen, Transistoren, Sensoren, OLED´s, Batterien und Energiespeicher bis hin zu Solarzellen erfordert in allen Anwendungsbereichen gleichermaßen hochwertige Trägermaterialien mit höchster Glätte, chemischer Beständigkeit und gewissen Barriereeigenschaften. Unterschiedliche Forschungsgruppen (PolylC, Heliactec, Fraunhofer Institut IMPS Dresden etc.) entwickeln derzeit Technologien, welche die Massenproduktion elektrischer Schaltungen auf flexiblen Substraten ermöglichen. Bisher werden als Substrat Kunststoff- oder Metallfolien eingesetzt, da selbst die im Markt verfügbaren glättesten Papiere nicht die hohen Anforderungen als Elektroniksubstrat erfüllen können (mittlere Rautiefe Gussstrich ca. 0.3 µm). Rauheitsspitzen und Löcher in der Substratoberfläche führen zu fehlerhaft gedruckten Leiterbahnen. Die bislang in diesem Bereich eingesetzten Folien haben mittlere Rautiefen von unter 40 nm bis hin zu unter 1 nm. Eine weitere Verbesserung der Glätte von Papier war bislang nicht erforderlich, da bei der herkömmlichen Verarbeitung in Druckmaschinen sonst auch negative Verarbeitungseigenschaften zu erwarten sind. Durch den Etablierung des Curtain Coater, der kosteneffizient eine mehrlagige Beschichtung erlaubt, wird nun beim Papier eine weitergehende innovative und wettbewerbsfähige Funktionalisierung und Weiterentwicklung des Papiers ermöglicht, welche im Anbetracht der wirtschaftlichen Situation in der Papierindustrie nicht nur wünschenswert sondern sogar unbedingt erforderlich ist.

Forschungsziel/Forschungsergebnis

Ziel des Projektes ist die Entwicklung eines Streichkonzeptes für die mehrlagige Beschichtung von papierbasierenden Substraten zur grundlegenden Verbesserung von Rauheit und Welligkeit, wenn möglich, bis in den Nanobereich. Eine der wichtigsten Aufgaben dabei ist es, zu klären inwieweit die Erzeugung höchster Glätte mittels eines ausgeklügelten Strichkonzeptes generell möglich ist. Die Arbeiten beinhalten unter anderem die topografische Beurteilung verschiedener auf wässriger Basis hergestellter Polymerfilme. Die Polymere zeigen wie erwartet ein unterschiedliches Potential abhängig von den Trocknungsbedingungen aus wässriger Lösung glatte Oberflächen zu erzeugen.

Die bisherigen Ergebnisse zeigen, dass sehr dünne plättchenförmige Pigmente, wie Talkum oder Kaolin, im Mittelstrich die bestmögliche Grundlage für einen höchstglatten Topstrich bieten. Ob ein weiter Auftrag rein polymerer Schichten eine weitere Verbesserung bringen kann, ist zum jetzigen Zeitpunkt noch nicht bekannt. Damit in der späteren Anwendung keine Faserbruchstücke von der Rückseite auf die glatte Oberfläche übertragen werden, ist eine Rückseitenbeschichtung erforderlich. Die Resultate zeigen, dass Stärke mit einem kleinen Anteil an Talkum in der Rückseitenbeschcihtung für eine ausreichend gute Abdeckung sorgt und die Planlage verbessert.

Anwendung/Wirtschaftliche Bedeutung

Die Ergebnisse ermöglichen im besten Falle eine Weiterentwicklung eines hochtechnischen Spezialpapieres als Massenprodukt mit folienähnlicher Oberfläche. Von den hochglatten Produkten mit dichter porenfreier Oberfläche wird, neben dem Einsatz als Trägermaterial für organische Elektronik aber auch eine Reihe weiterer Eigenschaften erwartet, die ebenfalls neue Märkte eröffnen können: filmähnliche Oberflächen bieten optimale Ausgangsbedingungen für Metallisierung, mehrlagige dünnste Schichten als Sicherheitsmerkmale z. B., hochglänzende Oberflächen für Dekorprodukte, Porenfreiheit und brillantere Bedruckung für hochqualitative Verpackungsmaterialien und andere innovative Produkte mit neuen Eigenschaften, überschaubarer Größe und mit hoher Wertschöpfung.

Das Know –how zur Veredlung von Papier zu optimierten Trägermaterialien ist für kmU die Basis zum Bau neuer Produktionslinien oder zur Erweiterung bestehender Produktionsprogramme. Die kurz und mittelfristig begrenzten Produktionsvolumina (Vorlauf) erlauben eine kosteneffiziente Produktion nur auf kleineren Veredelungsanlagen (bevorzugt kmU). Vor allem für diese sollten sich daher neue profitable Marktsegmente mit hoher Wertschöpfung eröffnen.

Bearbeitungszeitraum: 01.09.2009 – 31.12.2011

Bemerkungen

Das Forschungsvorhaben IGF 16193N (Kurztitel: Filmähnliche Papieroberflächen) wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

ceramic, preceramic paper, lightweight construction, kiln furniture

Title:
Ceramic lightweight constructions

Background/Problem area

Ceramic 3D structures are difficult to access with conventional approaches such as injection moulding, compression moulding and extrusion. Producing thin-walled structures is only feasible using extrusion processes which results in a very high effort and high costs. Moreover, it is not possible to realize a non-directional pore system throughout the product. Innovative solutions to produce cheap, complex and high temperature resistant ceramic lightweight constructions are still missing.

Pre-ceramic paper used as semi finished product is a cost-efficient and versatile approach for the construction of ceramic 3D structures. However, at the moment there are no optimized set of compounds and shaping techniques.

Objectives/Research results

The objective of this project is to optimize set of compounds for the paper recipe and develop new shaping techniques for the manufacturing of ceramic lightweight constructions based on conventional shaping techniques used in paper technology.

The project is articulated into two parts:

1. Optimization of the paper recipe in respect to formability (Papiertechnische Stiftung)
2. Thermal conversion (sintering) (Friedrich-Alexandern-Universität of Erlangen-Nürnberg)

PTS developed the paper making process and screened numerous parameters in respect to formability of the semi finished product. The focus was to create a homogeneous paper that can be easily converted by standard shaping techniques know from the paper technology while still granting access to high strength ceramics after the sintering process. Moreover, PTS improved the densification, corrugating, cutting and gluing process for multi layer systems. Friedrich-Alexander-Universität of Erlangen-Nürnberg adapted and optimized the sintering process. They also characterized the ceramics after sintering and recommended further adaptations to the paper recipe. The next step is to use optimized pre-ceramic paper for further trials on formability at industrial partners.

Application/Economic benefits

The use of pre-ceramic papers as flexible green body before sintering combined with paper converting technologies promises new and easily accessible ceramic lightweight constructions (for example corrugated structures). This new process should deliver a cost reduced way to achieve various ceramic 3D structures that are difficult to access by other ceramic producing processes such as compression moulding, injection moulding and extrusion. Possible application areas could be kiln furniture or filtration units.

The research results will be used by German paper manufacturer and converting plants. Secondly, they will have an impact on the future trend of German SMEs (small or medium-sized enterprises) in the technical ceramic and filter industries. Low cost applications of pre-ceramic based technical ceramics could evolve into a totally new market for German enterprises once the current technical problems such as formability and homogeneity of the semi finished products have been solved in research projects.

Project period: 01.12.2010 – 30.11.2012

Remarks:

The research project IGF 16485N is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with Friedrich-Alexander-University of Erlangen-Nürnberg, Chair for Glass and Ceramics.

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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

silicon dioxide, microporous coating

Title:
Nanoscale SiO_2 dispersions for cationic, microporous coatings

Background/Problem area

Coatings give rise to the optimisation and enhancement of performance characteristics and fields of application of materials. In the paper industry, coating is the most important upgrading process. Paper coatings are capable of significantly expanding the range of paper properties. The requirements on a coating that is used as the ink receiving substrate in a photo inkjet paper are especially high. It must be capable of absorbing 20 - 30 mL/m² of liquid very quickly. The shape of the particles must also be suitable for achieving such great porosity. Structures that are as irregular as possible, ideally fractals, are advantageous. The research project described in this paper is being conducted using pyrogenic silicas in such photo inkjet coatings. The cationic, acid-stabilising dispersion of SiO_2 is not possible for practical purposes, since the oxide reacts like an acid and even at pH 1 the zeta potential only attains a value near zero. After the charge of the pigments has been reversed using poly-(Diallyldimethylammoniumchloride) “poly-DADMAC“, however, this dispersion is successful. A phenomenon associated with dispersions of pyrogenic SiO_2 is the maturation time. Freshly prepared dispersions coagulate when polyvinyl alcohol (PVA) is added. As the dispersion continues to mature, however, the viscosity of such mixtures decreases steadily. The causes are unknown. In view of the storage requirements and the logistics associated with the intermediate storage of dispersions, avoiding or preventing such maturation is economically important. In addition, the use of high-shear procedures can shorten, but not entirely avoid the maturation time. In addition, it also gives rise to considerable costs owing to the extensive wear the dispersion systems suffer.

The problem area can therefore be described as follows:

The dispersion of pyrogenic silicas requires better knowledge of colloid-chemical possibilities. Restrictions of the electrostatic stability require additional stabilisation via steric effects. The relationship of pH and dispersion stability is unfavourable for productivity and the product properties of microporous ink receiving substrates. The measures currently necessary in order to use pyrogenic silica (thinning, high shear, intermediate storage, slow processing) are cost-intensive and relativise the favourable price of the raw material with respect to other alternatives such as aluminium oxide.

Objectives/Research results

The objectives of this research project are to investigate the potential steric stability of SiO_2 dispersions using the manufacture of highly filled inkjet coating colours as an example, to avoid the maturation of SiO_2 dispersions and to throw some light on the physical-chemical processes that occur.

The desired results of the research project include: polymeric dispersion aids and processes that make it possible to produce highly filled, low-viscosity SiO_2 dispersions at pH 4.5, a dispersion formulation for the production of cationic, transparent, highly absorptive SiO_2 dispersions like those required for photo inkjet coating colours, as well as an avoidance strategy for maturation-related intermediate storage of dispersions of pyrogenic silicas in the production of photo inkjet coating colours.

The desired economic results include an improvement in the cost situation of porous SiO_2-based coatings compared to Al oxide coatings whilst taking into consideration the processing problems and the reduction in the product costs for photo inkjet paper, thus improving the chances of inkjet technology compared to the silver salt and D2T2 processes (dye diffusion/thermal transfer).

Application/Economic benefits

A comparison of Al oxides and Si oxides reveals significant differences in the production costs with a cost advantage for SiO_2 of up to 50 %. This advantage will continue to grow in view of the expected rise in energy costs. This raw material cost situation is by far the most important motive force behind the use of SiO_2 in the inkjet sector. The special aspects associated with SiO_2 processing, however, do not allow the full benefit of this cost advantage to be derived. This explains why SiO_2 has still not been able to establish itself as the standard for photo inkjet pigments.

The development of a process for producing highly filled, low-viscosity SiO_2 dispersions at a moderate pH and the development of a concept for avoiding the maturation time before the further processing of the dispersions to form coating colours will provide industry with new coating materials. These materials will be used first in the paper industry. The modified polymers that might be required as dispersion aids will expand the product line of the chemical industry. In addition to the benefits yielded by the research results in the paper industry itself, it is possible to transfer them to the SME-relevant sectors by manufacturing the special-purpose chemicals on the part of a small and flexible supplier, thus making the transferability of the results to other applications conceivable within the scope of technology consultation and transfer. These achievements will support SMEs in their attempts to improve their products or more quickly market new products and to expand the range of applications and market share of inkjet printing by providing more inexpensive and tailored surfaces. Increase in turnover in services companies, e.g. photo-finishing service providers.

Project period: 01.10.2010 – 30.09.2012

Remarks:

Research project IGF 16486N (short title: SiO_2 dispersions) is being funded by the Federal Ministry of Economics and Technology.

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Research area: Product aims

Paper, paper board and board // Technical specialty papers

Key words:

cast metal, foundry, highly filled paper, high temperature, speciality paper

Title:
Paper derived metal casting systems

Background/Problem area

Large metal structures with complex geometries are typically produced by founding. In foundries large structures are realized by sand casting. The cavities for the castings are typically filled with liquid metal using ceramic tubes. These tubes are produced by an energy consuming sintering process, are heavy and difficult to handle. Moreover the regeneration of the casting sand is made more difficult due to heavy pieces of the used ceramic tubes. In the Japanese market recently pulp based tubes for casting systems were introduced. The tubes are fabricated by pulp molding and exhibit a huge content of inorganic fillers to show high temperature resistance. This tubes exhibit big advantages by means of handling and removal. However due to the production process the length of these tubes is limited and no gradient within the tube wall can be effectively realized to tailor the tube wall for the high temperature application.

Objectives/Research results

Objective of the project is the base development of paper derived metal casting systems (tubes) using a paper machine and the winding core process. For this purpose papers highly filled with inorganic fillers and inorganic binders with high temperature resistance are to be developed in lab and pilot plant scale. The papers are to be adapted to the core winding process. During the winding process a gradient within the tube wall is to be realized to tailor the tube wall for the high temperature application. Improvements in cost effectiveness and handling compared to conventional casting tubes are to be demonstrated.

In the first project phase the requirements for the use as metal casting system are defined and the selection of raw materials is performed. Based on the different inorganic filler systems highly filled papers were developed in laboratory scale. The paper variants varied in kind of filler, filler content and degree of densification. These paper sheets were characterized and used for paper stacks consisting of 4 paper layers. The layers were glued together using organic and inorganic binder systems. The multi layer paper stack simulated the multilayer structure of winding cores for first tests with liquid metal. In the frame of static and dynamic casting test the resistance of the different paper stacks to the liquid metal were tested. Based on the results the most promising filler/Binder systems were selected for further optimization loops.

Application/Economic benefits

Highly filled papers as speciality papers are a new interesting product particularly for small and medium-sized enterprises (SME) in the area of paper production. SME are flexible enough to incorporate new speciality paper species in their product portfolio. In addition to that smaller production masses of highly filled papers as precursors for metal casting systems fit to their business model.

Based on the project results the potential of highly filled papers as precursor material for high temperature applications is derivable. Paper industry (paper production and paper converting) in cooperation with metal industry will be able to start specific product developments in the area of metal casting systems. Due to the advantages of paper derived metal casting systems the competitiveness of foundries, comprising a lot of small and medium sized enterprises in Germany, is improved.

Project period: 01.07.2010 – 30.06.2012

Remarks:

The research project IGF 16610 N is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with the Institute of Casting Technology in Düsseldorf.

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Forschungsgebiet: Produkt-Ziele

Papier, Karton und Pappe // Technische Spezialpapiere

Schlagworte:

Brandschutz, Leichtbauverbundsysteme, Baustoffe

Thema:

„Brandschutz“: Entwicklung nichtbrennbarer Leichtbau-Verbundsysteme auf der Basis von dünnen Brandschutzplatten mit Faserarmierung und mineralisch hochgefüllten Papieren für die Hohlraumstrukturen

Ausgangssituation/Problemstellung

Leichtbaumaterialien werden im Brandschutz vor allem als nicht tragende innere Trennwände oder Paneele für abgehängte Decken eingesetzt. Die wesentlichen Anforderungen an Brandschutzmaterialien bestehen im Wesentlichen darin, dass sie leicht, temperaturbeständig aber vor allem nichtbrennbar sind. Sie müssen außerdem in der Regel mechanische Stabilität aufweisen, gut verarbeitbar und preiswert sein. Oft ist zusätzlich eine Schallschutzfunktion erwünscht z. B. bei Deckenpaneelen.

Die derzeit eingesetzten Materialien sind in der Regel zwar relativ preiswert, besitzen jedoch oft eine hohe Dichte und eingeschränkte Feuerwiderstandseigenschaften, um z. B. als Deckenpaneele in Fluchtwegen eingesetzt werden zu können. Verbunde aus dünnen Brandschutzplatten mit Faserarmierung (düBraFa) und mineralisch hochgefüllten Papieren bieten sich wegen ihrer hohen Temperaturbeständigkeit und Nichtbrennbarkeit zur Herstellung von Leichtbaustrukturen als Baustoff im Brandschutzbereich an.

Die wichtigsten Rohstoffe für die düBraFa, Füllstoffe und Fasern, stehen langfristig in großen Mengen und auch sehr preisgünstig zur Verfügung. Die Herstellung von mineralisch hochgefüllten Papieren mittels papiertechnischer Formgebungstechnik stellt eine leistungsfähige Möglichkeit dar, auch geformte, dünnwandige Leichtbauverbunde zu erhalten (z. B. Wabenstruktur). Durch die Verbindung der in Leichtbauweise gefertigten hochgefüllten Papiere mit den düBraFa wird ein leichter und nicht brennbarer Baustoff für den Brandschutz im Bauwesen geschaffen.

Forschungsziel/Forschungsergebnis

Das Hauptziel des Projektes besteht in der Entwicklung einer düBraFa und von mineralisch hochgefüllten Papieren, die nicht brennbar sind und in der Herstellung eines leichten Verbund-Baustoffs aus beiden Komponenten. Zur Herstellung der Leichtbaustrukturen sollen papiertechnologische Formgebungs- und Verarbeitungsverfahren genutzt werden können. Bei der Fertigung der düBraFa soll weitgehend mit der bestehenden Verfahrenstechnik gearbeitet werden können, die heute bereits zur Produktion von mineralisch gebundenen Holzwerkstoffen (Zementspanplatten, Gipsspanplatten, Blähglasplatten) genutzt wird.

Es soll ein dünner, plattenförmiger Verbundwerkstoff mit den höchsten Brandschutzeigenschaften (A1), einer geringen Dichte und ausreichender Festigkeit bei einem möglichst geringen Anteil organischer Fasern entwickelt werden. Damit soll ein neuer Brandschutzbaustoff mit speziellen Eigenschaften geschaffen werden, der in dieser Kombination derzeit noch nicht existiert.

In Kooperation mit dem Projektpartner wurden zunächst die Anforderungen an den neuen Werkstoff hinsichtlich Brennbarkeit und mechanischer Stabilität definiert und geeignete Faser- und Füllstoffe, Bindemittel und weitere Additive ausgewählt. Ausgehend von bei der PTS vorliegenden Erfahrungen wurden erste hochgefüllte Papiere im Labormaßstab hergestellt. Diese sollen im nächsten Schritt auf die für Komponenten eines Brandschutz-Baustoffs relevanten Festigkeits- und Brandeigenschaften untersucht werden.

Anwendung/Wirtschaftliche Bedeutung

Aus düBraFa und mineralisch hochgefüllten Papieren abgeleitete Verbunde als Brandschutz-Baustoffe sind bisher nicht Stand der Technik. Durch die ideal erscheinende Kombination aus Holzwerkstofftechnologie, mineralisch gebundener Platten und der Papiertechnologie bietet sich die Chance einer gemeinsamen Material- und Verfahrensentwicklung. Auf einer gesicherten und preisgünstigen Rohstoffbasis kann ein Leichtbaustoff für den Brandschutz produziert werden. Besonders für die meist kleinen und mittelständischen papierverarbeitenden Unternehmen besteht die Chance, eine neue Produktlinie aufzubauen bzw. anzupassen und einen völlig neuen Kundenkreis zu erreichen.

Für leichte Verbund-Brandschutzmaterialien ist ein hohes Marktpotential zu erwarten. Der Anwender erhält durch das neue Produkt im Vergleich zu herkömmlichen Brandschutz-Baustoffen vorteilhafte Eigenschaften: sie sind leichter als Gipsprodukte und gebundene Mineralfaserprodukte und besitzen eine höhere Feuchtebeständigkeit. Es ist daher zu erwarten, dass Leichtbau-Brandschutzverbundmaterialien dort eine wichtige Lücke füllen, bei der sowohl geringe Dichte als auch hohe Temperaturbeständigkeit und Nichtbrennbarkeit verlangt werden, was von den derzeit eingesetzten Baustoffen nicht in diesem Ausmaß erreicht werden kann.

KMUs wird mit der Entwicklung des Leichtbauverbundproduktes mit höchster Brandschutzklassifizierung die Chance gegeben, in Bereichen der Baubranche tätig zu werden, für die sie bisher wegen der hohen Anforderungen keine geeigneten Produkte anbieten konnten.

Bearbeitungszeitraum: 01.04.2011 – 31.03.2013

Bemerkungen

Das Forschungsvorhaben IGF 16613 wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert und in Zusammenarbeit mit der Holzforschung München (HFM) durchgeführt.

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Research area: Product aims

Paper, paperboard and board // technical speciality papers

Key words:

photo catalysis, titanium dioxide, paper coating, air and water purification

Title:
Photo catalytic active paper coatings

Background/Problem area

Contaminated potable water and air pollution are two main risks for human health. This problem concerns not only developing and newly industrialising nations but also developed nations. Caused by the further increasing world population this situation will get worse. In addition, the critical values for many harmful substances are expected to be reduced in the next years. Therefore it is imperatively necessary to develop effective, low cost and environmentally friendly technologies to purify water and air.

Photo catalysis is a well suited process to degrade organic matter and microorganisms from water or air. Titanium dioxide in its crystallographic form anatase is a well known, widely-used and powerful photo catalyst. As additional advantages titanium dioxide is biologically and chemically inert, non-toxic, resistant to photo corrosion and has a strong oxidation potential. Organic matter will be oxidised to water and carbon dioxide finally.

Objectives/Research results

The first objective of the research project is the development of water based coating formulations containing titanium dioxide as a photo catalyst, which can be used to functionalise paper surfaces with photo catalytic activity. Some of the technological difficulties, that have to be solved, are:

- Effective protection of the organic substrate (paper) to avoid undesirable damage caused by the photo catalyst particles, which are in direct contact with the fibres
- Development of coating formulations with sufficient photo oxidation stability
- Development of coating formulations, resulting in a sufficiently porous coating
- Development of coating formulations, resulting in paper coatings with enough photo catalytic activity
- Avoidance of a fully coated surfaces of the photo catalyst particles
- Suitable application techniques for the coating formulations.

The second objective of the research project is to screen possible methods for the detection of photo catalytic activity and to define a detection regime optimised for coated papers. The two main procedures are:

- Degradation of organic dyes and a photometric detection of the process
- Degradation of gaseous organic matter and detection of the process using infrared spectroscopy or gas chromatography linked with mass spectrometry.

Application/Economic benefits

Paper products with a photo catalytic active function can be used in individually designed stand alone units or filter systems to decrease contamination of potable water, especially in non-urban regions. In technical air filters the functionalised paper products can reduce air pollution caused by organic particulate matter (e.g. carbon black) and gaseous organic harmful substances.

Compared with conventionally used techniques, the photo catalytic active paper products have the following benefits: The photo catalyst will not be exhausted during the photo oxidation processes, so that this technology is cost-efficient. No toxic agents are necessary for the process and it is not extensive to be controlled. No special trained personal is necessary to use the materials. And no mud cake, sewage sludge or contaminated adsorbent materials have to be regenerated or depolluted.

Project period: 01.05.2011 – 30.06.2013

Remarks:

The research project IK-MF 110020 is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: Product aims

Paper and paperboard and board // Technical specialty papers

Key words:

inkjet, liquid absorption

Title:
Characterisation and modelling of the ink setting behaviour of printing inks on coated inkjet paper

Background/Problem area

The absorption of small liquid droplets (between 3 and 20 pL) into paper is the basic principle of the modern inkjet printing process. Dye inks (molecular size approx. 2 nm) are being used as well as pigment inks (particle size approx. 50 - 150 nm) to an ever greater extent. The technical implementation of the inkjet printing process up to the present was the line-by-line creation of the printed image by a printing head (line printer) that moved back and forth across the paper. At the moment, there is a transition to inkjet printers that are now capable to printing an entire line simultaneously by introducing printing heads as wide as the paper. This has dramatically increased the printing speed (high speed printing) which, however, also makes much greater demands on ink handling and in particular ink setting behaviour.

Guaranteeing an adequately rapid ink setting behaviour whilst at the same time assuring otherwise good printing quality places great demands on the surface of the inkjet paper (microporous structure). Suitable measuring procedures and conceptual models for ink setting behaviour are required for optimisation purposes. The current evaluation of the ink setting behaviour of inkjet inks in porous ink receiving layers are based on indirect measuring procedures such as the Bristow method. Indirect evaluation methods, however, are less sensitive, sometimes provide non-quantifiable results and employ large volumes of ink that distorts the results of measurement. The evaluation of the Bristow method as the most suitable indirect measuring procedure is based on the often criticised Lucas-Washburn equation and fails miserably when the ink setting behaviour of pigmented inks are to be evaluated, although the latter are becoming more and more important. Hence, an indirect measuring procedure (visualisation of individual droplets by means of a high-speed camera together with suitable lenses) is absolutely necessary if the ink setting behaviour of very small amounts of ink or pigment inks are to be evaluated.

Objective/Research results

The objective of the intended research project is to develop a measuring procedure for the objective, direct evaluation of the ink setting behaviour of inkjet inks on coated paper. The measuring procedure is intended to facilitate direct observation of the penetration of inkjet droplets (with a volume of a few pL) in porous layers by means of a high speed camera. This new procedure is intended to point out an economic alternative to previously used indirect measuring procedures. The results of the latter were normally evaluated in uncorrected form which in turn prevented systematic findings from being made. The reliable data obtained using the developed measuring technology is to be used to create models of the ink setting behaviour of dye-based and especially pigmented inkjet inks. In addition, it is intended to identify and evaluate the different factors that contribute to ink setting behaviour.

Application/Economic benefits

Coatings and coating layers with controllable sorption properties are of vital importance for optimising both existing and newly developed products. The concepts and models that will be worked out will pinpoint theoretical control variables for improving ink setting behaviour, thus laying the groundwork for selective product development and an elimination process for new developments. Similarly, a reliable, objective measuring technology and methodology construct an indispensible basis for product development. The liquid penetration models can be applied not only to paper but also to coatings of other web-shaped materials, thus giving rise to possible applications in the paper, plastic, metal and textile sectors.

Project period: 01.01.2011 – 31.12.2012

Remarks:

Research project IK-VF 100010 is being funded by the Federal Ministry of Economics and Technology BMWi.

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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

metal, metallic paper, filtration, porous media, semi product, sintering, fleece

Title:
Metallic sinter papers and sinter fleeces

Background/Problem area

The production of porous metallic materials is state of the art. In most cases classified metal powders, but also thin metal fibers are poured in forms and afterwards sintered. The generated sinter form bodies show wide pore dimensions (typically 1 – 30 µm). The total porosity can amount ~ 55 % by using powders and ~ 90 % by using fibres.

Porous "wide & flat sheet" products in the form of foils and tapes are hardly produced conventionally up to now. Basically two procedures are suitable for the production of porous foils and tapes: powder rollers and tape casting. Nevertheless, tape casting is not very cost effective as only low process speeds are realizable. In addition it comes to sedimentation effects while producing a thickness of more than 250 µm. Furthermore the width is limited to 200 mm up to now.

Powder rollers require high pressure within the nip to the production of tapes which leads to a relatively high compression. The maximum porosity is about 20 %. The maximum thickness is about 200 µm.

With this project highly efficient paper and fleece production technologies shall be used to develop flat semi products (sinter papers and fleeces) which are filled with metal powders or metal fibers. These metallic semi products are processed afterwards, e.g., to winding cores or folded structures. These structures can be directly used or be sintered to porous or highly porous metallic sheets with a thickness up to 1000 µm and a realistic width of about 200 – 500 mm. The pore dimensions are similar to the state of the art.

Objectives/Research results

By using paper and fleece procedures of processing, equipment and styling, complicated formed structures shall be generated which can't be realised by classical metal powder styling procedures (extruding, hose downpour).

The properties of these metal semi product and the sintered porous metal sheets shall be characterized and optimized according to relevant applications. Within the project the focus lies on water filtration applications and the principal technical and economic potential. Also lead or zinc should be checked to the production of flexible electrodes or for ray protection.

The proposed material development is based on different metallic powder and fibre combinations. Gradients within the pore size distribution shall be generated by using multi layer, material and coating variations.

Basic knowledge will be generated in lab scale and verified on pilot scale facilities. For example PTS will run different recipes on the pilot paper machine, which is predestined for material developments based on highly filled and heavy papers.

Application/Economic benefits

Typical applications could be filtration, sound absorption, heat exchanger, pore distiller, catalysts, etc.

Metallic materials are well cleanable, can own a high mechanical strength and also be started up to relatively high temperatures. Metal-based filters are successfully applied in water filtration, garbage combustion arrangements or power stations.

However, porous sinter metals are also used as an evaporator in different areas, e.g., in the chemical process technology and the biotechnology. Another interesting field of use explains the application than flaming-restraining element, e.g., in gas cylinders. A great importance also exists in the use of porous sinter metals to the efficient contribution of gases and liquids.

Since some years metallic fibre based highly porous materials are used as surface distillers. New areas of application are electromagnetic screenings and sensors.

The research results shall be used by Saxon paper production and converting plants. Secondly, they will have an impact on the future trend of Saxon SMEs (small or medium-sized enterprises) in filtration and environmental industries. Low cost applications of porous metallic sheets produced by paper and fleece processes could evolve into a totally new market for Saxon enterprises once the current technical problems such as porosity and strength has been solved within the research project.

Project period: 01.07.2011 – 30.06.2014

Remarks:

The research project SAB 14178/2455 is being funded by "Sächsische AufbauBank (SAB)" and is being performed together with:

- Fraunhofer-Institut für Fertigungstechnik und angewandte Materialforschung (IFAM)
- OecoPac Grunert Verpackungen GmbH (Coordination)
- Norafin Industries (Germany) GmbH
- MTH Metall-Technik Halsbrücke GmbH & Co. KG.

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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

ceramic, preceramic paper, filtration, support, membrane

Title:
Submerged flat filter membranes based on pre-ceramic papers

Background/Problem area

Membrane filter systems (support & membrane) can be made of ceramic or polymer materials. Ceramic filter systems compared to polymer filter systems have different properties and useful advantages regarding:

a) Higher bio-inertness
b) longer life cycles
c) higher temperature resistance
d) better regeneration

Since polymer filter systems are cheaper they have the greatest market share of low-cost applications in the area of micro-, ultra- and particle filtration.

Ceramic filter structures are limited mostly to tubes, which are produced by extrusion technologies. Conventional ceramic submerged flat filter systems are also made by extrusion which causes higher costs.

Objectives/Research results

The objective of this project is to develop a technology to using pre-ceramic papers after sintering in submerged flat fluid filtration systems. Pre-ceramic paper derived ceramic (PT-Ceramic®) will work especially as the filter support. A special filter membrane will be applied by water based membrane coating technologies on top of the paper derived PT-Ceramic®. The membrane coated and shaped ceramic structure will be built in adapted module concepts.

The project is splitted in four parts:

3. Paper development and shaping technology (Papiertechnische Stiftung)
4. Thermal conversion (sintering) (Werkstoffzentrum Rheinbach Gmbh)
5. Development of Membrane coating technology (atech innovations GmbH)
6. Development and adaption of module concepts (SGS Aqua Technologies GmbH)

Within these four parts quite a lot of development work has been done. PTS developed the paper making process and sorted out some good working paper qualities. The focus was to create a maximum homogenous paper which can be converted into a permeable and solid ceramic filter support structure. PTS improved the densification, corrugating, cutting and gluing process for multi layer systems. WZR supported the corrugating and gluing process. Also WZR adapted and optimized the sintering process. Atech developed the application of a micro filtration membrane and first filtration tests performed successful (milk filtration test!). SGS developed a polymer casting compound to fix the ceramic filter discs within a modular box. Next step is to produce a prototype.

Application/Economic benefits

The use of pre-ceramic papers as flexible green body before sintering combined with paper converting technologies promises new flat and formed filter structures with great filter areas (for example corrugated structures). This new process should deliver a cost reduced way to achieve new market segments in low cost water filtration. The focus herewith is the application of submerged flat membranes in local waste water treatment plants.

The research results will be used by German paper manufacturer and converting plants. Secondly, they will have an impact on the future trend of German SMEs (small or medium-sized enterprises) in the membrane and environmental industries. Low cost applications of pre-ceramic based filter systems could evolve into a totally new market for German enterprises once the current technical problems such as porosity and strength has been solved in research projects.

Project period : 01.10.2009 – 30.09.2011

Remarks:

The research project ZIM-KF 2037906WZ9 is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with Werkstoffzentrum Rheinbach GmbH, atech innovations GmbH and SGS Aqua Technology GmbH.

PRODUKT-ZIELE

Forschungsgebiet
Endprodukte aus Papier, Karton und Pappe

Druckprodukte
Schachtelprodukte
Wellprodukte
Sonstige

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Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton und Pappe // Druckprodukte

Schlagworte:

Nanoindentation, Topografie, Elastizität, E-Modul, Papierstrich, Beschichtung, Druckpapiere, Satinage

Thema:
Ermittlung des Einflusses der partiellen Oberflächenverformung von Papier auf Topografie und Druckergebnis durch Nutzung der Nanoindentation

Ausgangssituation/Problemstellung

Papier und Karton erfahren bei Herstellung, Veredlung und Weiterverarbeitung unterschiedliche Verformungen. Das sind in der Blattebene z. B. Zug- oder Druckkräfte, die entscheidend von Materialzusammensetzung und -aufbau beeinflusst werden. In z-Richtung wird Papier bzw. Karton insbesondere bei der Satinage, allen Veredlungsprozessen (z. B. Streichen und Lackieren) aber auch in der Weiterverarbeitung beim Druckprozess bzw. Rillen/Stanzen unterschiedlichen Belastungen ausgesetzt.

Verformungseigenschaften von Papier und Karton in z-Richtung werden heute über Kompressibilitätsmessungen am Gesamtquerschnitt unter Einwirkungen verschiedener Druckimpulse und über Rauhigkeitsmessungen an der Oberfläche bei verschiedenen Belastungen ermittelt. Dabei handelt es sich immer um integrierende Messungen, es können keine Differenzierungen zwischen z. B. Rohpapier und Beschichtung vorgenommen werden. Das Wissen über elastische bzw. plastische Verformungen oberflächennaher Schichten und die Möglichkeit der Optimierung im Hinblick auf Beibehaltung hoher Elastizität und damit hoher Schichtvolumina in der Weiterverarbeitung wird durch den Trend zu mehr Papierbeschichtungen mit speziellen funktionalen Schichten zwingend notwendig.

Indentationsverfahren sind für die Messung und Charakterisierung von Härte, Elastizitätsmoduli und Steifigkeit in z-Richtung in der Materialprüfung anderer Branchen verfügbar. Die Weiterentwicklung zur Bewertung elastischer und plastischer Eigenschaften sehr dünner Filme und Schichten auf einem Substrat, die sogenannte Micro- und Nanoindentation, beruht auf der messtechnischen Realisierung sehr kleiner Eindringtiefen und wird beispielsweise zur Charakterisierung von Nanobeschichtungen auf Wavern eingesetzt.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsvorhabens war die Entwicklung einer Messmethode auf Basis von Nanoindentation zur Charakterisierung von mechanischen Eigenschaften dünner funktionaler Schichten in z-Richtung auf das Satinageergebnis (matt, silk, gloss) gestrichener Druckpapiere und -kartone und die Druckqualität im Offset- und Tiefdruck. Es sollten Möglichkeiten zur verbesserten Spezifikation von Papieren bezüglich ihrer Strichkompressibilität und -steifigkeit im Hinblick auf Satinagequalität und Bedruckbarkeit aufgezeigt werden.

Mit Projektabschluss steht eine, auf spezielle Fragestellung im Papierbereich, applizierte Messmethode zur Charakterisierung mechanischer Stricheigenschaften in z-Richtung zur Verfügung.

Im Rahmen umfangreicher Labor- und VESTRA-Versuche, konnten die Einflüsse unterschiedlicher Pigmentabmischungen, weicherer bzw. härterer Bindertypen und Härter auf die elastischen Eigenschaften von Druckpapieren untersucht werden. Weiter wurden beim Vergleich unterschiedlicher Strichaggregate vergleichsweise sehr elastische Striche durch den Einsatz des Curtain-Streichens realisiert.

Verschiedener Kalandertypen, Variation von Liniendrücken und Walzentemperaturen haben unterschiedliche Auswirkungen auf die Veränderungen der mechanischen Stricheigenschaften. Bei elastischeren Strichen des Curtains wird beispielsweise durch die Erhöhung des Liniendrucks eine deutlichere Erhöhung des E-Moduls verursacht, als bei härteren Strichen der Filmpresse. Diese Untersuchungen wurden in Technikumsversuchen bei der Firma Andritz Küsters GmbH durchgeführt.

Bei nachweislich markierenden Offsetdruckpapieren konnte ein deutlich niedrigerer E-Modul gegenüber nicht markierenden Papieren gemessen werden, der Strich verfügt über einen höheren Anteil an elastischer Verformbarkeit.

Weitere Anwendungen werden in den Bereichen der Optimierungen von Lackierungen, Primerbeschichtungen aber auch bei Spezialpapieren und Verbundmaterialen gesehen.

Anwendung/Wirtschaftliche Bedeutung

Die Projektergebnisse sollen vorrangig in folgenden Branchen eingesetzt werden:

- Druckbranche (insbesondere Offset- und Tiefdruck) zur Optimierung hochvolumigerer Beschichtung mit hoher Elastizität,
- Spezialpapier- und Verbundmaterialhersteller zur Optimierung der Veredlung mit Folien, Primerbeschichtungen und Lacken,
- Hersteller und Zulieferer von Glättwerkstechnik zur Optimierung der Pressnips im Hinblick auf elastische und voluminöse Papiere und Kartone,
- Messtechnikhersteller und Papieranalytik zur Aufnahme der Methode ins Portfolio

Bearbeitungszeitraum: 01.06.2009 – 31.05.2011

Bemerkungen

Das Forschungsvorhaben IGF 16094BR (Kurztitel: Nanoindentation) wurde aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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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. Two 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.

For determination the influences of blankets of the printing results different blanket materials were procured from the market and examined before and after application to printing discs and sample backings. This was done by measuring the contact angle with different fluids and calculating the surface energies. The methodology of the contact angle determination was adapted to test printing forms. As a basis for the investigations of the aging behavior of blankets, the original state of the rubber materials has been extensively characterized.

New test methods have been developed for the properties, mottling, striking ink setting and pick. The proposed methods were critically evaluated, in joint work completed and upgraded. For the tests provided papers and inks were selected, procured and subjected to the papers of a basic characterization. The project partners are currently evaluating the quality of the developed methods and the reproducibility of test 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.

Project period: 01.07.2010 – 30.06.2012

Remarks:

The research project IGF 43 EBG is being funded by the German Federal Ministry of Economy and Technology BMWi under the Cornet programme. The research partners are Fogra e.V.; AIDIMA; CELABOR; VICG

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Research area: Product aims

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

Key words:

optical brightening agents, ageing, light fastness, fluorescence

Title:
Stability against UV light of optically brightened papers for offset printing

Background/Problem area

In the last decades an increasing need for optically brightened papers and boards could be detected, because most European costumers prefer bright white papers. Desired whiteness and chromaticity coordinates can not be achieved with bleaching within an adequate budget. Therefore optical brightening agents and dyestuffs are widely used.

Optical brightened papers are often not stable against light; in particular the UV light initiates the decomposition of the brightener. On a scale of 1 to 8, standard papers achieve a moderate light fastness of 3 (stock application), respectively a very poor 1-1.5 (used in coatings).

However, for many applications it is necessary that paper and printed product have a good stability in whiteness and colour.

In excessive solar radiation for instance posters must not age. Also sales packaging are exposed to sunlight over a long period, partly many months. Costumers rightly expect long lasting of packaging and no difference between a newly printed and an older packaging. Additionally, in archives and libraries light fastness plays an important role.

Objectives/Research results

In this research project the ageing behaviour of optically brightened offset printing papers and prints on it shall be determined.

At the end of the project one may estimate the consequences of light ageing onto the optical properties of papers and resulting from that the optical appearance of prints.

Moreover the basic information for a tool to minimise costs for paper and board manufacturers will be collected to reach optimal whiteness and UV stability with the optimum usage of optical brightening agents.

As a new method, fluorescence spectroscopy is used to quantify the optical brightening agents before, while and after ageing.

Application/Economic benefits

In Germany almost all printing papers are optically brightened. Every printing shop (about 10,000 in Germany, almost all SEM) has to deal with different brightened printing papers, which causes few problems in colour management. For planning the printing process and its materials it is very useful to know the content of optical brightener in the paper and the light fastness of the paper. Depending on the application the printer can choose out of a variation of different brightened and UV stable papers and avoids costumer complaints.

Paper and board manufacturers will get basic data for a tool to optimise the usage of optical brightening agents.

Project period: 01.10.2009 – 30.9.2011

Remarks:

The research project IK-MF 090073 is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton u. Pappe // Druckprodukte

Schlagworte:

Rezyklierbarkeit, Deinkbarkeit, Digitaldruck, Zeitungsdruck

Theme:
Recyclability of Printed Products 2011

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 modification of 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 2011, it was decided to study more detailed the deinkability of digitally toner and inkjet prints and on red discolouration of process water. The following subprojects were carried out:

1. Investigations on several inkjet prints of newspapers on conventional newsprint on their 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. Investigations on liquid toner prints on special coated paper on their deinkability behaviour.
4. Deinkability tests of two offset prints wit UV curing inks.
5. One test of stickies resulting of a new coating formulation for inkjet inks.

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: 01.01.2011 – 31.12.2011

Remarks:

The research project (INGEDE 13311) is being funded by the INGEDE.

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Forschungsgebiet: Produkt-Ziele

Endprodukte aus Papier, Karton und Pappe // Schachtelprodukte

Schlagworte:

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.

A smart label for UHT milk in beverage carton shall predict the use by date based on the actual storage temperature. This first basic demonstrator will be a plastic label with printed organic electronics placed on liquid packaging board. The consortium partners are aiming to complete the first basic demonstrator in a three-year period.

The contribution of PMV is focused on the recyclability of printed organic electronics 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. In recent trials, plastic labels with printed organic electronic have been placed on liquid packaging board with different adhesives. Some adhesives particularly dispersion adhesive 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) is being funded by the Federal Ministry of Education and Research (BMBF).

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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 TiO2 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 angewandeten methods:

- steric stabilization, using fixed bond
- Major pigments as a carrierr
- TiO2 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.

Project period: 01.10.2010 – 30.09.2012

Remarks:

The research project IK MF 100025 is being funded by the German Federal Ministry of Economy and Technology BMWi .

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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.

Project period: 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 .

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Research area: Product aims

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

Key words:

superparamagnetism, nanoparticle, energy efficiency

Title:
Induction drying by ferromagnetic nanoparticles in the manufacture of coated papers

Background/Problem area

In coating paper suspensions of mineral pigments in combination with most synthetic binders with a partly wide range of different functional additives at high speeds on the are applied moving web. The water-based coating color is then dried under considerable energy. For these processes a lot of energy is needed, whereby the thermal removal of water causes the highest costs. In industrial begins the drying section of a coater classically practice with gas-fired infrared heaters to heat the web quickly and to immobilize the coating color. In modern installations after a film press, a so-called air turns attached, in which the coated paper web is deflected by contact by means of an air cushion. This diversion is due to the operation of hot air is also used for drying.

Objectives/Research results

The aim of this research project therefore was to provide the necessary data and insights for future development of a method for induction heating of coatings on roll to roll carriers, using the example of painting colors on paper. This new process was intended to show an economic alternative to the previously used drying method. The use of ferromagnetic nanoparticles was the energy efficiency, due to the properties of the particles, and thus helped ensure a contribution to sustainable energy use and development of new technologies. The most important innovation was the deliberate use of the properties of the nanoparticulate ferromagnetic particles in the coating composition. The key to use was the development of a suitable dispersion method and the optimum setting of the induction field in coordination with the particles used.

This project was to demonstrate the feasibility and a calculated estimate of the cost.

Application/Economic benefits

Induction field are only used for drying for metallic substrates. One example is the use of paint systems on body parts, the inductive drying is used here for the heat generation on the surface of the metallic parts.

Through the use of ferromagnetic materials within the paint and coatings systems to the metallic nature of the carrier may be omitted. Macro or micro particles, however, have significant disadvantages in such a system. First, they typically have a magnetic remanence, that the coating or paint drying, retains a magnetic "charge balance". Secondly, such particles are not color neutral.

Nanoparticles offer an innovative solution. First, they have over a certain size no more remanence, and secondly they are transparent due to their size. They should therefore be an ideal additive for coating compositions or paints in order to dry them without metallic support by means of induction field.

Of course, the market made a number of competing systems with which induction drying must be measured. Widely used systems are:

- Flue-curing
- Electric IR drying
- Gas IR drying
- Microwave drying

However, this has decisive disadvantages, especially with the application in thin layers. The limit is at the required high electric field strengths the ionization and plasma or spark discharges and possible local overheating of the use significantly. The induction drying offers some advantages:

- Accurate controllability of the heating and drying process
- Small space requirement
- Lower energy demand

Project period: 01.11.2009 – 28.02.2011

Remarks:

The research project IK VF 090043 was funded by the German Federal Ministry of Economy and Technology BMWi .

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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 (Materialvolumen vs. mechanische Eigenschaften) 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 unterschiedliche Werkstoffverhalten von Metall- und Keramikwerkstoffen zu kombinieren.

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

Das Teilprojekt C3 „Formgebung und Fügen multifunktionaler duktiler Keramik-Metall-Werkstoffverbunde mit definierten Nano/Makro-Strukturmerkmalen für die Energie- und Umwelttechnik (CeraDuct)“ hat zum Ziel, das an sich grundsätzlich unterschiedliche Werkstoffverhalten von Metall- und Keramikwerkstoffen zu kombinieren. Für die Umsetzung des resultierenden Werkstoffverbundes sollen neue fertigungstechnologische Konzepte entwickelt werden. Auch wenn zusätzliche multifunktionale Eigenschaften einzelner Strukturbereiche (z. B. für eine integrierte Beheizung durch leitfähige Komponenten) angestrebt werden, besteht das vorrangige Entwicklungsziel in einer duktilen Keramik mit bisher nicht bekannten geometrischen Freiheitsgraden für die Realisierung von Strukturen für die Filtration und den Leichtbau.

Teilprojekt an der Forschungsstelle ist die Adaption papiertechnologischer Verfahren wie der Streichtechnik auf die Herstellung keramischer Verbundwerkstoffe. Es hat sich gezeigt, dass 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 denen konventionell durch Foliengießen hergestellter Keramiken vergleichbar.

Anwendungen/Wirtschaftliche Bedeutung

Das Vorhaben verfolgt somit das technische Ziel, eine neue Technologie zur flexiblen und kostengünstigen Fertigung von komplexen, kundenindividuellen keramischen Bauteilen zu entwickeln. Kernstück 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. Im Rahmen des Projektes sollen dafür beispielhafte Produkte entwickelt und getestet werden. Das Projektziel soll durch die Nutzung von Synergieeffekten, die sich aus der Verbindung von bisher „keramikfremden“ Technologien mit pulvertechnologischen Verfahren ergeben, erreicht werden. Mit der neuen Technologie wird die serienfähige Fertigung von strukturierten und miteinander verbundenen sehr dünne Einzellagen möglich, wie sie mit konventionellen Verfahren (Foliengießen, Pulverwalzen) nicht realisierbar sind

Eine wirklich optimale Ausnutzung potentieller Werkstoffeigenschaften in den keramischen Produkten erfordert deshalb neue Fertigungskonzepte für eine kostengünstige, endformgerechte und Ressourcen schonende Serienfertigung komplexer keramischer Bauteile. Dann werden intelligent aufgebaute, aus multifunktionellen Schichten bestehende, mit hohen Freiheitsgraden versehene und in einer für Keramik bisher unbekannten Komplexität zusammengesetzte Produkte künftig auch einem Hochleistungsanspruch gerecht. 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

Bearbeitungszeitraum: 01.04.2009 – 31.03.2012 (31.03.2014 bei Bewilligung des zweiten Teils)

Bemerkungen

Das Forschungsvorhaben (ECEMP – Verbundprojekt C3) wird aus Mitteln der Europäischen Union und des Freistaates Sachsen gefördert.

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Research area: Product aims

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

Key words:

printed electronics, organic photovoltaic, solar cells, paper-based materials

Title:
Transformation of paper surfaces for paper-based printed solar cells - Mass printed Organic Paper-based Solar cells (MOPS)

Background/Problem area

Solar energy is supposed to contribute significantly to the energy supply in times of reduced fossil resources, even more when nuclear power generation is abandoned. Today, the majority of solar cells are based on silica. These cells, however, are manufactured in rather cost- and energy- intensive manufacturing processess. In order to accelerate energy return (which is calculated to take about 10 years), other processes and materials need to be developed.

Printing is a cost-effective manufacturing process and paper is a substrate with a number of advantages as compared to others, like plastic foils: cost-effectiveness (1 € per t versus 7 € per t), printability and dimensional stability in temperature ranges of interest, and recyclability.

The layered structure of a conventional solar cell has to be inverted if a paper (of little opacity) serves as a substrate.

Objectives/Research results

PTS as a research partner in this project concentrated on substrate development. The necessary functionalities are placed in different layers a multi-layered structure.

Coating the cathode based on metals like nano silver as spherical particles or needles is possible, but the costs for pilot investigations are in no proper relation with the gain in knowledge, especially as the coating process does not allow a structured cathode. Lab investigations mostly lack in smoothness. Temperature stability as an effect not foreseen as clearly in the application, turned out to be an important issue.

The organic structures of the solar cells need to be encapsulated in order to prevent water vapour and oxygen from reacting with the organic layers. Significant barrier properties could be realized in pilot trials. It was found that the production machinery needs to be adapted, i.e. a longer drying section is required than for commodity paper production in order to wind a dry roll without blisters. Pilot runs often had to be performed in a small operating window where machine speed, coat weight and drying energy had to be adapted to avoid blisters and ensure through drying to prevent blocking at the winder.

Surface smoothness was a major issue. In order to meet the requirements for solar cells, a substrate had to be developed where a surface morphology is avoided with peaks that would pierce following layers and lead to short cuts destroying the functionality of the system. Pigment free coatings often lead to structures with less smoothness than was obtainable using pigmented coatings. Mixtures of selected pigments exhibit a very good surface smoothness as a base for printing semiconductive and conductive layers.

Only metal based inks lead to the required conductivity of the cathode, and they usually require a sintering process. The inorganic material of the coating layer like binder and co-binder could not withstand these temperatures without special measures. A change from acrylic acid or SB-based latex to other organic binders proved to be feasible.

Würzburg University provided much of the theoretical background knowledge and characterized the solar cells, investigated stability and performed simulation studies to optimize the printed solar cells. New semi conductors were developed at BU Wuppertal. TU Chemnitz conducted the printing trials in order to investigate and improve the interdependencies between material and process parameters.

The new solar cells produced in Chemnitz are not as effective as conventional silica-based solar cells, and also life time is probably lower with the newly developed materials. But a lower energy demand for the manufacturing process and less expensive materials are the basis for a number of possible applications.

Application/Economic benefits

Especially the low manufacturing costs will allow for many new fields of application of solar cells like on displays, packages or even newspapers. Printing solar cells allows for cost effective use of regenerative energy sources and comparatively short times to regain the energy necessary for the cell manufacturing. The low manufacturing costs for papermaking and printing can open up a new markets for inexpensive solar cells with a short life time, which is not available for the more effective but also more expen-sive silica based solar cells. International competitiveness on a seminal market is to be strengthened when low cost solar cells are included in the fields of competences of German enterprises.

Project period: 01.07.2008 – 30.06.2011

Remarks:

The research project BMBF 13 N 9864 is being funded by the German Federal Ministry of Education and Research BMBF. Project partners of PTS are BU Wuppertal, Makromolekulare Chemie und Institut für Polymertechnologie, TU Chemnitz, Institut für Print- und Medientechnik and Universität Würzburg, Experimentelle Physik VI.

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Research area: Product aims

End products made of paper, paperboard and board / other

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

The research project aims to investigate the influence of material- and process-specific parameters on the surface quality of wood materials (HDF) and to develop a procedure for assessing the quality of (un)coated wood board (HWP) which makes it possible to estimate the print image quality beforehand. Project aims achieved so far include:

- selecting several methods of producing HDF under laboratory conditions,
- determining the technical details and requirements of different measurement procedures,
- selecting materials and measurement methods and designing the trials,
- production and measurement of HWP using the optimized methods,
- assessment of the wood materials with the reference methods,
- studies on the reproducibility of the process,
- development of a mathematical correlation between the reference data and the measurement methods.

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.

Project period: 1.8.2009 - 30.1.2012

Remarks:

The research project IGF 16170 BR is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with the Institut für Holztechnologie Dresden GmbH (IHD).

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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 posssibility 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.

Made on the basis of fundamental considerations for tactile softness perception of the human hand, using biomedical knowledge, the ways to describe tactile sensations by means of metrological facilities analyzed. Furthermore, a workable standard in industry-developed test panel and in initial experiments and tested in a comprehensive round-robin test its applicability.

The measurements of the metrological properties are completed. Based on these results and the panel test results is a standard procedure designed to reflect the softness of tissue product. The test method will be validated on the basis of a second Round Robin test with new and old handkerchiefs from the last Round Robin. It is studied if the test method can be scaled up to other tissue products (toilet papers).

Currently, the influences of selected contributing factors in tissue converting (embossing, multiply structure, finishing with additives) on the softness of tissues will be examining.

Application/Economic benefits

A reproducible evaluation of the overall impression of softness both in the form of a standardised and possibly accredited panel test and in the form of a metrological evaluation method should be of benefit to manufacturers, converters, dealers and consumers alike. In addition to establishing serious and reliable benchmarks, such an evaluation would make it possible in particular to optimise products, the associated processes and definitions of appropriate supply parameters.

Converters, dealers, suppliers and measuring equipment manufacturers in particular are firms that in most cases represent small and medium sized enterprises. With the results of the project rrecommendations to the paper industry will be given on how to enhance the perception of softness and how to optimize their measuring systems concerning softness of tissue products.

Project period: 01.09.2009 – 29.02.2012

Remarks:

The research project IGF 21 EBR is being funded by the German Federal Ministry of Economy 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 area: Product aims

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

Key words:

cross-linking, coating, inkjet

Title:
Development of a new cationic coating colour enabling the cross-linking of polyvinyl alcohol (PVA) without boric acid

Background/Problem area

The polyvinyl alcohol used as a binder in photo inkjet paper coatings is cured today by means of boric acid or borate. The boron compounds make it almost impossible to control the cross-linking reaction. Cracking or coat defects occur, and deposit formation leads to high broke rates, causing production costs to rise.

Furthermore, boric acid and its salts have been classified as hazardous substances since August 2008. This means they must be labelled accordingly and are subject to certain conditions regarding handling, storage, shipment, distribution, tracking etc.

Consequently, boric acid is to be eliminated from the formulations and PVA curing is to be achieved by means of alternative curing agents or new methods.

Objectives/Research results

The research project aims to develop new, feasible solutions enabling the cross-linking of polyvinyl alcohol binder in the production of photo inkjet papers. Project aims achieved so far include:

- the examination of cross-linking using boric acid
- examination of other chemical crosslinkers
- develop new coatings with other crosslinking agents
- start the testing of the properties of these new coated surfaces,
- studies on radiation crosslinking and the beginning of practical tests.

Application/Economic benefits

Initial applications of the project results are expected in the segment of high-quality coated inkjet papers, but producers of conventional photo papers, their suppliers as well as printers / photo service providers can be acquired as initial users in the course of the project work as well. According to market investigations, inkjet prints have taken over increasing market shares from traditional photo products since the year 2000. Assuming a relatively constant global paper demand for high-quality prints and continued positive development of the inkjet market, their share is estimated to reach 20 % in 2010.

The project results can also be used for further work in the fields of material coating of plastic, textile and glass surfaces or polymer production. The implementation of new methods will make manufacturers of machinery and plant systems a potential target group as well.

Project period: 01.01.2010 - 30.6.2012

Remarks:

The research project IK MF 090098 is being funded by the German Federal Ministry of Economics and Technology BMWi.

PROZESS-ZIELE

Forschungsgebiet
Faserstofferzeugung

Zellstoffherstellung
Holzstoffherstellung
Altpapieraufbereitung
Faserstoffbehandlung

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Research area: Process aims

Pulp production // Pulp treatment

Key words:

microfibrillated cellulose, nanocellulose, graphical papers, paper and paperboard, speciality paper, 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 24 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.

Objectives/Research results

The SUNPAP project will address the strengthening of European paper industry competitiveness by means of nanocellulose based processes to provide radical product performance improvements, new efficient manufacturing methods and the introduction of new added value functionalities. NANO-FIBRILLAR CELLULOSE (NFC) is the most promising nano-material for wide-variety applications in papermaking. However, today it is only prepared and applied in lab-scale. Therefore the target in the SUNPAP project is to first up-scale the NFC production processes and then adapt the production of this nanomaterial for modern papermaking processes via the demonstrated pilot lines.

The final goal of the SUNPAP project is to enable the introduction of NFC based processes to various types of applications in the papermaking value chain. The SUNPAP project duration will be 3 years and within this time frame the aims in particular are to develop and demonstrate:

- High performance products and environmentally friendly NFC enabled production processes, demonstrated for graphical papers and packaging boards
- Functional products and innovative processes enabled by NFC with active functionalities, demonstrated for papers and packaging materials
- High added value fibre based products with highly specific properties made only possible by NFC, demonstrated for fibre based filters and other selected innovative materials.

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.

Project period: 01.07.2009 – 30.06.2012

Remarks:

The research project SUNPAP (EU-FP7-NMP-2008-LARGE-2) is being funded by the European Commission and coordinated by KCL/VTT, Finland, in cooperation with leading European paper research institutes (PTS, Germany, CTP, France; SSCCP, 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, Germany; StoraEnso, Sweden; UPM, Finland; and Ahlstrom, France.

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Research area: Process aims

Pulp production // Recovered paper treatment

Key words:

sorting, sensor, NIR, colour, image analysis, identification, characterisation, raw material, eco-effiency

Title:
Recovered Paper SORTing with Innovative Technologies (SORT IT)

Background/Problem area

Recovered paper is the most important fibre raw material for paper production. High demand on international markets for fibrous raw materials affects regional industries by shortage in supply and increase of costs. These trends put recovered paper sorting in perspective of suppliers and paper manufacturers. In the past intense sorting was not economically reasonable due to low raw material prices. But improved raw material quality and quantity will be of great importance for the competitiveness of paper-related industries in the future and it is of interest yet today.

For increased usage of recovered paper and thus a more environmentally and economically sound paper production, appropriate raw materials for high quality papers as well as increased amounts of recovered paper have to be provided. Homogeneity of recovered paper raw materials has to be improved as their composition varies are depending on the origin and sorting. The proposed project SORT IT will develop the key technology to provide both, increased quality as well as increased quantities of recovered paper.

Objectives/Research results

The concept of this project is the development of new and improved sensor and measurement technologies for recovered paper sorting. The main objective of this work is to enable sustainable and cost effective paper recovery at more than 95 % yield for all recyclable paper and board grades, and to provide recovered qualities allowing the best possible re-use in paper & board products. Another important objective is to enable paper recovery from paper-containing waste streams and provide raw materials meeting the users' specifications by implementation of online quality assessment techniques. SORT IT aims at paper recovery from pre-sorted streams with a yield of >95 % and a purity of 98 % for desired materials. For paper recovery from unsorted mixed waste streams an optimal balance between yield and quality shall be identified; and quality impacts by raising the yield up to > 95 % shall be evaluated.

The state of the works encloses the following partial results:

The research and development is done for sensor applications in WP2. Pre-treatment options are analysed and research and development for sorting machinery and implementation of new sorting units are done in WP3. New sorting concepts are analysed in WP4. The improvement to sorting technologies was demonstrated in WP5 with full scale sorting. A Monitoring procedure was developed and realised. The public section contains general information about the project and partners, SORT IT events, scientific events organized by partners and worldwide, EC environmental legislation, CEPI and ERPA activities in the field, periodic newsletters.

Application/Economic benefits

The project will enable continuous quality control, pre-mixing will be obsolete. The recovered paper composition can be controlled by the demand of the customer. Furthermore this project will contribute to more homogeneity within the standard grades and give recommendations on EN643 in terms of more specific quality parameters describing the technical value of the raw material.

Advanced sorting of recovered paper will contribute to deliveries to the mills containing less non-recyclable material, which can result in:

- reduction of transport costs and related emissions;
- less amount of wet rejects in the mill and low energy consumption, respectively;
- better solutions for valorisation of refusals and waste stream minimizing, since these will be in dry state and gathered in a high amount at the sorting place.

The results of the project in this field may serve as a basis for the development of the European environmental policy in waste management.

Project period: 01.05.2008 - 31.10.2011

Remarks:

The research project SORT IT (EU-FP7-ENV-211888) is being funded by the European Commission and coordinated by PTS, Germany, in cooperation with leading European paper research institutes (CTP, France; STFI-Packforsk, Sweden; ITENE; Spain and UTI, Romania) and nine industrial partners (suppliers and paper mills): Bumaga, The Netherlands; Bollegraaf, The Netherlands; EVK, Austria; Rauch Recycling, Austria; VRANCART, Romania; Papeteries Grégoire, France; Norske Skog, Norway; RTT, Germany and Europac, Spain.

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Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Deinking, Fraktionierung, Dispergierung, Flotation

Thema:
Reduktion des Energieeinsatzes durch Optimierung der Prozessführung bei der Altpapieraufbereitung in Deinkinganlagen durch den Einsatz einer Fraktionierung

Ausgangssituation/Problemstellung

Die Verschlechterung der Altpapierqualität hat dazu geführt, dass Deinkinganlagen wurden über die Jahre immer komplexer und damit teurer in Investition und Betrieb wurden. Es ist üblich geworden, Anlagen mit zwei Flotationsstufen auszustatten, weil die zwischengeschaltete Dispergierung noch Druckfarben ablöst. Diese sehr aufwendige Technologie verfügt über mehrere Prozessstufen Zerfaserung – Vorflotation – Entwässerung – Dispergierung – Nachflotation – Entwässerung. Mit der Komplexität der Deinkinganlagen steigen die Kosten vor allem für Rohstoffe, Entsorgung und Energie.

Um dem Trend steigender Kosten bei der Altpapieraufbereitung entgegenzuwirken, besteht der Bedarf, effektiv und wirtschaftlich geeignete Altpapiermischungen in Anlagenkonzepten, die mit geringem Energieverbrauch und hoher Ausbeute Deinkingstoff hoher Qualität produzieren, aufzubereiten.

Forschungsziel/Forschungsergebnis

Das Projekt verfolgt als Hauptziel eine Optimierung der Prozessführung in Deinkinganlagen bei Sicherstellung der Qualität des Deinkingstoffs und verringerten Kosten. Durch den Einsatz einer Fraktionierung und einer Dispergierung ausschließlich eines Teilstroms (Verfahrensstufe mit hohem Energieeintrag) nach einer effektiven Vorsortierung und vor der Vorflotation soll der Energieeinsatz reduziert werden.

Hauptaugenmerk liegt auf der Verbesserung der Druckfarbenablösung durch eine Dispergierung nur des Teilstroms (Langfaserfraktion) mit hohem Anteil an nicht abgelösten Druckfarbenpartikeln. Neben der Energieeinsparung bei der Dispergierung soll durch die verbesserte Druckfarbenablösung eine effektive und selektive Entfernung in der darauf folgenden Flotation sichergestellt werden. Dies bietet die Möglichkeit, auf eine 2. Flotationsstufe zu verzichten und damit die Ausbeute zu erhöhen.

Es konnte gezeigt werden, dass nach der Zerfaserung kleine abgelöste Druckfarbenpartikel in der Kurzfaserfraktion und nicht abgelöste und große Druckfarbenpartikel in der Langfaserfraktion angereichert werden. Durch Behandlung der Langfaserfraktion im Disperger werden diese Druckfarbenpartikel abgelöst und fragmentiert. Die erzielten Weißgrade waren geringfügig niedriger für ein Konzept mit Trennung und Teilstromdispergierung sowie nachgeschaltete Flotation im Vergleich zu einem Konzept mit zwei Flotationskreisläufen (2-Loop Konzept), allerdings bei geringeren Verlusten. Bei höherem Schmutzpunktanteil im Ausgangsstoff vor allem bei hohem Druckfarbenanteil > 250 µm war die Schmutzpunktfläche für ein Konzept mit Trennung und Teilstromdispergierung im Vergleich zu einem 2-Loop Konzept höher. Für eine effektive Schmutzpunktreduzierung sind daher nach einer Fraktionierung weitere Behandlungsschritte für die Langfaserfraktion notwendig, wie eine Flotation des Teilstroms oder eine zusätzliche Dispergierung. Auch durch diese zusätzliche Teilstrombehandlung können Energiekosten und Altpapierkosten im Vergleich zu einem zweistufigen Flotationskreislauf eingespart werden. Die Anreicherung von Makrostickys in der Langfaserfraktion erfordert eine effiziente Reduzierung von Makrostickys entweder der Langfaser vor der Dispergierung oder des Gesamtstoffs vor der Fraktionierung.

Anwendung/Wirtschaftliche Bedeutung

Die Ergebnisse sollen eine sichere Ableitung optimierter Prozesskonzepte ermöglichen sowie eine darauf aufbauende Prognose zur Verringerung vor allem des Energiebedarfs.

Kenntnisse zur optimalen Aufbereitungstechnologie für unterschiedliche graphische Altpapiere zeigen den Altpapier verarbeitenden Papierfabriken neue Möglichkeiten zur Reduzierung des Energieeinsatzes aber auch zur Steigerung der Ausbeute und damit Kosteneinsparung bei Sicherstellung der Qualitätskonstanz bzw. zur Erhöhung der Produktqualität.

Bearbeitungszeitraum: 01.04.2009 – 31.03.2011

Bemerkungen

Das Forschungsvorhaben IGF 16025 N (Kurztitel: Fraktionierung Deinking) wurde aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Process aims

Pulp production // Recovered paper treatment

Key words:

deinking, water circuit quality, water based inks

Title:
Deinking potential of recovered paper depending on water circuit quality

Background/Problem area

Deinking mills are forced to reduce their fresh water consumption with a resulting higher load of various contaminants in the process water and/or getting higher contamination levels in their mills due to lower recovered paper quality. This has an influence on achieving the targeted brightness since more bleaching chemicals are now required to recover the optical properties. Several reasons could explain this trend: (i) process water quality is altered (more coloured dissolved and colloidal molecules), (ii) conventional ink particles are less efficiently removed due to unknown interactions disturbing the flotation behaviour (iii) ink particles are being smaller due to the development of new printing processes including water based inks or getting larger due to more oxidative inks, (iv) peroxide in the pulping phase or during the bleaching treatments is less efficient due to the water loop closure.

It is therefore necessary to understand first the main causes and mechanisms of the impact on DIP quality and reduced water consumption. Based on those findings investigations on solutions are performed to overcome the problems including optimization of bleaching and possibilities of efficient process water cleaning at minimum cost.

Objectives/Research results

The objective of the work is to determine the main reason explaining poorer DIP quality or poorer deinking potential based on the impact of process water quality. Poorer DIP quality results in higher bleaching chemical consumption or has to find preventive process water treatment possibilities to stabilize optical DIP characteristics.

Application/Economic benefits

The project will increase the knowledge of the facts how to clean the water circuits in an economic way by evaluating chemicals, cleaning technology and dosage points of chemicals.

Project period: 01.05.2010 – 31.12.2011

Remarks:

The research project INGEDE 13210 is being funded by the International Association of the Deinking Industry INGEDE e.V. and is being performed in cooperation of CTP Dr.Bruno Carré , PMV Dr.-Ing.Hans-Joachim Putz and PTS.

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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. The balancing investigations in paper mills to determine the sinks of BPA in recovered paper processing are still going on. In the last work package the 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 should be 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 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 should be developed. The reduction of BPA amounts in the recycling papers is an important aim in the current discussion about contaminants in recycling papers.

The expected 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 INFOR.

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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, there is the question whether the reuse of all recovered paper components is reasonably. 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 use of both fractions.

In recovered paper suspensions disturbing materials like inorganic particles, ink particles and VOC/SVOC substances are concentrated in the fine particle fraction. A removal of fine particles from recovered paper suspensions effects a reduction of such disturbing materials in fibre suspensions. The VOC/SVOC content is clearly reduced and the brightness is increased. But particularly for old newspapers (ONP) the defibration conditions have a large influence on the removal of ink particles because the conditions are extremely affected by the ink detachment from the fibres. The ink detachment is better for high consistency defibrating with chemicals than for low consistency defibrating without chemicals. The removal can be done by screening with 150 µm hole screen. The effect of a fine particle removal on strength properties is different. For coated paper grades the tensile strength increases with increasing removal, for newspaper the tensile strength stays constant and for corrugated base paper the tensile strength decreases. Thus the fibre fines must have various qualities in different paper grades.

So a recycling of removed fibre fines can make sense if the fibre fines are separated from disturbing substances. If a 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.

Currently separation processes as flotation and sedimentation are investigated for generating an organic and inorganic fraction from fine particle suspensions. For a successful separation the fine particle suspension must be pretreated in a kneading process. After the pretreatment the fine particles can be separated in an organic and an inorganic fraction by a counter flow sedimentation process as well as a flotation process.

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: 01.01.2009 – 31.12.2011

Remarks::

The research project is being funded by the “Fritz und Margot FAUDI-Stiftung”.

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Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Recycling, Stickyentfernung, 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 allows so far 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 phase 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 agency. 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. Dispersion adhesives could not be removed from the paper suspension using this method. For different ratios between oil and paper 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 1:9 from oil to pulp and a consistency of 0.5 % were found. 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 has to be processed after oil extraction in order to remove the residual oil content. If oleic acid is used for oil extraction a saponification can be applied followed by a flotation process which is already available in paper mills which produce graphic paper form recovered paper. Another possibility is the centrifugal treatment of the pulp suspension at high G-forces as they are applied in decanters. A decanter could also be used for reprocessing the oil phase.

After the basic research, investigations are now focussing on continuously operating extraction processes. For those two laboratory devices are needed: one for mixing the oil phase into the pulp suspension and one for segregation and separation of oily and aqueous phase. These two devices will be built at the PMV. Afterwards optimal parameters will be established and the process will be up scaled and verified under industrial conditions.

Application/Economic Benefits:

With the completion of the research 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 – 30.09.2012

Remarks::

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Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Altpapierrecycling, Explosionen, Gase, Wasserstoff, Unfallverhütung

Theme:
Reason for Explosions and Deflagrations in Pipes and Chests of the Paper Industry

Background/Problem Area:

In the last four decades there were around twenty incidents in paper mills all over the world of exploding vessels. Mostly the damages at the paper mills were as destroyed roofs and burst chests. In some cases people were even injured or killed.

All incidents happened after shut down of the stock preparation. Investigations up to now have shown that anaerobic gas production of unstirred stock in the chest has caused the explosions.

All the companies worked with recycled fibre stock. The time between the shut down and the incident was between 20 minutes and several hours to days. Ignition was welding, electrical sparks or unknown causes. The explosions took place in storage towers filled half way. In all documented cases the stirrer was switched off.

One case happened after four hours of paper production. The explosive gas hydrogen was supposed to be the cause in some cases. In most cases there was no documented investigation of the incident.

Objective/Research Results:

The anaerobic degradation of paper stock is a topic for research in waste water treatment but the behaviour of bacteria in paper stock within the mills is mainly unknown. The initial production of explosive gas needs further investigation as well as the composition of this gas. Methods of investigation are online gas chromatography and high speed mass spectrometry. Examination is in laboratory scale with closed vessels for anaerobic storage of pulp and process water to simulate conditions in an unstirred chest of a paper mill.

The amount of explosive gas generated in the first minutes and hours of unstirred pulp in anaerobic conditions at various temperatures is the main topic of the examination.

The composition of the created gas showed to be explosive from the beginning of the anaerobic condition. In the first two days there was a concentration of hydrogen gas up to more than 20 %. This gas was consumed by methanogene bacteria in the third day and converted to methane. The methane concentration rose up to 35 % to the end of the one week experimental period. Over seven days 55 litres of paper stock from a corrugated mill with 1.01 (mixed recovered paper) as raw material created 12 litres of gas at a temperature of 55 °C.

Further examination showed immediate gas consumption on the temperatures of 35 °C, 55 °C and 65 °C from the first minute on different process waters. The gas creation rates rose up to 180 ml of gas within the first 600 minutes after the creation of an anaerobic condition. The samples were taken in the mill and used for examination after only few minutes.

Application/Economic Benefits:

The examination shows the risk of further explosions in paper mills.

Project Period: 01.01.2009 – 30.06.2010

Remarks::

The research project (INFOR 126) was performed in cooperation with the Fraunhofer Institute in Pfinztal and funded by INFOR.

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Forschungsgebiet: Produkt-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 to be investigated. The total amounts are 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 is applied. The quantitative determination of phthalates is carried out by means of a gas chromatography with MS detector.

Additionally, balancing investigations in three recovered paper processing paper mills will be done. Thus, balancing and evaluation of sources and sinks of phthalates and photoinitiators in the production process is possible. These investigations include the analyses of the contaminants in the waste water and the sludges in the different steps of waste water treatment plant. After evaluation of the results, possible technical solutions for removal of phthalates and photoinitiators in the recycling circuit should be 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 should be developed. The reduction of phthalate and photoinitiator amounts in recycled fibres containing papers is an important aim in the current discussion about contaminants in recyced papers.

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

Project Period: 01.01.2011 – 31.12.2011

Remarks::

The research project (INFOR 149) is being funded by INFOR.

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Forschungsgebiet: Prozess-Ziele

Faserstofferzeugung // Altpapieraufbereitung

Schlagworte:

Recycling, Stickymessung, Messtechnik

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 sloth width before visualization of sticky particles by powder or coatings. Therefore the limit of detection is larger than 100 µm (macro-stickies) circle equivalent diameter. For particles smaller than 100 µm (mirco-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 CCD-camera. Information about the particle size distribution and quantity will be available. According to the used camera, the limit of detection is close to 5 µm; therefore the method can evaluate micro- and macro-stickies. It is tested, if it is possible to measure laboratory sheets to accelerate the method.

To reach the given tasks a new measurement system with CCD-camera and UV light is built up at PMV laboratory. Simultaneous 10 different fluorescing agents are investigated for their use in paper stock to ensure marking only hydrophobic impurities and not fibres. At the moment the agent is dosed to the stock before sheet forming on a laboratory sheet former. Later on also different application techniques to an existing laboratory sheet will be tested. Different dosages of the agent are investigated and evaluated, as well as correlation between existing sticky methods (INGEDE Method 4) and industrial stock samples.

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

Gefördert durch:

Bundesministerium für Wirtschaft und Technologie

aufgrund eines Beschlusses des Deutschen Bundestages

Das IGF-Vorhaben 16709 N 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.

PROZESS-ZIELE

Forschungsgebiet
Papier- und Kartonherstellung

Stoffaufbereitung
Papierherstellung
Oberflächenbehandlung

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Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

refining, cavitation, fluid dynamics

Title:
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 a 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.

In order to evaluate the intensity and excess of the cavitation forces, 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.

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. As a consequence, fibre damage might be reduced, thus allowing the paper to be recycled several more times.

Project period: 01.01.2011 – 31.12.2012

Remarks:

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Research area: Product aims

Paper and board production // Stock preparation

Key words:

recovered paper, strength values, board, linerboard, modelling, prediction, optimisation, costs

Title:
Guaranteeing the product properties of packaging paper and board in a changing global context

Background/Problem area

The production of packaging paper and board is being governed by the growing pressure of rising costs as a result of the increase in energy costs, the upsurge in competition from Asian markets and the creation of overcapacity. The sector has been recording falling profit margins and even an ever greater number of plant closures. The situation is being aggravated by the cost- and market-induced use of often low-grade or substandard recovered paper which has been recycled several times and contains an ever growing percentage of fillers and ash. It is reasonable to assume that the strength potential of these raw materials will continue to decline in future. For reason of material and ecological efficiency, on the other hand, the market is making ever greater demands for lighter packaging materials made from paper and board whilst at the same time demanding the same strength requirements.

With this interplay of different factors, the question arises as to how production can be realised under the given framework conditions so that it is as cost-effective as possible whilst at the same time maintaining the same product properties.

Today, most producers of linerboard and other board products must be capable of manufacturing saleable products with specified characteristic values under fluctuating framework conditions without the help of computer-assisted optimisation methods. Some mills are employing in-mill tools which are usually based on classical cost calculations and make short-term options possible based on current day rates.

PTS has developed methods and algorithms aimed at comprehensive cost, product and process optimisation which until now have been used for the simulation-assisted prediction of strength properties and cost optimisation in linerboard production. These tools can be used to meet business management demands of taking additional strategy-oriented cost calculations into account in view of changing production conditions.

The prediction and optimisation tools have been expanded in scope to take into account additional product grades, properties of products and raw materials as well as cost factors (such as emissions trading and changes in the recovered paper market, among other things).

Objectives/Research results

The aim of this research project was to make a contribution to guaranteeing the requisite product properties of packaging paper and board based on the lowest possible production costs in the awareness of the changing quality of the raw materials.

A method was further developed for the simultaneous optimisation of product properties, use of resources, process engineering and production costs in the manufacturing process.

General strength parameters such as tensile strength and ply bond strength are predicted. If linerboard in particular is the object of study, additional characteristic values such as SCT, CMT, bursting strength and the bending stiffness of board can also be forecast.

Making a prediction involves quantifying the effects qualitative changes in the recovered paper grades will have on the product properties. The resources that were taken into account included several grades of recovered paper with varying degrees of recycling and blending based on the global recovered paper flows and important process chemicals (e.g. starch).

The process configuration, process control, specific energy consumption and separation efficiency values are important aspects in process engineering. When studying the production costs for different process alternatives, all variable costs and the important fixed costs (e.g. investment costs and costs for emissions trading) were taken into account.

Application/Economic benefits

The economic benefits will accrue when the method to minimise production costs is actually put into practice. The prerequisite is that the effects of the changed framework conditions on certain product properties be quantified and viewed in an overall context with all cost factors.

Paper mills that implement concept developments using their own technology staffs are thus given a tool with which they can back up their strategic decision-taking. Using the optimisation method within the framework of process optimisation can help paper mills reduce their costs of raw materials and chemicals, energy costs, disposal costs and the costs of rebuilds or of constructing new facilities. Additional users are planners, engineering offices and plant manufacturers.

Project period: 01.07.2009 - 30.06.2011

Remarks:

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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, de-spite 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. The ultrasound technology is not implemented in full scale in the paper industry due to the imbalance between benefits and energy demand mainly caused by the lack of adequate technology and equipment. 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 com-pared to other stock preparation processes, refining is the most energy-intensive sub-process. High-power ultrasound tech-nology has the potential to improve the traditional refining process with regard to the development of fibre properties without affecting the fibre length and at considerably 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 Ultra-sound 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, logistic and socio-economic aspects will also be considered.

Overall objectives are to achieve more energy and resource efficient processes and to broaden the fibre supply to the pa-per 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.

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. There is a need for another pulp treatment / stock prepa-ration method which demands less energy whilst maintaining / ensuring the quality characteristics of fibres. Exploring the potential of high-power ultrasound treatment in this respect is a key objective of SONOPULP. Stock preparation is the main process step in any paper mill. Even though the majority of paper mills are part of large company groups today, there are still many SME looking for alternative solutions in particular in terms of energy economy (high energy demand for stock preparation - refining).

Project period: 01.01.2010 – 30.06.2012

Remarks:

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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 somit 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 dem der heute eingesetzten Auflösetechnologie. Da jedoch Fasern und mineralische sowie andere Bestandteile im trockenen Zustand vorliegen, könnte auch eine separate Abtrennung erfolgen. Damit könnten sich neue Freiheitsgrade der Prozessgestaltung ergeben, die im Rahmen des Projekts weiter untersucht und bewertet werden sollen.

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 bekannte Optimierung.

Abbildung 1:

Granulat vor und nach dem Adsorptionsdeinken

Wirtschaftliche Bedeutung

Vor der in Deutschland tätigen Papierindustrie steht die Herausforderung, den massespezifischen Energieverbrauch bis zum Jahr 2020 um 40 % zu senken, um den aktuellen politischen Zielsetzungen zu entsprechen. Dies dürfte auf dem Wege ausschließlich evolutionärer Technologieentwicklung schwierig bzw. unmöglich sein. Das diesbezügliche Potenzial der untersuchten, in anderen Branchen bereits erfolgreich angewandten Technologien ist sehr hoch und für alle Altpapier verarbeitenden Papierfabriken von Interesse. Sie könnte einen signifikanten Beitrag zum Erreichen der vorgegeben Einsparzielen leisten.

Bearbeitungszeitraum: 01.04.2010 bis 31.03.2012

Bemerkungen

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

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Forschungsgebiet: Prozess-Ziele

Papier- und Kartonherstellung // Papierherstellung

Schlagworte:

Papiertrocknung, optische Eigenschaften, Topografie

Theme:
Correlation of Different High Resolution Measurements of Paper Properties

Background/Problem Area:

Paper production is an energy consuming process. Most of the energy is used up in the drying section of the paper machine. To reduce the energy consumption, it seems feasible to take a closer look where the water is located in the paper and how the local properties like composition, thickness, formation, etc. affect the local drying speed.

Objective/Research Results:

In this project, several new high resolution image analytical measurement techniques (resolution up to 2 µm) are developed. To correlate the single measurements, they are digitally aligned via punched-in markers. These markers are visible in all measurements and are robust against modifications like wetting and calendaring.

- The local paper topography is measured contactless with a Nanofocus µscan device. For this measurement, a focused laser beam is used which is projected on the surface. The sample is moved by a motorized x-y table while the z-axis is adjusted to the appropriate height. Both – top and bottom side – are measured. Both topologies are aligned and subtracted from each other. To get positive values which resemble to an integral measurement, an offset is added.
- The local optical properties are measured with reflected and transmitted light. With these measurements, the local absorption and scattering coefficients S and K can be calculated according to the Kubelka-Munk theory. These measurements are also done in a high resolution and correlated with other measurements.
- The local drying rate is calculated by the shrinkage of the single fibres used to form the paper web. Each fibre type has a characteristic shrinkage ratio. These shrinkage ratios are recorded in a table for different kinds of fibres. From these tables it is possible to derive a statistic from which the local water content can be calculated.
- Different paper components have different absorption spectra. These spectra are recorded. The difference of these spectra is typical for the used paper components. The local composition can be measured with the illumination with different wave length from LEDs. From the ratio of the recorded spectra, the local paper composition can be calculated.

For digital imaging, a high resolution, Pelletier cooled CCD camera is used with an attached long distance microscope. This setup provides a fast access to the sample as well as the possibility for using additional apparatuses like scales or spraying devices for adjusting the water content of the sample.

All results are plotted in Cartesian diagrams. The results form clouds. From the shape of the cloud, it is possible to see the correlation between the single properties.

Application/Economic Benefits:

This work offers deeper insights into paper drying and offers the possibility to identify for example material combinations which are more energy intense to dry.

Project Period: 01.01.2009 – 31.12.2011

Remarks:

This work is part of the project GRK 1114 „Optische Messtechniken für die Charakterisierung von Transportprozessen an Grenzflächen” and is funded by the DFG.

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Research area: Product aims

Paper and paperboard production // Papermaking

Key words:

highly filled paper, filler, ceramic, metal, silicagel, mechanism

Title:
Specific control of the morphology of highly filled special papers by investigation of active mechanisms dependent on materials and processes

Background/Problem area

On the basis of IGF project work it was proved successfully that interesting product ideas can be generated by strong enrichment of the papers with fillers. Finally the present projects show that the laboratory results (in particular the recipes) can be transferred practically on the trial paper machine at PTS-Heidenau. On the basis of the long-standing experience at PTS Heidenau the influencing control about process and material parameters of the continuous paper web production of highly filled specialty papers should be examined and optimised systematically.

A new process approach to the production of specialty papers consists in fixing functional fillers in the paper extremely. With filler contents up to 90 weight-% the quality profile of the paper is not only complemented or modified with the filler any more, but stamped by it. The filler with its specific qualities (e.g., sinterability, adsorption capacity, heat accumulator capacity or electric conductivity) is given in "paper-like" consistency. The highly filled papers can be supplied typically for paper processes (coated, formed) and accordingly variably to the corresponding application systems. The paper-technical realisation of such highly filled papers shows a special challenge and assumes an adaptation of the paper production process as well as the specific fixation of the raw materials (like filler, binding agent, fibrous material) in z direction. Universally valid knowledge to the specific setting of the paper morphology (in particular of the raw material distribution and porosity) has not been published up to now for such highly filled papers. Therefore, it is necessary to expand the knowledge on the basis of the available knowledge about filler-containing papers (e.g.: To extend Sc papers with filler salary between 34 and 36 % by weight).

Objectives/Research results

By specific adaptation of the process parameters, fillers and raw materials were arranged straight in the paper. Concerning this the measuring-technical know-how of the department of metrology flew in into the result evaluation, while the raw material distribution was assessed in the cross section (z direction) of the paper (in particular the filler distribution). Also the impact of densifying the papers by calendering was focus of the examinations in one of the 7 work packages. Several trials were run at PTS trial paper machine in Heidenau with different kind of fillers like ceramic, silica, calcium carbonate and copper. Especially wet end process parameters like de-watering, wet pressure and online drying conditions were tested. The produced sample material was used for detailed densifying tests to investigate the influence of pressure, temperature and time to control density and paper strength of highly filled papers. Filler distribution was analyzed by computer tomography and preceramic paper was sintered and characterized.

Application/Economic benefits

Target markets are all those markets which are financially active currently with the application of fillers. Fillers used to the production of highly filled specialty papers can be organic or inorganic powders by particle dimensions smaller 50 µm. For example, ceramic manufacturers use ceramic powders, which were formed by conventional styling procedures (extrusion, pressing) into the desired prefabricated part shape. Activated carbon filters for the car industry are filled or coated with activated carbon powders or fibres.

Finally the development of highly filled special papers offers a new procedure to organise fillers in flat form to transfer this afterwards in complicated structures (e.g., corrugated cardboard structures). This filler-dominant semi-finished product is made available to the respective user for the subsequent treatment. Some possible target markets are accordingly industries to the areas of paper, ceramic, metal, filter, fire prevention, climate, Electric, automotive engineering.

The research results will be used by German paper manufacturer and converting plants. Secondly, they will have an impact on the future trend of German SMEs (small and medium-sized enterprises) in the filler industry. Low cost applications realized by highly filled paper solutions could evolve into a totally new market for German enterprises once the current technical problems such as raw material distribution and paper strength have been solved.

Project period: 01.06.2009 – 31.05.2011

Remarks:

The research project IK-MF 090022 was funded by the German Federal Ministry of Economics and Technology BMWi

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Research area: Process aims

Paper and paperboard production // Papermaking

Key words:

retention, retention aids, retention mechanisms

Title:
Development of retention systems by using core-shell latices as starting point for the production of innovative, highly filled, functional papers

Background/Problem area

In the production of specialty papers with filler contents up to 85 %, fillers have decisive effects on the paper properties. Fillers with their specific characteristics (e.g., sinterability, adsorption capacity, heat storage capacity or electric conductivity) are present as "paper-like" structures and can be processed accordingly. A special challenge is the development of suitable retention systems capable of retaining these filler quantities and holding them in the dry paper structure. Conventional retention systems enable filler contents of more than 50 %, but the strength of the resulting paper web is no longer sufficient to withstand the tensile loads in the paper machine.

Adequate tear strength can be achieved by means of elastomeric latex particles lending strength and elasticity to paper coatings, for example. Latex particles with modified surfaces can form bridges between fibres and fillers. Latex particles with an internal multi-layer structure are suitable for new retention systems because their structure provides unlimited possibilities for surface modification.

Objectives/Research results

Aim of this research project was the development of a retention system for highly filled functional papers. Essential component of the recipe of retention components were latex particles fitting into the retention system and acting as strengthening agents. The development of the retention system was developed for two filler systems representing the broad range of filler qualities for highly filled functional papers.

From this retention system, basic knowledge had to be acquired to produce highly filled paper based on filler characteristics, the desired properties of the paper product and process-technological demands. The following results were to be achieved:

- Systematic procedure to arrange retention systems for highly filled papers
- New core-shell latices for use in the paper suspension
- Understanding the mechanisms of retention systems to transfer them to other fillers

In the first step, the retention components and raw materials were defined and procured. Industrially available latices were characterised and suitable retention systems for these latices were optimized by variation of charge, dosage amount, molar mass, chemical constitution and dosage sequence of the different components. Drainage behaviour, retention, formation and strength properties of the produced paper sheets were determined. An analytical centrifuge was used to study the flocculation behaviour of the additives in order to optimize the recipes and the dosage strategy.

New latices synthesized by the project partner were characterized analogous to the standard latices. They were tested in laboratory scale for their retention and flocculation behaviour using the analytical centrifuge. The paper sheets produced were tested for their relevant properties in the same way as samples produced with commercially available latices.

Based on the results, a suitable latex was selected from the newly synthesized types and produced in pilot scale by the project partner. The latex was tested with the optimized retention system on a pilot paper machine with a zeolite-based filler to evaluate the efficiency for the practice of papermaking. The produced papers were tested for their relevant strength and adsorption properties. Finally, the results were transferred to another filler, based on diatomaceous earth, which was also tested on the pilot paper machine.

Application/Economic benefits

The transfer of results into industrial practice opens up various different possible applications:

- It offers latex manufacturers opportunities to develop new products
- Optimisation of existing retention systems and development of new adsorptive papers

The economic efficiency of SMEs in the circle of users of highly filled papers can be improved by new products, energy cost reduction and higher machine availability due to improved process stability and product quality.

Project period: 01.04.2009 – 31.03.2011

Remarks:

The research project IGF 318 ZN was funded by the German Federal Ministry of Economics and Technology BMWi within the framework of the ZUTECH programme and was performed together with Deutsches Kunststoff-Institut (DKI), Darmstadt.

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Research area: Process aims

Paper and paperboard production // Papermaking

Key words:

wet strength agents, fluorescence, dynamic simulation

Title:

"Dynamic simulation of wet strength agents"

Tracing and dynamic simulation of adsorption and distribution of wet strength agents in the production of wet strength papers to reduce of the additive costs and increase production in accordance to quality

Background/Problem area

Wet strength agents (WSA) strongly dominate the chemical equilibrium of the wet end of a paper machine in the production of wet strength papers. For efficient application, a very high proportion of the additive has to be bound to the fibres and transferred to the paper web. Nevertheless, high dosage decreases the efficiency of WSA and promotes the build-up of undesirable agglomerates, causing paper specks to occur. This means a loss of effective additive and an increase of off-spec production.

The setting of a high wet strength of the paper without the risk of deposits is already difficult under stable production conditions. It is increased by discontinuous effects like fluctuating broke use, web breaks, grade changes and starting-up processes. Especially the production of wet strength papers in SMEs is defined by frequent process changes which complicate the optimal dosage of wet strength agents.

Objectives/Research results

The aim of the research project is to indicate new ways of increasing the effectiveness of wet strength paper production. The accumulation of off-spec production is to be reduced by more rapidly achieving the target values after grade changes, web breaks or machine start-ups. Overdosage of WSA which leads to deposits as well as raising the costs of additives should become avoidable. The following objectives are to be achieved:

A procedure was developed to trace the adsorption of polyamidoamine epichlorhydrin type WSA on a lab scale and in practice. A suitable method for separating pulp fibres from fibre fines was evaluated. Wet strength agents were synthesised with a fluorescence label. Different methods based on fluorescence spectrometry, Kjeldahl nitrogen detection and charge titration were applied to trace the adsorption behaviour of WSA on pulp fibres, fibre fines and fillers.

In typical dosages, the WSA adsorbed completely to the fibre stock. The amount adsorbed on fines was determined; it was markedly higher than the amount adsorbed on the fibre coarse fraction. Further results show the influences of several process steps (e.g. refining, separation/mixing, reallocation of adsorbed WSA) on the amount of adsorbed WSA and paper wet strength. After mixing of WSA loaded fractions, WSA already adsorbed on one fraction migrates to other fractions until the distribution equilibrium is reached. Desorption does not occur within the time scales regarded. The adsorption characteristics allow for describing the behaviour of WSA within the process steps of the paper production by distribution models (adsorptions and separation functions).

The behaviour of the wet strength agents in stock preparation and wet end of a paper machine is dynamically simulated. The distribution models are integrated into a process-wide physical, dynamic simulation model. Scenarios for the static and dynamic optimisation are to indicate the possibilities of simulation.

Application/Economic benefits

The research project aims at optimising of the production process for wet strength papers. The main benefit is to be expected in a reduction of off-spec production against the background of low production volumes and frequent grade changes. Highest priority has been given to the avoidance of web breaks and cleaning shutdowns caused by deposits. The fast adjustment of the demanded wet strength after a change becomes more important, the more frequent grade changes are. A special aspect is the soiling of wires by inactive wet strength agent. This leads beside greater cleaning expenditure, to diminished drainage performance and accordingly to greater consumption of drying energy. For SMEs without their own steam and power stations, this additional consumption leads to add-on costs due to further rising energy prices.

Project period: 01.05.2009 – 31.10.2011

Remarks:

The research project IGF 16064 N is being funded by the German Federal Ministry of Economics and Technology (BMWi).

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Research area: Process aims

Paper and paperboard production // Paper production

Key words:

recovered paper, deinking, ink particles, brightness, modelling, forecast

Title:
Forecasting method for the brightness of deinked pulp (DIP) as basis for optimization of ink removal processes

Background/Problem area

The optical characteristics of paper – especially brightness – are of particular interest in the production of graphic papers and of packaging papers increasingly used as advertising media. Growing contaminant loads of the starting materials and the high demands made on finished papers, in particular on the brightness of graphic papers, require additional measures of recovered paper treatment to improve the optical quality of recycled fibre pulps. The methods used to remove these contaminants - especially ink particles - are more costly and time-consuming, leading to higher investment and operating costs.

To better estimate the effects of new technologies and their associated process concepts, it would be extremely helpful to forecast the achievable quality of finished pulps, in particular their brightness. This would enable planers, consulting engineers, plant manufacturers and operators (paper mills) to better manage the high technological and planning risks involved.

No method is currently available which can describe the quantitative relationship between brightness and pulp characteristics (especially ink particles / background brightness) in order to forecast the brightness based on balanceable and simulatable pulp characteristics (pulp composition, background brightness, ink particle loading and size distribution).

Objectives/Research results

Aim of this research project is the development of a method making it possible to reliably forecast the brightness of finished and other pulps on the basis of the following balanceable parameters which can be influenced by process optimization:

- loading and size distribution of ink particles,
- pulp composition (fibre fractions, fillers),
- background brightness based on lignin content.

The result of the research project will be a method making it possible to reliably calculate the brightness taking into account the properties of ink particles and other suspension components. The following results are envisaged in the course of the project work:

- provision of models to describe the relationship between the absorption effects caused by ink particles and the size distribution or total area loading of ink particles,
- utilization and adaptation of calculation approaches to determine the proportional effects of ink and other suspension components (fibres, fillers, …),
- verifying the suitability of forecasting algorithms for practically relevant, routine application, based on extensive practical data,
- verifying the quality of models as a prerequisite for combining them with process models later on to ensure reliable result forecasts.

Application/Economic benefits

A calculation method for brightness is a key prerequisite for simulation-based optimizations of ink removal processes as well as for stabilizing and improving the DIP quality. The envisaged research results can therefore be used primarily by companies producing or using deinked pulps. The calculation method is not limited to deinked pulps, though. There is a growing demand for high brightness also in the production of certain packaging papers, which must be met by suitably selected raw materials and treatment processes.

The calculation method contributes significantly to the transfer of knowledge about the optimization of individual process stages and evaluation of overall pulp treatment concepts, resulting in the following main economic effects:

- reduction of raw material, disposal and chemical costs,
- less costly and time-consuming process optimizations and reduced risk of new process concepts,
- fast estimation of the effects of alternative raw materials.

Project period: 01.01.2010 – 31.12.2011

Remarks:

The research project IGF 16315BR is being funded by the Federal ministry for economy and technology (BMWi).

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Research area: Process aims

Paper and paperboard production // Surface treatment

Key words:

curtain coating, multi layer, transport, drying

Title:
Simultaneous wet on wet coating utilizing multi layer curtain coating for manufacturing coated cardboard packaging, especially taking into account the transport processes of coating colour ingredients during drying of the coating

Background/Problem area

Folded cardboard boxes offer manifold possibilities concerning the design on the packaging surface and therefore claim a considerable share of the packaging market. Each layer of the coating on the cardboard possesses defined properties which in combination are responsible for the quality of the product. Commonly, these different layers are applied by repeated single layer coating techniques such as blade coating. In recent years simultaneous multi layer curtain coating has become a cost reducing alternative, since only one multi layer coating pass is necessary.

However, it can be expected that there are significant differences in penetration or transport of coating colour ingredients, especially during the drying process, when comparing multiple pass single layer coating (wet on dry) with one pass multi layer curtain coating (wet on wet). Such differences in mobility of coating colour ingredients could have a significant effect on the desired function of the different coating layers, thus having an influence on the properties of the final coated cardboard product.

Objectives/Research results

The aim of this project was to elucidate the amount of potential lateral transport of coating colour ingredients in multi layer curtain coating, especially depending on the drying parameters. In comparison with single pass coating the influence of such potential mixing of different layers on the performance of the resulting multi layer structure was investigated. Regarding drying parameters, especially the type of drying (convective or irradiative) was varied.

As a first step, two layers were applied with a bar coater on top of one another. The first layer contained methyl blue, a water soluble colouring agent. Through comparison of applying the layers wet on wet and wet on dry with subsequent measuring of the colour intensity on the top layer, an indication of how far the colour had penetrated could be expected. Unfortunately the measurements did not yield the expected result – the wet-on-dry samples revealed a more intense blue than the wet-on-wet samples. An explanation could be the shining through of the concentrated blue in the wet on dry case, whilst in the wet on wet samples the more blurred interface led to a less strong shining through of the blue colour.

The next step involved coating on the Laboratory Curtain Coater. The main goal was to obtain images of cross sections which would show if the Ti in the top layer would penetrate into the bottom layer. Therefore SEM-EDX (Energy Dispersive X-Ray) analyses of coat layer cross sections were taken. Fine titanium dioxide particles were used in the top coat (20 parts related to overall pigment shares). After achieving the proper rheology for the coating colours, the coatings were applied by multilayer coating as well as by single coating steps using the curtain coater with intermediate drying. Compared to the coating with intermediate drying, the multilayer coating process produces a slightly less clear-cut interface. Regarding particles of this size, however, the integrity of layers was largely maintained. As a possible advantage, the slight mixing (blurred interface) was likely to improve the adherence between adjacent layers.

Also regarding the investigation of cross section with TOF-SIMS no significant migration of the detected binder (nitrile-detection) was observed. Both the in SLCC and MLCC samples revealed that the binder remained in the layer it was applied in. In the samples where the detectable binder was applied in the precoat on the base paper, a slight penetration of approx. 10 % of the binder into the base paper was be observed. In summary no unwanted negative differences in quality between MLCC and conventional rod/blade application technique due to migration phenomena were observed.

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 as well as mechanical engineering may profit from this research project.

The most obvious benefit would be cost reduction due to reduced counts of machine passes. Use of multi layer curtain coating in a single machine pass instead of multiple single pass blade coating, whilst achieving the same or even better quality would result in a significant cost advantage. Additionally the transition from blade coating to curtain coating leads to a more uniform surface resulting in better printability for certain products.

More specifically, the following industries may profit for the following reasons. Cardboard and paper manufacturers would profit because of higher capacity and reduced average costs per unit. Paper converters and printers would benefit by receiving better quality combined with less complaints necessary to the supplier and less complaints from the customer of the final product. Finally, also smaller and more specialized coating chemistry producers may gain access to new markets in the area of chemical additives for curtain coating.

Project period: 01.05.2009 – 30.04.2011

Remarks:

The research project IGF 16065 N was funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: Process aims

Paper and paperboard production // Surface treatment

Key words:

co-binder, self levelling, metering blade, scratches

Title:
Development of concepts for Co-binder systems regarding the enhancement of self levelling properties of paper coating colours with the aim of reducing the intensity of application induced damages of the coating

Background/Problem area

The paper coating process nowadays involves mostly contact application. After application of the coating colour, the coating is levelled through the contact of a blade which has the advantage of creating very well levelled surfaces suited for printing. However, a problem of 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 produced scratches/grooves present a problem especially in high quality sheet fed offset printing.

Several co-binders, especially casein and crosslinked poly(vinyl alcohol) are known to show self levelling phenomena in different applications. E.g. for casein, due to its complex supramolecular structure it may be possible that a self levelling phenomena is linked to self organisation. Such special behaviour is also known from self levelling cementitious floor screeds which contain casein as 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 the development of concepts for co-binder systems for the enhancement of self levelling properties of paper coating colours in order to avoid defects caused by the application process (metering blade). Therefore classic systems known to give a smooth surface will be investigated regarding the levelling mechanism. The ensuing knowledge will then be transferred to new co-binder systems from renewable resources such as e.g. modified starches 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 due to manifold possibilities of property design and low costs completely took over. However, casein was always well-known for achieving nicely levelled, smooth coatings. In order to recall these properties and as a starting point for this project, an offset paper coating colour was prepared containing 50 % casein as binder and compared to the standard without casein. For comparable rheological properties an appropriate amount of synthetic thickener was added. The microscope pictures reveal that the grooves which were applied on purpose are much less pronounced in the recipe containing the casein.

First results include the dependency of the levelling on the amount and type of co-binder. A coating colour with 50 % of Casein co-binder (with 50 % standard latex binder) shows better levelling than a coating colour with 50 % dextrin co-binder which is again better than 100 % latex binder. The Brookfield viscosities in all of the colours were kept constant through addition of thickener. For a significant levelling effect concerning the Casein at least approx. 25 % Casein is required.

Further steps in this project include the thorough investigation of the identified self levelling coating colours (e.g. rheology and water retention) which should then lead to an idea about the mechanism of the self levelling. This knowledge will then be transferred to other renewable resource materials such as e.g. starches or other polysaccharides. Additionally, the mechanical treatment of the paper web which could also lead to a better levelling will be investigated. Finally, the overall most promising new self levelling coating colours will be tested on a pilot scale. Industrial printing trials will finally determine the quality of the finished coated paper products.

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 and agricultural industry (additives, starches) as well as mechanical engineering may profit from this research project.

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

More specifically, prevention of scratches/grooves in the coated paper has advantages for the printer, because less discard is produced if the quantity of defective sheets becomes less. 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 for the development of new special products, which cannot be produced economically on large industrial scale. Manufacturers of special vibration machines as well as machine builders may acquire new business fields through successful working out of the mechanical treatment of the paper web in this project.

Project period: 01.03.2010 – 31.08.2012

Remarks:

The research project IGF 16409 N is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Forschungsgebiet: Prozess-Ziele

Papier, Karton und Pappe // Oberflächenbehandlung

Schlagworte:

Raps, Protein, Stärke, Bindemittel

Thema:
Substitution synthetischer Bindemittel und Cobindemittel durch Kombination von Stärke und speziell aufbereiteter Rapsproteine für den Kartonstrich

Ausgangssituation/Problemstellung

Bindemittelsysteme in konventionellen Streichfarben für gestrichenen Karton enthalten überwiegend synthetische Produkte. Die Verknappung fossiler Rohstoffe und die sich ändernden politischen Rahmenbedingungen, z. B. bedingt durch den Emissionshandel, erfordern ein Umdenken. Neben der Verringerung der spezifischen Wassermenge und Optimierungen des Energieeinsatzes bei der Papierherstellung ist der Einsatz nachwachsender Rohstoffe bei der Papierveredelung zu forcieren. Stärke wird bereits erfolgreich als Binde- und Cobindemittel in der Streichtechnik eingesetzt, doch der Anteil am Bindesystem ist je nach Papiersorte bei rund 2/3 zurzeit noch begrenzt.

Forschungsziel/Forschungsergebnis

Im Rahmen des Forschungsvorhabens soll auf Basis rein pflanzlicher Rohstoffe ein Bindemittelsystem für das Streichen von Karton entwickelt werden. Als Substitutionsmöglichkeit fossiler Rohstoffe bei gleichzeitiger Sicherstellung der Produktqualität kommen Stärkederivate sowie speziell modifizierte Rapsproteine zum Einsatz.

Der industrielle Einsatz von Rapsproteinen ist bislang nicht vollzogen. Für die Übertragung von Ergebnissen sowohl aus dem Labor- wie auch aus dem Technikumsmaßstab sollen entsprechende Verfahren für eine spezifische Anwendung von Rapsproteinen im Kartonstrich entwickelt werden. Mit dem Forschungsvorhaben sollen daher für diese Anwendung, mit einem grundsätzlich neuen Lösungsansatz zur Reduzierung des Einsatzes fossiler Rohstoffe, Ergebnisse aus Laborversuchen in den Technikumsmaßstab übertragen und Muster für die vorindustrielle Verarbeitung bereitgestellt werden.

Das Projekt besteht aus einem Teil zur Erzeugung geeigneter Rapsproteine, die im zweiten Projektteil hinsichtlich Applikation proteinhaltiger Streichfarben und der qualitativen Auswirkung auf den gestrichenen Karton untersucht werden.

Im Rahmen von Labor- und Technikumsversuchen werden proteinhaltige Streichfarben hinsichtlich ihrer qualitativen Auswirkungen auf die Streichfarbenrheologie sowie der erreichbaren Kartonqualität hin untersucht. Die Bewertung der erzeugten Rapsproteine in Strichrezepturen durch Streichversuche und die Identifizierung der Anforderungen an den Proteinaufbereitungsprozess, um die gewünschten Strichbindemitteleigenschaften zu erreichen, sind Aufgabe der Forschungsstelle Oberfläche.

Anwendung/Wirtschaftliche Bedeutung

Im Ergebnis des Projektes wird die Erweiterung des Einsatzes und Herstellung pflanzlicher Proteinprodukte aus Raps aus dem einheimischen Anbau und Verarbeitung für die industrielle Kartonherstellung entsprechend der europäischen Qualitätsanforderungen erreicht. Daraus resultiert neben der Entstehung neuer Geschäftsfelder für die Ölsaatenverarbeitung und einzelner Bereiche des Maschinenbaus ebenso eine höhere Wertschöpfung für das Rapsschrot aus der Ölpressung.

Rapsschrot wird auf eine höhere Veredlungsstufe gehoben und für den Anlagenbau ergeben sich neue Absatzmärkte durch die Errichtung neuer Verarbeitungskapazitäten. Bei einer Substitution von 12 Teilen Latexbindemittel und 0,5 Teilen synthetischer Additive in Streichfarben durch 10 Teile Stärke und 6 Teile Rapsprotein ergeben sich Rezepturkostenersparnisse von etwa 8 %.

Bearbeitungszeitraum: 01.03.2010 – 31.08.2012

Bemerkungen

Das Forschungsvorhaben IGF 16410N (Kurztitel: Rapsprotein und Stärke als Binder im Strich) wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Forschungsgebiet: Prozess-Ziele

Papier, Karton und Pappe // Oberflächenbehandlung

Schlagworte:

Etikett, Klebstoff, Induktion,

Thema:
Trägerpapierloser Selbstklebeetiketten durch den Einsatz einer induktionsaktivierten Klebschicht

Ausgangssituation/Problemstellung

Die Selbstklebeetikettierung wird in vielfältigen Anwendungsgebieten eingesetzt. Da die SK-Etiketten (Selbstklebeetiketten) stets klebrig sind, besitzen sie ein silikonbeschichtetes Trennpapier. Das sogenannte Release Paper verursacht jedoch verschiedene Nachteile. Einerseits werden Gewicht und Volumen einer Etikettenrolle erhöht, was neben den Herstellungskosten unnötige Kosten bei Transport und Lagerung und Entsorgung für das Release Papier bedeutet. Nach der Applikation der SK-Etiketten muss das Trennpapier aufgewickelt und entsorgt werden. Dies verursacht weitere Kosten. Ferner sind die als Müll anfallenden silikonisierten Papiere ökologisch bedenklich.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsprojektes ist es, eine neue, ökonomische und energieeffiziente Technologie auf Basis von induktionsaktivierbaren Klebstoffen für das Verbinden von Etikett und Substrat zu nutzen, ohne jedoch Trägerpapier wie Silikonrohpapier einsetzen zu müssen.

Wärmeaktivierte Klebeetiketten stellen einen vielversprechenden Weg dar, das Trägerpapier einzusparen. Bisher stellte dabei die effiziente Wärmeübertragung die größte technologische Hürde dar. An Stelle eines von außen wirkenden Wärmetransportes werden die Klebstoffe in Gegenwart von Nanoferriten per Induktion in der Klebschicht direkt erwärmt, ohne andere Werksstücke und temperaturempfindliche Substrate zuvor oder zeitgleich zu erwärmen. Der Wärmetransport erfolgt lediglich aus der Klebschicht heraus. Induktionsaktivierbare Etiketten vereinen die wirtschaftlichen Vorteile eines trennpapierlosen Etiketts und die effiziente Energieübertragung der Induktionstechnik, so dass trennpapierlose Etiketten auch als ökologisch sinnvolle Alternative zu den heutigen Selbstklebeetiketten entwickelt werden kann.

Das Projekt besteht aus einem Teil zur Erzeugung geeigneter Klebstoffdispersionen, die im zweiten Projektteil hinsichtlich Applikation auf Etikettenpapiere und der klebetechnischen Eigenschaften untersucht werden.

Es werden Laborversuche unternommen, die zum einen der Entwicklung einer induktiv erwärmbaren Klebstoffschicht dienen und zum anderen, die für ein optimales Auftragskonzepte zur Beschichtung von Etikettenpapier mit Streichfarben für die optischen Eigenschaften und Bedruckbarkeit sowie der induktiv erwärmbaren Schicht auf der Etikettenrückseite notwendig sind. Die im Labormaßstab gewonnen Erkenntnisse werden an der Technikumsstreichanlage umgesetzt und um Trocknungsführung für die Erzeugung von induktionsaktivierbaren Etiketten ergänzt.

Anwendung/Wirtschaftliche Bedeutung

Durch den Wegfall von silikonhaltigem Trägerpapier wird die Ökobilanz der Selbstklebeetiketten deutlich verbessert. Gelingt es zudem die eingesetzten Nanoferrit-Pigmente wiederzuverwenden, verbessert sich die Ökobilanz der zu entwickelnden induktionsaktivierbaren Selbstklebeetiketten weiter.

Die zunehmende Sensibilisierung der Bevölkerung im Bereich der Ökobilanzen, lässt derzeit für besonders effektive Technologien mit hoher Ressourcenschonung höhere Preise am Markt durchsetzen.

Dabei profitieren die Etikettendrucker (überwiegend KmU) überproportional von der neuen Technologie, da die Entsorgungskosten für das silikonhaltige Trägerpapier konventioneller Selbstklebeetiketten für deren Kunden entfallen.

Den angesprochenen Industriezweigen eröffnen sich neue Produkte bzw. Marktbereiche entlang der Prozesskette. Dabei handelt es sich um Klebrohstoffe, Klebstoffe, Etiketten (überwiegend KmU), Induktions- und Etikettieranlagen (überwiegend KmU).

Bearbeitungszeitraum: 01.11.2010 – 30.04.2013

Bemerkungen

Das Forschungsvorhaben IGF 16792N (Kurztitel: INDUKLEB) wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Process aims

Paper, paperboard and board // Surface treatment

Key words:

silicone, curtain coater, separating layer, multi layer

Title
Siliconization by means of the multilayer curtain coater

Background/Problem area

A total of 30.5bn m2 of release paper, 50 % thereof for labels, were consumed in 2006. A worldwide growth rate of 9.9 % is given while in Europe about 4 to 6 % increase is estimated.

Silicon coating is state of the art for production of release paper since the 1950s. A thin silicon layer is applied as separating layer on a substrate and then cured or rather cross-linked.

High-quality raw materials and complex production processes are responsible for about 20-30 % of the cost of label laminates. Additionally they are usually not recycled and are disposable products.

75 % of all silicone coatings are created by means of poly addition, where two silicone compounds are cross-linked under the influence of a Pt catalyst. The Pt catalyst is of high chemical activity and prone to inhibition by contamination through amines, phosphoric-, sulphuric-, or heavy metal compounds. These compounds can be present in the paper, paper coating or in the environment. They can migrate through the substrate to reach the surface, or can be transferred via contact areas between felt and wire side in the paper roll. For this reason only high-quality paper or films are used as basic substrates. They are intended to provide a sealed surface in order to save silicone, but cannot ensure a chemically inert surface.

Objectives/Research results

A simultaneous application of silicone coating together with a chemically inert barrier layer in a single curtain coating step with ensured release properties is target of the project.

Curtain coating technology is the only coating technique to apply multiple layers wet-in-wet and in one run on a substrate. The ideal contour coating enables an excellent coverage in spit of low coat weights.

Analysis of chemical compatibility between silicone coating and barrier layer is required to avoid damage to the silicone coating. This has not been investigated so far. Process-technological compatibility between the two layers is of major importance to ensure good converting properties. The advantage of a barrier layer may result in a significant reduction of the silicone layer including a reduced Pt catalyst. The suitability of different chemicals and compounds for use in the barrier layer and in the curtain coater is to be investigated. Apart from being chemically inert, the liquid barrier layer should have a high hold-out, and its surface should provide enough anchoring points for the silicone.

Beside improvement in siliconization result, this will primarily save operation and production costs in the entire value chain.

Suitable silicone coatings and barrier chemicals have been chosen in initial laboratory trials and have now been tested for their application in the curtain coater. Aspects of chemical compatibility and inertness of the barrier chemistry against the silicone coating are of major importance. Paper sheets have been produced in the laboratory. The tests of various paper properties, e. g. surface properties but also release forces, are finished and lead to selected silicone coating compounds and barrier chemicals, which are currently tested on the laboratory curtain coater. While the barrier layer forms a good curtain on the curtain coater, the silicone does not yet show such behaviour. In the next step we have to add chemicals to the silicone which will convert the silicone property to form a curtain without effect on the cross-linking. The barrier compound and silicone mixture are then simultaneously coated onto selected papers.

Application/Economic benefits

Up to now, curtain coating technology has not yet become established in the field of silicone release papers and siliconization. The project is to help establishing the technique in these production areas.

The envisaged research results are mainly related to the field of materials. Further applications are seen in the field of chemistry, process engineering and production, but also in the paper-, publishing and printing industries.

Project period: 01.03.2010 – 29.02.2012

Remarks::

The research project IGF 16407N is being funded by the Federal ministry for economy and technology BMWi.

PROZESS-ZIELE

Forschungsgebiet
Weiterverarbeitung

Trennen
Verbinden/Fügen
Umformen
Beschichten

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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. The 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 for paperboard significantly differ from those predominantly used in metal or plastics forming. Hydroforming – a variety of deep drawing that allows the production of complex shapes at high degrees of deformation – is commonly used for sheet metal forming. 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 behavior 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 will include an investigation of the influences of temperature, anisotropy and friction on the forming results. Also a deeper look into the drying conditions and improvements of the FEA modelling are scheduled.

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 Elemente 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 (SCHA1246/2-1) is performed in cooperation with the Institut für Produktionstechnik und Umformmaschinen (PtU) an der TU Darmstadt and is funded by the German Research Foundation (DFG).

PROZESS-ZIELE

Forschungsgebiet
Messen/Steuern/Regeln im Prozess

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Forschungsgebiet: Prozess Ziele

Messen/Steuern/Regeln im Prozess

Schlagworte:

Topografie, Glätte, optisches Messgerät

Thema:
„Entwicklung eines mobilen und handgeführten optischen Messsystems zur produktionsnahen Bewertung der Topografie von Papieroberflächen “

Ausgangssituation/Problemstellung

Zur Messung der Papierglätte wurde eine Vielzahl von Geräten entwickelt und am Markt eingeführt. Für die Akzeptanz der Geräte spielten dabei bisher häufig die Aspekte geringer Preis, einfache Bedienung, robuste Technik und schnelle Bereitstellung einer eindimensionalen Messgröße eine Rolle. Diese Randbedingungen wurden jedoch von Messgeräten, die eine direkte Messung der Oberflächenstruktur ermöglichen, in der Vergangenheit meist nicht erfüllt, so dass in der Papierindustrie heute noch Geräte eingesetzt werden, die eine indirekte Größe für die Glätte liefern. Am meisten verbreitet sind die Luftstrommessverfahren, bei denen der Durchgang der Luft zwischen der Probenoberfläche und einer ebenen Glasfläche oder aufgesetzten Stahlkanten gemessen wird. Nachteilig ist, dass die Porosität der Proben einen zusätzlichen Luftdurchgang bewirkt, der das Ergebnis beeinträchtigt. Diese indirekten Messverfahren reduzieren eine dreidimensionale, komplexe Eigenschaft des Papiers auf einen Messwert, wobei wertvolle Informationen verloren gehen. Auf diese Informationen kann bei der gezielten Entwicklung von neuen und verbesserten Papierprodukten nicht verzichtet werden. Deshalb findet gegenwärtig ein Findungsprozess in der Papier- und Druckindustrie bezüglich der Auswahl leistungsfähiger Topografiemessgeräte statt, wobei eine Orientierung auf optische Systeme zu erkennen ist.

Forschungsziel/Forschungsergebnis

Ziel des Forschungsvorhabens ist die Entwicklung eines mobilen und handgeführten optischen Messsystems zur produktionsnahen Bewertung der Topografie von Papieroberflächen. Das Gesamtprojekt unterteilt sich in zwei Teilprojekte, die jeweils von den Projektpartnern bearbeitet werden. GFMesstechnik GmbH obliegt innerhalb des Projektes die Entwicklung des handgeführten Sensors inklusive Steuerungs- und Auswertesoftware. Ziel des Teilprojektes der Papiertechnischen Stiftung (PTS) ist die Erarbeitung der Anforderungen an die optische Topografiebewertung mittels phasenmessender Streifenprojektion von ungestrichenen und gestrichenen Papieren, die sich im Wesentlichen aus der Weiterverarbeitung und dem Gebrauch der Papiere ableiten. Eine Schlüsselrolle nehmen in diesem Zusammenhang die grafischen Papiere ein, die einerseits mengenmäßig bedeutungsvoll sind und an die andererseits hohe Anforderungen an die Oberfläche zur Gewährleistung eines guten Druckergebnisses gestellt werden.

Derzeitig gibt es keine Normung der optischen ortsaufgelösten Oberflächenbewertung von Papier, so dass im Rahmen des Projektes die zur Charakterisierung der Papieroberfläche geeigneten Kenngrößen und gegebenenfalls deren Algorithmen erarbeitet werden müssen. Des Weiteren ist die PTS in die Erarbeitung des geräte- und softwaretechnischen Messgerätekonzepts involviert. Ein wesentlicher Bestand der Arbeiten der PTS ist die Generierung einer Datenbasis der Topografie der wichtigsten Papiersorten als Grundlage für die objektive Bewertung des entwickelten Messsystems.

Gegenwärtig liegt ein erster Prototyp des Messsystems vor und wird von der PTS in Kooperation mit der Papierindustrie umfassend getestet. Dies erfolgt anhand bereits mit verschiedenen Laborsystemen bewerteter Papiere. Die Ergebnisse der Testphase stellen die Basis für die Geräteoptimierung dar.

Anwendung/Wirtschaftliche Bedeutung

Die Entwicklung eines mobilen Messsystems zur Topografiebewertung von Papier stellt einen technologischen Fortschritt im Bereich der Anwendung von Mikrospiegelsystemen dar, die die Voraussetzung für eine Miniaturisierung von Messsystemen auf der Basis der phasenmessenden Streifenprojektion ermöglicht. Des Weiteren wird mit dem zu entwickelnden System die Grundlage für den produktionsnahen Einsatz dieses optischen Messprinzips in der Papier- und Druckindustrie geschaffen. Durch die schnelle, produktionsnahe Papieroberflächenbewertung mittels topografischer Kenngrößen wird dem Papier- und Drucktechniker ein effizientes Werkzeug zur Produktoptierung und –weiterentwicklung bereitgestellt.

Bearbeitungszeitraum: 01.04.2010 – 30.09.2011

Bemerkungen

Das Forschungsvorhaben KF2037908AB0 wird im Rahmen des ZIM-Programms aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert und in Zusammenarbeit mit der GFMesstechnik GmbH durchgeführt.

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Research area: Process aims

Process measuring and control technology

Key words:

Tissue, softness, panel test, objective measurement

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

Background/Problem area

Within the "*SOTIPA*" (softness of tissue papers) project researchers from three European countries – Germany, Spain and Belgium – combine their experiences and capabilities to achieve a better understanding of tissue softness. 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 subjectiveness 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. Therefore the project aims at changing this situation by creating a unified panel-test procedure and finding a combination of measurement parameters, which correlate with human perception. To reach that goal, parameters, affecting the softness sensation, are illuminated also in view of neurophysiology.

Objectives/Research results

A reproducible evaluation of the overall impression of softness both in the form of a standardised and possibly accredited panel test and in the form of a metrological evaluation method should be of benefit to manufacturers, converters, dealers and consumers alike. In addition to establishing serious and reliable benchmarks, such an evaluation would make it possible in particular to optimise products, the associated processes and definitions of appropriate supply parameters.

Application/Economic benefits

Measures of tissue manufacturers designed to enhance product softness are some of the best-kept secrets of corporate know-how and in some cases are even protected by patents. The consequences that a new measuring methodology for characterizing softness might have on the efficiency of the products and process can therefore not be expressed in numbers. It is an incontestable fact, however, that such a methodology would contribute to a more meaningful product characterization and thus create a basis on which selective optimization of individual processes and products could be further developed.

Project period: 01.09.2009 – 29.02.2012

Remarks:

The research project IGF 21EBR is being funded by the German Federal Ministry of Economics and Technology BMWi and performed together with other European institutes.

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Forschungsgebiet: Prozess-Ziele

Messen/Steuern/Regeln im Prozess

Schlagworte:

Initiale Nassfestigkeit, Modellierung, Online, Festigkeitssteigerung, Abrissreduzierung

Thema:
Online-Voraussage der initialen Nassfestigkeit

Ausgangssituation/Problemstellung

Die Initiale Nassfestigkeit (INF) von Papier ist ein Parameter, der für die Effizienz der unmittelbaren Papierherstellung von wesentlicher Bedeutung ist. Eine genaue Kenntnis der INF würde sowohl die Möglichkeiten als auch die Grenzen der Steigerung der Effizienz aufzeigen. Allerdings ist die INF bisher nicht direkt im Prozess messbar.

Bei der Produktion von grafischen Papieren kann die Effizienz durch Einsatz kostengünstiger Rohstoffe, einen erhöhten Füllstoffanteil, geringere Flächenmasse sowie höhere Maschinengeschwindigkeiten und Senkung der Stillstandszeiten gesteigert werden. Diese Maßnahmen dürfen aber nicht zu einer verringerten Papierqualität führen.

Ein erhöhter Anteil von Füllstoff oder funktioneller Additive verringert die Bindungsmöglichkeiten der Fasern und damit die Aufnahme von Kräften. Geringere Qualitäten von Rohstoffen müssen durch Additive ausgeglichen werden, um die Festigkeit auf dem Niveau zu halten.

Höhere Maschinengeschwindigkeiten führen zu größeren Zugbeanspruchungen der Papierbahn. Da Bahnrisse mit höchster Priorität zu vermeiden sind, muss das Papier dieser Beanspruchung standhalten. Besonders kritisch ist dabei der erste freie Zug innerhalb der Papiermaschine, da dort die Bahn erstmals ohne Siebunterstützung eine genügende Festigkeit aufweisen muss.

Forschungsziel/Forschungsergebnis

Dieses Forschungsvorhaben verfolgt folgende Zielstellungen:

- Verfahrensentwicklung zur Online-Vorausbestimmung der initialen Nassfestigkeit (Modellbildung)
- Untersuchung der stofflichen und strukturellen Einflussgrößen auf die initiale Nassfestigkeit

Anwendung/Wirtschaftliche Bedeutung

Bislang kann die initiale Nassfestigkeit online nicht bestimmt werden. Eine Modellierung und Online-Voraussage dieser Größe kann zu folgenden Effekten führen:

- Verbesserung der Produktivität der Papiermaschine
  - durch Reduzierung der Abrisse im Bereich des ersten freien Zuges
  - durch optimale Nutzung des Betriebsfensters
- Verbesserung der Effizienz der Papiermaschine
  - durch Optimierung des Additiveinsatzes zur Festigkeitssteigerung
  - durch Erhöhung des Füllstoffanteils

Bearbeitungszeitraum: 01.12.2009 – 30.11.2011

Bemerkungen

Das Forschungsvorhaben IGF 16275 (Kurztitel: Initiale Nassfestigkeit Online) wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Forschungsgebiet: Prozess-Ziele

Messen/Steuern/Regeln im Prozess

Schlagworte:

MuMAS, Bildanalyse, Papiereigenschaften, Spektralanalytische Bildauswertung, Bildfusion

Thema:
Multispektrales Modulares Analysesystem (MuMAS) für die Papierindustrie

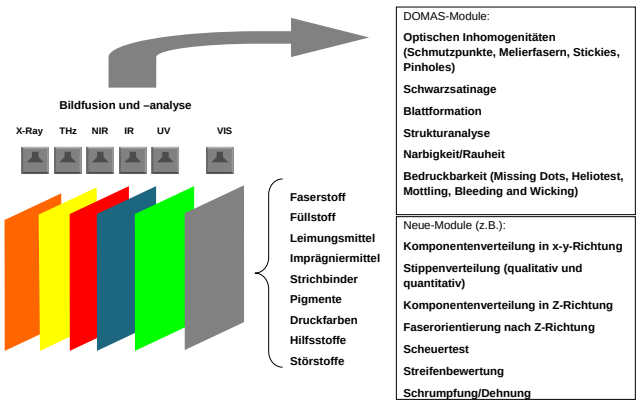
Ausgangssituation/Problemstellung

PTS entwickelt und vertreibt seit ca. 10 Jahren das Bildanalysesystem DOMAS (Digital Optical Measurement and Analysis System). Für wichtige Aufgabenstellungen zur Qualitätssicherung in der Papierindustrie ist es das Standardsystem geworden. DOMAS arbeitet mit Bildinformationen von Scannern und Kameras. Damit sind die Analysemöglichkeiten auf den sichtbaren Bereich beschränkt. Neue moderne Imagingsensoren liefern zusätzliche Abbilder von Materialproben. Dabei wird die Wechselwirkung von Strahlung aus anderen Bereichen des elektromagnetischen Spektrums mit Papierkomponenten genutzt. Die Auswertung dieser Bilder kann zusätzliche Informationen über die Papierproben liefern. Für die Zukunftsfähigkeit ist es notwendig, die Systembasis von DOMAS, derzeit das Bildverarbeitungssystem OPTIMAS, zu modernisieren. Damit sollen sowohl Funktionserweiterungen ermöglicht, als auch die langfristige Produktpflege gesichert werden. Die Verwendung immer neuer Hilfsstoffe und Komponenten für die effektive Erzeugung von Papier mit neuen Funktionen weckt den Bedarf nach neu- und weiterentwickelten Qualitätssicherungs-Tools, die für die Nutzer möglichst geringen Aufwand für die Probenvorbereitung und kurzer Analysezeit erfordern.

Forschungsziel/Forschungsergebnis

Das Forschungsprojekt soll einen Beitrag zur Qualitätssicherung in Forschung, Entwicklung, Herstellung und Verarbeitung von Papierprodukten leisten. Ausgehend von DOMAS soll ein Multispektrales Mess- und Analyse-System entwickelt werden.

MuMAS wird ein Produkt, welches den Nutzern mit Hilfe von Abbildungen der Papierproben in verschiedenen Spektralbereichen und deren Auswertung zusätzliche, objektive Informationen über Papier liefert. Weitere Möglichkeiten wird die Fusion und Auswertung verschiedener Abbilder bieten (siehe Abbildung).



MuMAS wird ein modulares System und ist gleichzeitig ein offenes Konzept. Künftige Forschungsprojekte zu Papiereigenschaften können MuMAS als Softwarebasis nutzen, um effektiv zu forschen und die Forschungsergebnisse schnell für Nutzer kommerziell zugänglich zu machen.

Im Projekt wird das Systemkonzept umgesetzt. Als Basis des Systems sollen am Markt verfügbare Hardware (PC, Imagesensoren, Kameras) und Software (Windows®, Bildanalysetools) genutzt werden. Der Schwerpunkt des Projekts liegt auf der Entwicklung neuer Analysealgorithmen und Auswertemodule, z.B. für die XY-Verteilung von Papierkomponenten (Strich, Pigmente, Leimungsmittel) und (optisch nicht sichtbare) Ungleichmäßigkeiten von Beschichtungen. Dies wird an Beispielapplikationen realisiert. Weiterhin werden bewährte DOMAS-Module auf die moderner Plattform mit verbesserter Funktionalität umgesetzt.

Anwendung/Wirtschaftliche Bedeutung

Die Anwendung erfolgt bei Qualitätssicherung (FuE, Produktionsüberwachung, Reklamationsbearbeitung) in Papierfabriken, Druckereien, Sieb- und Filzproduktion, Forschungseinrichtungen. Spezielle Module für Textilien, Faserverbundstoffe, Beschichtung und Pulver können den Anwendungsbereich erweitern.

Die wirtschaftliche Bedeutung für Endanwender liegt in der Erhöhung der Informationsvielfalt über Papierqualität und Herstellungs-/ Verarbeitungsprozesse, in der Reduzierung des Aufwands für Probenvorbereitung und in der Verkürzung des Zeitaufwands für Analysen. Hersteller von Imagingsensoren erhalten eine branchenspezifische Anwenderplattform für den Verkauf ihrer Erzeugnisse. Letztendlich bringt das Produkt MuMAS Verkaufserlös für den Antragsteller.

Bearbeitungszeitraum: 01.01.2010 – 31.12.2012

Bemerkungen

Das Forschungsvorhaben IK-MF 100044 (Kurztitel: MuMAS) wird aus Mitteln des Bundesministeriums für Wirtschaft und Technologie BMWi gefördert.

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Research area: Process aims

Process measuring and control technology

Key words:

filler measurement, measuring instruments

Title:
Development of a testing method for the quantification of the mineral content of painted and unpainted papers

Background/Problem area

The mineral content of the painted or unpainted paper plays always a large and important role since during the paper trade, since the kind and the quantity of the contained so-called fillers affect and determine the characteristics of the paper considerably.

So far the mineral content was determined by measuring procedures, which was based partially on the absorption measurement of photons of certain energy. This procedure is used mainly for on-line measurement. It needs however for the indication of the mineral content the mass extinction coefficients of the contained mineral mixture. In order to be able to indicate these, the mineral components and their portion of the total quantity must admit to be.

The problem lies now in the fact that as production of recycling paper and the associated employment of waste paper these relations cannot be indicated in a while ago the no more, since does not admit the mineral components and their proportions in this waste paper is.

Objectives/Research results

Classical filler measuring procedures supply indication of the filler content only under the condition that admits all individual filler components and their concentration (portion of the total filler) is. With employment of waste paper as raw material is however not given. In this case the individual components and concentration must be determined additionally instrumentation. The project is concerned with the development test and/or measuring procedure, which is able to detect the individual components of an unknown filler quantity and to determine their portion of the filler whole. Such a measuring procedure becomes ever more interesting, since the waste paper portion is already large for paper trade and will continue to rise.

The procedure of the x-ray fluorescence measurement uses the characteristic from atoms that when their ionization in internal electron shells re-organization processes run off, in whose consequence photon radiation, characteristic x-ray so called, is emitted. The photons emitted thereby have a discrete energy distribution typical for the respective chemical element. The highly soluble detection of this radiation makes possible thus the identification and the quantitative analysis for the chemical element composition and concomitantly the filler composition. The procedure which can be developed in the project and the sensor system are developed into a complete measuring instrument in form experimental setup/prototype, which is parallel to the production process suitable to the inline measurement of the filler content.

The procedure which can be developed in the project and the sensor system are developed into a complete measuring instrument in form experimental setup/prototype, which could be already tested and presented as complete laboratory instrument. At present the planned test run in a real test environment, e.g. a paper mill, will prepared.

Application/Economic benefits

For many paper manufacturers the filler content of the produced paper is an important quality parameter. The filler content determines and/or affects numerous characteristics of the paper such as firmness, surface finish, printability, drying process etc.

Details or at least a more exact knowledge of the composition of the mineral content of a waste paper pulp suspension are very important for the following reasons for the paper manufacturers, than application. The filler measurement can take place directly, without destruction and parallel to production, within shortest time. Thus the filler content can be affected directly and in time and a continuous and/or a requirement-fair quality of the papers be thus always ensured can. The laboratory fair equipment planned as aim of the project is to fulfil this necessity and makes thereby a substantial contribution for the production and quality control of the paper manufacturers.

Project period: 01.10.2009 – 30.09.2011

Remarks:

The research project KF2037903KM9 is being funded by the German Federal Ministry of Economics and Technology BMWi and performed together with Technische Universität Dresden, Institut for nuclear and particle physics, working group physics of radiation; emtec Electronic GmbH and Papierfabrik Freital-Hainsberg GmbH.

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Research area: Process aims

Process measuring and control technology

Key words:

data-based modelling, process optimisation, process data extraction, data coupler

Title:
Process oriented extraction and preparation of production data as basis for model-based improvements of complex procedural processes using the example of paper production

Background/Problem area

Mathematical modelling is a fundamental method for revealing and invoking the optimization potentials of procedural production processes. This technique is amongst others applied to simulations of cause-and-effect chains, forecasting, model-based controls and soft sensors. The workflow of mathematical modelling typically consists of

1. Determining target and cause variables,
2. Extraction of data base from a real process (extraction and processing of raw data),
3. Modelling and model validation,
4. Offline and/or online application of the model.

The various characteristics of mathematical modelling are scientifically well-proven. Nevertheless, just a few factory installations have been realized so far. Major reason for sporadic application is the complexity of the procedure that is necessary to gain usable data out of the process. Often it is this complexity and the expected initial investment in this context that prevents the realization of promising optimization projects in smaller and medium-sized business. The operating expense is caused by the following currently existing shortcomings:

- Time-consuming procedure to determine target and cause variables since the operational background that is necessary for this purpose is undocumented and distributed to different staff members. Thus, operational background is not available transparently to project participants.
- Real time series data is subject to various quality reducing effects such as process noise, atypical process states, sensor failure, data handling errors or outlier. The subsequent data processing is costly and time consuming.
- In general, a multitude of heterogeneous data sources exist. As a consequence, the data is provided in different dimensions and different chronological resolutions. This makes it difficult to perform a correlated analysis.

Objectives/Research results

Within modelling projects so far, the process of data pre-processing was often underestimated concerning its need and effort. Lack of methods and tools for data extraction usually caused substantial and incalculable costs in advance of data collection for the purpose of modelling. The current research project, which is realized in collaboration with LeiKon GmbH, a company with high expertise in process control engineering, started at the weak point in the process of generating data-based models: the low-effort data extraction from the real process. The project partners aimed to develop methods and tools of data extraction that significantly increase the efficiency of the total development of model applications. One outcome of the research project is a novel methodology for systematically and effectively determining all target and cause variables of model-based applications that are necessary for data extraction and data processing. The starting point of this methodology was a formal description of the phase model of a production. The phase model is a graphical representation of a production process that allows for precise specification of relevant variables including their characteristics of validity. A pilot application was selected and its production process has been captured in a phase model together with all the necessary target and cause variables. The essential result of the research project is a generic data coupler that provides data pre-processing methods online, i.e. the pre-processing methods are available already during data extraction. For this, the data coupler takes into account the specifications of target and cause variables that were captured in the phase model. Thus, in customer projects the data coupler will be able to provide, as an immediate result of a coupling process, pre-processed data that can be used directly for modelling or for applications of model-based processes. Moreover, model-based applications that require online extracted data such as soft sensors or model-predictive controls can be operated more robustly. The design and development of methodology and data coupler have been realized and verified in the context of a pilot application. Experiences obtained here have been iteratively included in the development work.

Application/Economic benefits

It is assumed to have eliminated or at least significantly reduced a major hurdle for the use of model-based applications in industry. We know from experience that the process of extracting data for projects with 50-100 measurement points currently requires about 1-2 weeks; this corresponds to about 30% of total expenditure. This period should now be reduced to 1-2 days. The project addresses explicitly and for the first time this step of the modelling and develops a practical solution. Hence, analysis and optimization projects that include model-based applications become economically attractive for operators of process plants. Using the example of the pilot application, the development results and their benefits have been validated.

Project period: 01.09.2009 – 31.08.2011

Remarks:

The research project ZIM-KF 2037905KM9 is being funded by the German Federal Ministry of Economics and Technology BMWi and is carried out in collaboration with LeiKon GmbH, Herzogenrath.

QUERSCHNITTS-ZIELE

Forschungsgebiet
Energie

Energiegewinnung
Energienutzung

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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 aud der Basis dreier unterschiedlicher Papiermaschinen 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 Nr. 136) wird in Kooperation mit dem Institut für Holz- und Papiertechnik der TU Dresden durchgeführt und aus Mitteln des Kuratoriums für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V. gefördert.

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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. Furthermore, process-related options and product concepts for energy savings are to be developed and tested together with the manufacturers and suppliers over and above the previous state of the art. These options and product concepts are to be made available to all corrugated board manufacturers in the form of a sector energy concept.

Generally speaking, the inclusion of process and product innovations for the continued improvement of energy efficiency and evaluation of availability and feasibility including sustainability by means of SWOT analyses is new and trend-setting for the sector energy concept.

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.

Project period: 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.

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Research area: General aims

Energy // Energy use

Key words:

energy, heat, energy management system, certification

Title:
Recommendations for applicable evaluation of energy and heat demand as basis for energy savings and certification

Background/Problem area

The paper industry is one of the five biggest industrial energy consumers. The specific energy demand has been reduced extensively in the last decades e.g. by optimisation of paper machines and amounted in 2009 to an average of approx. 3.100 kWh/t of paper due to information of VDP. The biggest part of energy in the production process is necessary for the drying section. Approx. 70 % of the total energy demand is represented by heat demand. Drying takes place mostly by steam.

In the field of energy and heat demand paper mills are confronted with the problem of unsatisfying observation and measuring of energy consumption. In many cases the calculation of energy consumption of single aggregates from the total energy consumption is not possible. Effects of this missing transparency are:

- A differentiated evaluation and definition of measures for reduction of heat demand is hindered or even impossible.
- A proof of the achieved savings after realisation of single measures in particular with small saving potentials is nearly impossible when only the entire heat and/or steam demand is determined.
- An investigation and assessment of saving potentials, which is necessary since the amendment of the Renewable Energy Law (EEG) was coming into effect in 2009 for the hardship provision scheme, is suitable to only a limited feasibility.
- A differentiated formulation of energy saving targets, which are testable and measurable and could be updated in connection to energy management systems within the newly established DIN EN 16001, is not succeeding.

Objectives/Research results

In connection to this research project recommendations for a systematic, applicable, and economical recording of heat and steam demand in paper mills were developed to provide a basis for reduction of energy demand and certification.

In a first step the current situation in the paper industry of measuring steam and heat demand was surveyed to evaluate the demand of measurement techniques. To allow an extensive examination production lines and attendant facilities were taken into account. In a second step adequate calculation and estimation methods have been assessed to allow an applicable and traceable calculation of steam and heat demand of single aggregates. Furthermore available instruments for measuring steam and heat streams in connection to its application, accuracy and costs have been rated.

The analyses of the requirements of certified systems related to collection and analyses of steam and heat consumers was also an important part of the project.

Fundamental for this project was the conformity of the proposed recommendations with the requirements of energy management systems and certifications, respectively, in connection to §41 EEG. Together with the participating companies experiences with energy management systems were discussed and integrated into the project.

Based on the generated knowledge recommendations for systematic and extensive recording of steam and heat demand were formulated. Important was to keep the necessary work for the paper mills as low as possible by suitable calculation and estimation methods and additional measurement techniques. The worked out recommendations contributed to a differentiated analyses of energy use and consumption and an identification and quantification of saving potentials. The improved recording by measuring technique and the more easy formulation and traceability of measurements led to an input for a successful energy management.

Application/Economic benefits

With the research results companies can evaluate and display its heat and steam demand more transparent. This is an important precondition for further reductions of the energy demand. The decision-making and responsibility of companies will be forced in this area. In addition the success of measures for steam savings will be detectable. Within the certification and implementation of energy management systems the elaborated recommendations can contribute to a better documentation of steam and heat demand and to a development of quantifiable targets for savings. Requirements will be created to afford companies to gain benefits, which can be connected in the future to the implementation of a certified energy management system.

Project period: 01.06.2010 – 31.05.2011

Remarks::

The project (INFOR Nr. 145) was funded by the curatorship of research and technique of the pulp and paper industry within VDP e. V.

QUERSCHNITTS-ZIELE

Forschungsgebiet
Umwelttechniken

Wasser
Emissionen
Reststoffe

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Research area: General aims

Environmental technology // Water

Key words:

ceramic membranes, wastewater

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

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. By means of ceramic NF membranes, it is possible to obtain ultraclean permeates from hot partial streams, thus keeping the thermal energy in the process cycle. Depending on the process, concentrates can be reused or treated separately. Studies will include effluents from chemical pulp bleaching and effluents containing coating colour pigments. In laboratory trials at PTS and pilot-trials performed on-site at the partner companies, the process parameters stability, concentrate utilisation and fouling processes will be studied.

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.

Project period: 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 Verede¬lung Peppermint Holding GmbH
- Universität Stuttgart - Lehrstuhl für Bauphysik LBP

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Research area: Process 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

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” 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 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 bio-mass, pilot plant trial, evaluation of the benefits of effluent treatment by single algae bioreactor or mixed algae-bacteria bioreactor, evaluation of economics.

COD-degradation and settling of biomass are comparable to the sole activated sludge treatment most of the time in low load operation conditions. O_2-production by algae is sufficient to supply bacterial O_2 demand in these trials. Improved COD-elimination has been experienced at medium load operation but lacks stability of biomass composition and system has to be aerated in this case.

Mixed algae-bacterial biomass offers a higher content of carbohydrates and sugars and provides a good potential for anaerobic digestion therefore.

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.

Project period: 01.09.2009 – 31.12.2011

Remarks:

The research project Cornet ALBAQUA IGF EN 23 is being funded by the German Federal Ministry of Economics and Technology BMWi and performed together with Technical University of Hamburg-Harburg, CELABOR, Pulp and Paper Institute Ljubljana, Federation of Hungarian Printers and Paper Makers and Paper Research Institute.

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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 recently been planned and discussed. The layout of pilot plants and corresponding treatment sequences has been fixed. For the paper sector, the following steps are performed from April to October 2011: anaerobic treatment, calcium elimination & softening, MBR, ozone, evapoconcentration and membrane filtration (NF/RO).

Project period: 01.06.2008 – 31.05.2012

Remarks:

The integrated research project AquaFit4use (EU-FP7-ENV-211534) is being 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.

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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. The modular membrane system will be tested in the flue gas duct of a gas and coal-fired power plant, a cooling tower, a geothermal well and in the hood outlet of a paper machine. The produced demineralised water from this system should be competitive with existing demineralised water technologies. Also a key objective is the profitability of the process in order to foster its implementation.

To reach these ambitious goals the selective membranes must be thermal/chemically stable under the existing environmental conditions (50 – 150°C) and resistant to fouling.

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.

Project period: 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.

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Research area: General aims

Environmental technology // Water

Key words:

membrane, MBR, thermophilic aerobic, wastewater

Title:
Energy and water savings in the paper industry trough enhancement of the thermophilic MBR process for integrated treatment of deinking wastewaters

Background/Problem area

A membrane bioreactor (MBR) employs ultrafiltration (pore size of 0.04 – 0.2 microns) to retain solids and micro-organisms in the activated sludge tanks of the biological treatment stage. The ultrafiltration module thus replaces the final sedimentation stage. Topic of the research project were experiments with a thermophilic aerobic MBR (TMBR) at 50 °C. A new and innovative use of submerged MBR-modules to treat paper industry circuit wastewater was studied. Up to now state of the art literature describes thermophilic treatment with conventional sedimentation only, or, if membranes are used, with mainly side-stream type modules. The advantages of the submerged system used in these experiments are a lower energy demand as well as a more compact design. The thermophilic degradation, compared to the mesophilic process, has got the advantages of a lower sludge yield and higher degradation rates. Disadvantage of the thermophilic treatment is a higher sludge volume index due to very fine and loose sludge flocs. In a MBR, the membrane takes care of the separation of solids, so the technological drawback of the critical sludge settleability becomes a thing of the past. Instead, the benefits of the thermophilic process could be utilised. Unlike other industrial sectors, the paper industry benefits from the advantage that its partial flows have a sufficiently high temperature to enable them to profit from this technology.

Objectives/Research results

Overall objective was the further development of an existing technology (MBR) in order to save energy and water by treating hot partial flows from the stock preparation of deinking mills. Because there are almost no experiences with full-scale systems, various aspects of submerged plate-and-frame MBR module operation under thermophilic conditions (45 to 55 °C) were investigated. The studies were performed using a lab scale MBR plant in the laboratory of PTS as well as on-site in a German paper mill over a period of several months.

The elimination rates of the TMBR regarding COD and BOD5 respectively were 83 % and 99 % at mean COD loading rates of 0.19 to 0.5 kg COD/kg MLSS/d. The permeate was totally free of turbidity and solids but still coloured. Two continuous lab experiments were conducted during a period of each more than 2 months with a flux of 8 to 13 L/m2/h. The transmembrane pressure TMP in these lab experiments reached only 0.06 bar. No chemical cleaning was performed during the lab experiments. In the pilot trial a higher TMP was noticed due to fouling and scaling. In general, the smaller particle sizes of the thermophilic sludge (50 % were smaller than 28 µm) lead to a more compact fouling layer on the membrane surface and a higher pressure drop than it would be expected in a comparable mesophilic MBR system.

The observed sludge yield of the TMBR was very low with 0.07 – 0.29 g MLSS/g CODeliminated. Because of this low sludge yield, also a lower nutrient concentration of ammonia and phosphate is necessary compared to a mesophilic process. Based on the results from the performed experiments, the required ratio of BOD5:N:P was determined to be 100 : 1-2 : 0.2-0.4 to ensure a sufficient nutrient supply of the thermophilic microorganisms. That means the lower need of the TMBR for nutrient concentration is a further advantage of this technology.

Gene probe sampling revealed a comparable high diversity of microorganisms in the TMBR as in the mesophilic sludge used for the start-up. This result is contrary to the state of the art literature which reports a general reduced diversity in thermophilic aerobic reactors. A high diversity is desirable for wastewater treatment because it leads to a better stability of the process in terms of a more constant effluent quality at unsteady inflow parameters.

Application/Economic benefits

The project has proven the TMBR to be a promising reliable technology with economical benefits in comparison to state-of-the-art aerobic end-of-pipe treatment. Major advantages are a low sludge yield, a high quality permeate with 50 °C, high process stability at fluctuations of feed water parameters and a lower nutrient demand.

By investigating and developing new technologies, the paper industry has the chance to meet the challenges of the future when a further closure of the water circuits and lower energy consumption is needed. The transfer of the expected results could lead to a totally new application of a technology which has already been approved as end-of-pipe solution at mesophilic operating conditions. For SME of the environmental technology sector, economic benefits will emerge from the development of a new application of membrane technology in the industry.

Project period: 01.05.2009 – 31.07.2011

Remarks:

The research project IGF 16063 N is being funded by the German Federal Ministry of Economics and Technology BMWi.

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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. Replacement has become necessary for economic reasons. Organic N-compounds are available as a nutrient 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, sources, development and degradation, especially when passing through the waste water treatment plant. This knowledge may then be used to establish measures on how 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 is taking a data survey to obtain comprehensive nitrogen parameter data available at paper mills. 147 paper mills got a form to give information about legal guidelines, analysis of N-parameter and -elimination and problems in wastewater treatment. 41 paper mills send an answer which means 33 % of the amount of production of paper and board in Germany, but only 14 paper mills using virgin fibres. Data analysis of the survey showed that meeting the limit value especially may be a problem in some paper mills using waste paper or which produce wood free and special paper.

Now suitable paper mills have been selected from this database and examinations are in process. Examinations include an evaluation of waste water treatment plant operational data, production data, use of additives and effluent characterisation.

A method to analyse TNb in solids, e.g. virgin fibres, paper and sewage sludge is in development to later complete the balancing of N-amount through the wastewater treatment plant.

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 plants, should allow measures to be taken that will be used to prevent higher TNb-concentrations in paper mill effluents. In the best-case scenario, examinations 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, producing special 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.

Project period: 01.03.2010 – 31.05.2012

Remarks:

Research project IGF 16408N is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: General aims

Environmental technology // Water

Key words:

wastewater treatment, critical trace compounds, reduction

Titel:
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, 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 / species relevant to the paper industry and to develop effluent treatment concepts to reduce them economically.

The desired research results include the following:

- Further development of the analytical methods: 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. The investment costs will be estimated and the working capital costs calculated.

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 is scheduled after enrichment procedures will have been adopted to the paper mill effluent matrices. For this purpose the method of stir bar sorptive extraction (SBSE) is used 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.

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, can an important contribution 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.

Project period: 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.

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Research area: General aims

Environmental technology // Emissions

Key words:

effluent treatment, MBBR, biofilm

Title:
Application of biofilm processes for advanced COD reduction in paper mill effluents

Background/Problem area

The residual COD level of biologically treated paper mill effluents is in the range of 100 to 500 mg/l. In some cases this level is too high and exceeds the environmental discharge limit values. Hence expensive advanced processes for further COD elimination like precipitation, oxidation or membrane processes are needed.

Biofilm processes, like MBBR (Moving Bed Biofilm Reactor) are often used as primary high loaded stage for aerobic biological treatment. Because of the potential of biofilms (bf) to afford slow growing microorganisms an opportunity to proliferate, this process should be able to increase the total COD elimination of aerobic biological processes.

Objectives/Research results

The aim of this project was to use bf processes as a second stage process for the enhancement of biological treatment of pulp & paper mill waste water. This was to be arranged by using bf's which incorporate microorganisms with a high elimination potential for slowly degradable organic substances.

Biofilms with increased COD reduction potential were to be identified and characterised. Samples of biofilms, which grow in waste water treatment plants (wwtp) under substrate restricted conditions (e.g. at the end of a cascade or at the outflow of the secondary clarifier) were investigated by static degradation tests to determine their potential for COD reduc-tion. Samples with a high potential were used to continuously test cultivate biofilms. The conditions for optimum immo-bilisation and operation were to be elaborated. Based on these results the operation conditions of an adapted biofilm proc-ess stage were derived.

At first a continuous 5 l-laboratory wwtp was equipped with a control unit to perform sequencing batch process which was to be used for breeding of adapted bf's on carriers and put in operation. Also the methodology of the static degradation test (Zahn-Wellens-Test) was adapted to low loaded conditions (COD values of 100 – 400 mg/l).

To characterise the elimination potential of slowly degradable substances by bf's comparative static degradability tests with activated sludge (as) and bf's from industrial wwtp's were performed. Samples of as, bf and biological treated effluent of 8 paper mills (5 deinking mills, 2 office paper mills, 1 integrated pulp&paper mill) were investigated. The results showed slightly higher degradation performances for bf's. In the case of deinking mill effluents residual COD respectively TOC reduction was increased by 5 – 10 %. So far bf have been operated as suspended cultures and therefore not under optimum conditions. Taking this fact into consideration the available results were very promising. The respirometric activity also showed higher values for bf's.

After the start up of the laboratory wwtp under substrate limited conditions the reactor was inoculated with a bf sample, which showed a high COD elimination potential and a special composition of microbial organisms (detected by gen-probes) During a trial period of 25 weeks no additional effect on COD removal was observed. After a repeated small dosage of easily degradable substances and addition of nutrients a 50 % reduction of COD after 40 weeks of operation was measured. This reduction resulted from biological degradation by bf as well as physical processes like adsorption onto bf. The characterisation of the generated biofilm by molecular genetic methods showed a high diversity of organisms.

The last working steps dealt with the optimisation of the operation of the bf reactor and the elaboration of optimal operating parameters.

Application/Economic benefits

A further decrease of COD by these processes may lower the costs for the reduction of the discharged organic load. The available processes of advanced treatment are mostly expensive and often need special installations. In addition separate steps for the disposal or treatment of generated wastes are oftentimes required. The specific costs of COD-elimination by bf processes are generally lower then this of oxidation or membrane processes.

MBBR processes as second or final stage can be easily integrated in existing aerobic treatment stages of wwtp and are a cost effective alternative to advanced chemical and/or physical processes. Hence the treatment costs can be reduced, the economic competitiveness of the sme can be secured or the extension of production capacity is possible while still meeting the environmental limits.

Project period: 01.08.2008 – 31.01.2011

Remarks:

The research project IGF 15740 BR was funded by the Federal ministry for economy and technology (BMWi)

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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. Amongst other things 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 their particle size distributions. Here, 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 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 liquid phase such that they can be easily detected by light scattering methods. To accomplish this growth, chemical and physical coating methods shall be examined. Knowing the respective reaction conditions an algorithm shall be derived to trace the result back to the initial particle size and provide indirect access to the original size distribution of the ensemble.

The project shall thus provide a universal method on the basis of which a gap in nano-particle metrology can be filled: the determination of particle size distributions in a very low concentration regime. It is planned to utilise photon cross-correlation spectroscopy (PCCS) as the primary measurement method. Determination of growths characteristics shall be achieved by means of reaction-kinetic or statistical approaches or using numerical modelling algorithms.

First results have demonstrated that by addition of a surface active polymer to a nanoscale silica suspension an increase of scattering intensity and the apparent particle size can be observed. Whether this effect can be attributed to a coating of the nano-particles in the sense of the project idea is currently under examination.

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.

Project period: 01.04.2011 – 31.03.2013

Remarks:

The research project IK-VF 100023 is funded by the Federal ministry for economy and technology (BMWi).

QUERSCHNITTS-ZIELE

Forschungsgebiet
Produktionswirtschaft

Managementsysteme
Beschaffung
Logistik
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Forschungsgebiet: markierungsfreie Positionsbestimmung

Papiermaschinen-Aufrollung/Rollmaschinenansteuerung

Schlagworte:

Winder Control, Produktverfolgung, Längenpositionen

Thema:
Längenpositionsbestimmung bei gewickelten Produkten an Auf- bzw. Umrolleinrichtungen

Ausgangssituation/Problemstellung

In der Papierproduktion werden vielerorts Bahninspektionssysteme eingesetzt, um Produktfehler zu erkennen und - in vielen Fällen vor der Weiterverarbeitung – auszubessern. Das Auffinden erkannter Fehlerpositionen geschieht mit verschiedenen Markier- bzw. Codiersystemen, die in einer Reihe von Fällen Probleme verursachen oder an Grenzen stoßen. Die vorliegende Untersuchung diente zur Prüfung eines Verfahrens, das ohne besondere Markierungs- bzw. Markenerkennungseinrichtungen auskommt. Stattdessen werden berührungsfrei erzeugte Signale der Bahnbewegung sowie der Winkelbewegung an der jeweiligen Auf- oder Umrolleinrichtung aufgenommen und zu einander in Beziehung gesetzt. Die so erzeugten Werte zeigen eine signifikante Veränderung mit laufender Bahnlänge einer Produktrolle auf. Sie werden protokolliert und dienen an der jeweils nachgeschalteten Bearbeitungsstation als Vergleichsmaßstab zum Abgleich bzw. Auffinden einer angestrebten Längenposition. Zur Ermittlung der Messwerte für die fortlaufende Bahnbewegung (Längensignale) kamen sehr genaue Laser-Doppler-Velozimeter, für die Rotationssignale hochauflösende Inkrementalgeber zum Einsatz, wobei jeweils die Rotationssignale als Bezugssignale für die Bahnlängensignale dienten.

Forschungsziel/Forschungsergebnis

Vergleichbare Genauigkeit bei der Lokalisation ausgewiesener Längenpositionen in Produktrollen, wie sie dem Stand der Technik beim Einsatz von Kodiersystemen entspricht. Ein besonderer Messansatz zur mathematischen Kompensation von Bahndehnungseffekten konnte aus maschinenbaulichen Gründen nicht umgesetzt werden. Die so erreichte Messgenauigkeit liegt bei ca. drei Produktlagen (a 80 µ), was bei einer vollen Produktrolle mit 3,8 m Durchmesser einer Lokalisierungsgenauigkeit von etwa 40 m entspricht. Da der Kompensationsberechnungsansatz eine doppelte Anzahl der kostspieligen LDV-Sensoren erfordert, erschien eine Weiterverfolgung desselben nicht sinnvoll. Als sehr interessantes Ergebnis stellen sich dagegen charakteristische Verlaufskurven der Einzelmesswerte dar. In ihnen zeichnen sich Dehnungsschwankungen infolge von variierenden Zugspannungen ab sowie Schwankungen in der Lagenstärke/Produktdicke. Letztere dürften bei den Messungen an jeder Rollstation annähernd gleich bleiben, während die durch Dehnungsschwankungen hervorgerufenen Schwingungsanteile für jeden Auf- bzw. Umrollvorgang als spezifisch anzunehmen sind. Gelingt es, gemeinsame Schwingungsanteile aus den Messwertreihen mathematisch herauszufiltern, so ist per Phasenabgleich das Ziel erreichbar.

Anwendungen/Wirtschaftliche Bedeutung

Das gewählte Verfahren ist bei Verwendung der genannten Sensoren bei allen regulär gewickelten Produkten universell einsetzbar, die Erreichung einer hinreichenden Messgenauigkeit vorausgesetzt. Dabei gibt es keine Beeinträchtigung durch Unterbrechungen, Abrisse, Schlupfeffekte, Farbeigenschaften oder Texturen des Produkts. Das Produkt wird nicht verändert. Von besonderem Interesse ist zudem die Eignung für Produktverfolgungsprozesse über beliebige nachgeschaltete Bearbeitungsstationen, solange sich ein neues Messprotokoll erstellen und weiterreichen lässt.

Bearbeitungszeitraum: August 2002 – August 2010

Bemerkungen

Das Projekt wurde gefördert durch die Arbeitsgruppe Innovative Projekte beim Ministerium für Wissenschaft und Kultur des Landes Niedersachsen, Postfach 920 251, 30441 Hannover.

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Research area: General aims

Production economy // Monitoring and control systems

Key words:

terahertz spectroscopy, thickness, mono- or multi-layers

Title:
Development of a Procedure based on Terahertz-Technology to Measure the Thickness of Layers to Reduce Material and Energy Consumption

Background/Problem area

The share of multi layer paper products, especially with more than one functional layer, is rising. These layers are often made of new, innovative but also more expensive materials. As the expenses for these products rise and the opportunities to apply measuring devices shrink, the need for selective, online process monitoring is growing. State of the art measuring systems use several types of radiation and in all cases give only a summary signal. In case of two layer or multi layer products only the complete amount of the applied material can be measured or the measurement has to be performed after every single application of the layers. Non destructive, selective measurement of layer thickness of materials like paper is not possible. Especially in this field online measurement techniques are needed. Using terahertz-methods it is possible to quantify the thickness of certain layers in a multi layer material by analyzing the reflections at the different layers. Terahertz methods are at the moment in the state between laboratory and practical applications.

Objectives/Research results

The project aimed at the development of a procedure to measure the thickness and/or the grammage of certain layers of multi layer paper products. The procedure had to be capable to work online directly after the coating. Using the specific interactions of terahertz radiation with paper, coatings and plastic layers the type and thickness of the layers had to be calculated.

Technical aims were the optimization of terahertz measuring systems to reach the project coals, the development of new terahertz components to reach the state of an online system and the construction of apparatus to simulate online measurements.

Scientific aim had been the development of mathematical methods to calculate the number of different layers of a paper product and their thickness using terahertz signals as well as the use of multivariate methods to treat terahertz signals in specific ways. The Philipps University Marburg created after the identification of relevant parameter a metrological approach. Furthermore software was developed at PTS to analyse the THz-pulses in a detailed way and to obtain thickness related information. Based on physical laws, the calculation of sample thickness could be achieved for single layer papers and thin plastic material. In a second step the evaluation of multi layer materials was undertaken, so that the opportunities and limits of the THz-technique are known.

Generally speaking paper samples of a thickness-range between about 30 µm and 2 mm can be evaluated in terms of their thickness in an absolute way. Relative information on thickness is available even outside this range using simple mathematical procedures. The precision of the thickness-measurement is in some cases about 1 µm. This value is rising when the surface of a sample is not perfectly even.

Inner layers of compounds are not detectable in every case. If possible, the precision of the thickness-measurement is below the result of the whole compound.

Using several rolls of paper the opportunities of online measurements with THz-systems were analysed. These measurements showed that with the setup measurements can be undertaken with a precision of about 10 to 20 µm.

Application/Economic benefits

The results of the project can be used in the field of applied engineering, production, measurement, monitoring and automation techniques as well as in the industry sectors paper, printing and press. With the expected results of the project producers of measuring devices will be capable of developing specific measuring systems for paper and similar material on fast running production machines. Based on the 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 coated products. These often small and medium sized companies can replace or complement their monitoring devices.

After the transformation of the measuring system into a practical usable system the producers of multi layer products are potential users of the system. In a long term it is expected that common monitoring systems using radiation (e.g. x-ray) will be replaced by terahertz systems.

Producers of papers with barriers such as plastics are responsible to deliver 100 % save products. On the other hand they are interested in thin layers to save resources and money. These producers are also potential users of terahertz applications.

Project period: 01.06.2009 – 31.05.2011

Remarks:

The research project IGF 16117BG was funded by the German Federal Ministry of Economics and Technology BMWi and was performed together with Philipps University Marburg, section physics.

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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 is 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 have 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 durabil-ity (outdoor use, safety, wear)

In close coordination with Sentronic and SensoLogic the operating software has 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 is to be placed on a solid hardware basis.

This project will use 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 leads to optimal conditions for achieving the objectives of project.

Through the design and on the basis of prior knowledge, a procedure with unique features can be developed. Since the project also aims to RP-related and completely new applications, new markets can be opened up and existing can be addressed.

Project period: 01.11.2009 – 31.01.2012

Remarks:

The research project ZIM KF 2037907DB9 is being funded by the German Federal Ministry of Economics and Technology BMWi.

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Research area: General aims

Production economy // 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.

Project period: 01.01.2011 – 31.12.2012

Remarks:

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QUERSCHNITTS-ZIELE

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Forschungsgebiet: Querschnitts-Ziele

Ressourceneinsparung

Schlagworte:

Energieeinsparung, Ressourcen, Altpapierkreislauf

Theme:
Product Design According to Energetic Needs

Background/Problem Area:

Paper is made from organic fibres and minerals. These raw materials enable nearly endless recycling and an environmentally friendly product. Recycling is common since the beginning of papermaking and saves a lot of energy and raw material compared to the production of paper out of virgin fibres. But the hydrophilic properties of paper cause high costs for dewatering. The main part of the water can be removed by mechanical dewatering but the rest has to be evaporated. The drying process demands over 90 % of the total energy consumption of a paper mill. Closed recycling loops worsen the problem of dewatering.

Many efforts in research were made about the paper properties and its behaviour in converting but there is no research on paper optimized taking into account the energy demand of its production.

Objective/Research Results:

The first part of the project contains a basic research about the role of the most important fibres and fibre fractions according to dewatering and paper properties. These results are used for the simulation as well as for hand sheets to evaluate new paper compositions in the second part of the project.

The middle fibre fractionation showed to have negative influence as well on the dewatering of the wet fibre stock as on the strength properties. With this knowledge a fractionation process can enhance the mechanical properties of the paper and enable lower basis weights.

The reduction of the paper weight helps to save energy and raw material simultaneously.

The data of the experimental part can be used in new simulation software. The software enables the user to create different scenarios for the recycled paper circles. These scenarios can predict the composition of the future recycling material. The second part of the simulation allows the optimizing of a multilayer product to the achieved new quality.

The results of different scenarios can help together with the basic examination of the fibre fractions to figure out new formula for energy saving paper. As better paper demands the elimination of some of the fibre fractions there will be suggestions for the use of these excess fibres in an energetic way at the end of the project. Probably use can be incineration or the creation of bio gas by anaerobic treatment.

Application/Economic Benefits:

Energy is a big issue for paper mills. Recycled paper stock is the most important raw material in Germany so an improved dewatering and drying can save a lot of energy for graphic paper as well as for packaging paper and enables a cost effective and more environmentally friendly paper production.

Project Period: 01.01.2010 – 30.09.2011

Remarks:

The research project INFOR 143 R is funded by the „ Kuratorium für Forschung und Technik der Zellstoff- und Papierindustrie im VDP e. V.“.

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Research area: General aims

Resource savings

Key words:

recovered paper, optical properties, modelling, prognosis, best costs strategy

Title:
Minimizing raw material and process costs during built up of defined optical properties in bright papers made from recovered fibres

Background/Problem area

The production of high-quality bright papers for graphic and non-graphic use made from recovered paper is subject to high cost pressure. Office papers, high-quality printing paper, recovered paper-based tissue paper and white top liner all belong to the paper grade studied. Due to the high requirements placed on the optical properties, a large number of recovered paper grades from grade groups 2 and 3 are used for these products, although they differ significantly regarding utility value, required treatment processes and costs, availability and purchase costs. Fluctuations in recovered paper quality as well as changes in availability and cost structure raise the question of how production can realize constant product properties at the lowest possible costs.

PTS has developed methods and algorithms for overall cost, product and process optimisation which until now have been used for the simulation-assisted prognosis of strength properties and cost optimisation in the production of corrugated base papers. These tools can be used to meet the practical business demand of making additional strategy-oriented cost accounting based on changing raw material compositions and production conditions. Within the project, the methods and algorithms developed for simulating strength properties are to be expanded to cover the specific production conditions and quality properties of deinked stock for the production of bright papers, where the focus is primarily on the optical property requirements. This would give the producers of these papers an opportunity to optimally coordinate raw material properties, process parameters, product properties and cost factors.

Objectives/Research results

The research project is intended to make a contribution to minimising the costs of producing white papers based on recovered fibres that place high requirements on optical properties. Final result should be the creation of a simulation model for calculating optimal raw material use in consideration of the treatment processes in order to achieve the lowest possible costs at defined optical properties of the furnish.

The following results were uptained in the finished workpackages up to now:

- a suitable measuring method for small dirt particles (< 50 µm) was defined and the corresponding measurement of big dirt particles (> 50 µm) was improved
- a new application routine for ELREPHO measurement at different wavelength was implemented
- a detailed database for optical properties of many different recovered paper grades and several base papers with different printing principles was fulfilled
- a model for the prediction of optical properties of the pulp suspension during the process steps bleaching and washing was created at the basis of detailed lab tests and industrial experience
- the data for the increase of optical properties during stock preparation system was measured in several paper mills

Application/Economic benefits

The economic benefits are derived by using the simulation model within the framework of pre-process optimisations. Paper mills can use variation calculations to determine optimal raw material use or to assess process concepts and thus reduce the costs of raw materials, additives, energy, waste and equipment needed for plant reconstruction or new plant concepts. All variable and essential fixed costs (e.g. investment costs) are taken into consideration when calculating total production costs for different scenarios.

After completion of the project, the calculation models will be offered to paper mills by way of a web-based simulation tool and may thus be used sustainably as aids when taking strategic decisions. Other users are planers, engineering offices and plant manufacturers.

Project period: 01.01.2010 - 31.12.2011

Remarks:

Research project IK-MF 090185 is being funded by the German Federal Ministry of Economics and Technology BMWi.

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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 foot-print. 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 defined and elaborated; they are tested in lab- and pilot scale with promising results.

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 CO_2 and other Green House Gases (GHG);
- raw material savings;
- operating cost reduction or productivity increase.

Project period: 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.

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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 H_2O_2, 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.

On-site investigations have been performed in two paper mills to gather information about locations and required water qualities for replacement of fresh water by AOP-treated effluents. Main water users have been identified as well as effluents and associated water quality requirements and quantities. The main part of the fresh water in mill A is used for showers. Water use for the preparation of chemicals is on a high level. Also fresh water was used for pulp dilution. Due the low specific effluent volume in mill A and the used raw materials, COD (15,031 mg/l), chloride- (502 mg/l) and calcium concentrations (572 mg/l) in process water are on a quite high level, sulphate concentration (353 mg/l) is typical for the paper grade produced. In mill B the main part of the fresh water is used for showers. A high amount of fresh water is used as sealing water and only a small part is used for pulp dilution. Due to a well working water circuit separation and a quite open water circuit, COD (859 mg/l), chloride (80 mg/l)- and calcium concentrations (123 mg/l) in circuit water are on a low level. Sulphate concentrations (543 mg/l) are on a high level.

Based on required water qualities, the following suitable combinations of AOP-technologies have been chosen to perform laboratory trials: O_3 + UV, O_3 + H_2O_2, O_3 + US, US + UV, US + H_2O_2 + O_3. Until now laboratory ozone trials have been performed with biologically treated waste water from the first selected paper mill. A series of experiments have been performed varying ozone dosage. In mill A the COD could be reduced from values between 175 and 230 mg/l to 112 mg/l by 0.8 g O_3/g CSB_0. The BOD_5 increased from 2 mg/l to 15 mg/l and the BOD_5/COD ratio increased correspondingly from 0.01 to 0.12, which means an increase in biodegradability. 0.8 g O_3/g CSB_0 reduced the colour at 436 nm significantly from 11 m^{-1} to 1.2 m^{-1}. The COD/DOC ratio of the effluent prior to ozone treatment was about 3.0 for the tested mill and was decreased by ozone treatment to 2.0

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

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