PTS FIBRE based solutions

24th INGEDE Symposium
11 February 2015

» NEW MATERIALS / » PACKAGING / » PRINT PRODUCTS / » RESOURCE EFFICIENCY

Overview of relevant Research Projects - An insight into PTS research activities

Elisabeth Hanecker, Johannes Kappen

Overview

I. Research in Deinking: What are the needs?

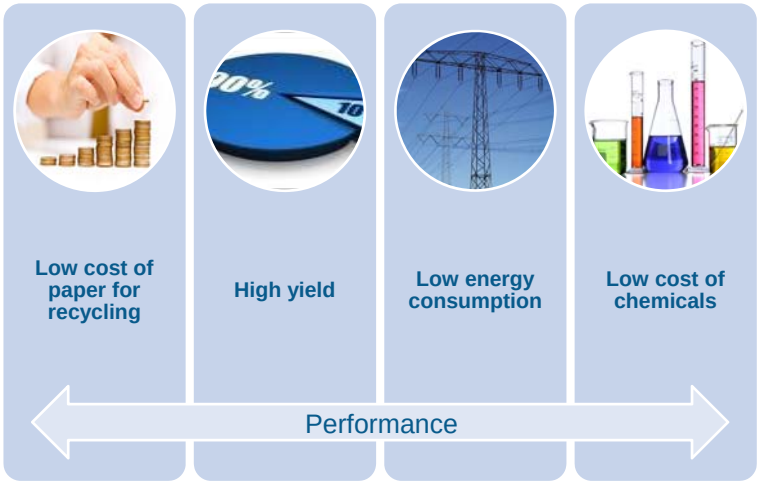
II. Overview on research activities of PTS

III. Results of research during past years

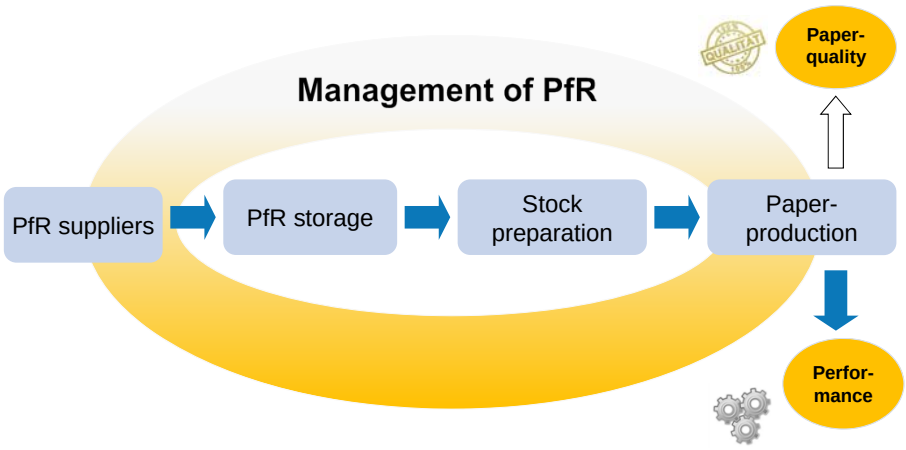
IV. Ongoing and planned activities

V. Outlook

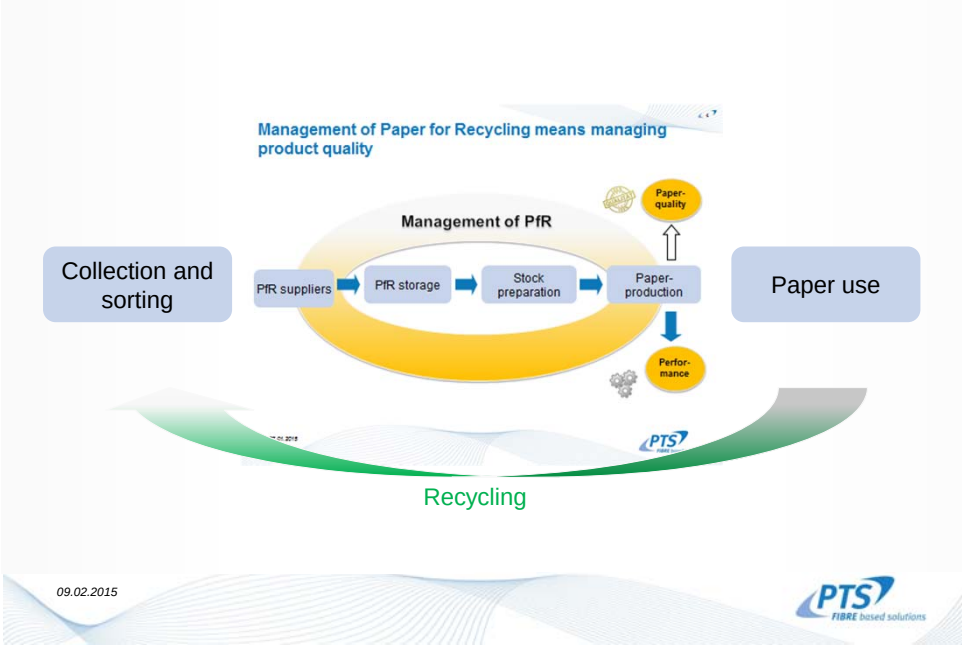
Producing succesfully with Paper for Recycling



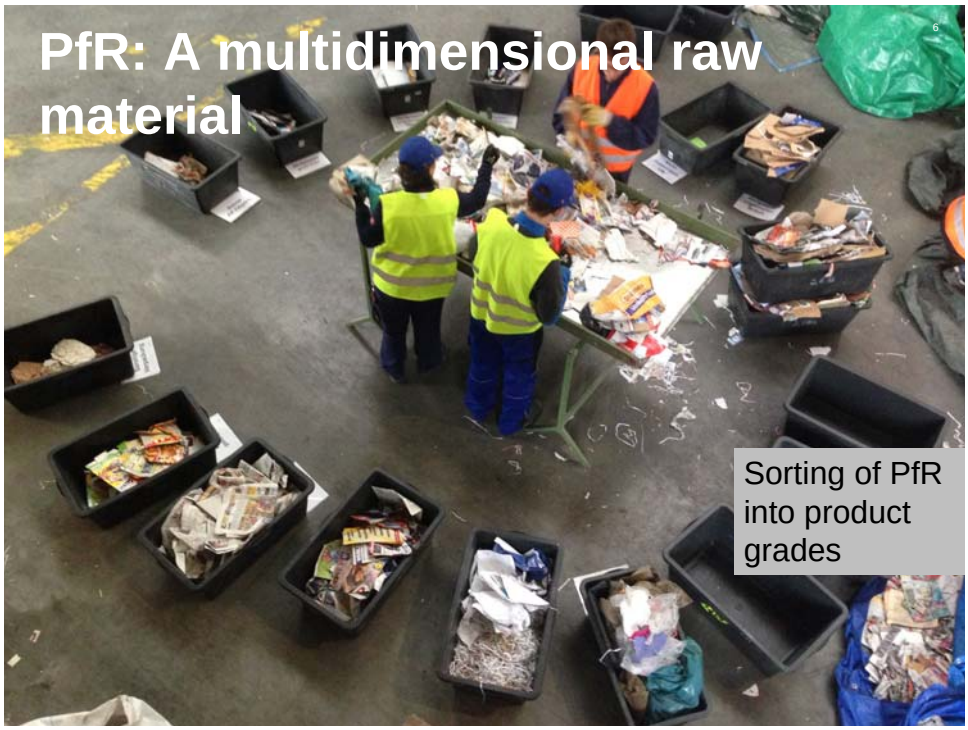
Management of Paper for Recycling means managing product quality



...and never to forget about the full story



PfR: A multidimensional raw material



Sorting of PfR into product grades

Do we know enough about PfR and Deinking?

It all starts with PfR: The stock we know least about

Do we really know the limits of recycling and when do we expect to meet them (or will we ever)?

Energy efficiency: Are we satisfied with still investing 200 - 400 kWh/t into cleaning and treating our stocks properly?

How far have we come on our way to zero waste?

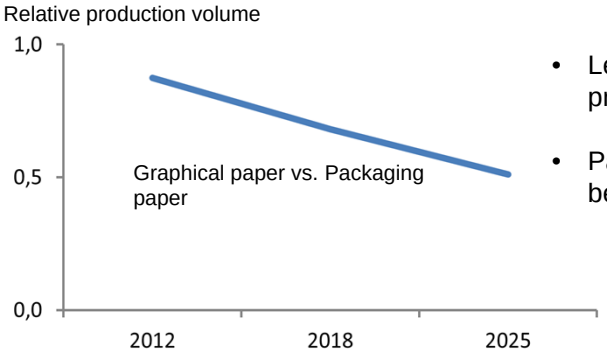
Some results of research at PTS during past years

Topics

- Forecasting the future “setup” of paper recycling and its impact on quality of paper for recycling and the economical situation of operations
- New options to enhance process control
- New options to assess product quality

The presented projects and related results cannot represent the full scope of results achieved but may provide an insight into some of the promising developments with respect to their application in mill practice.

A look into the future – Change in grade structure of the industry: Supply of PfR continues to change (GER)

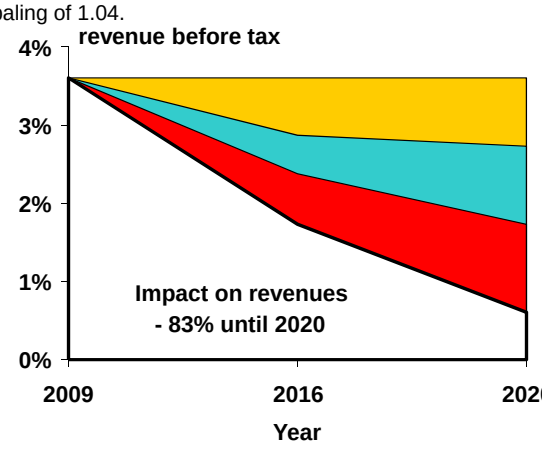


- Less graphical paper will be produced.
- Packaging grades will become more important

Source: based on C. Seidemann et. al INFOR 171 R

The economic future of paper sorting?

The calculation is based on the assumption that sorting plant troughput is constant, change in input quality leads to less 1.11 being produced, higher variable cost and higher effort for baling of 1.04.



… lower product price Grade 1.11

… rise in variable cost

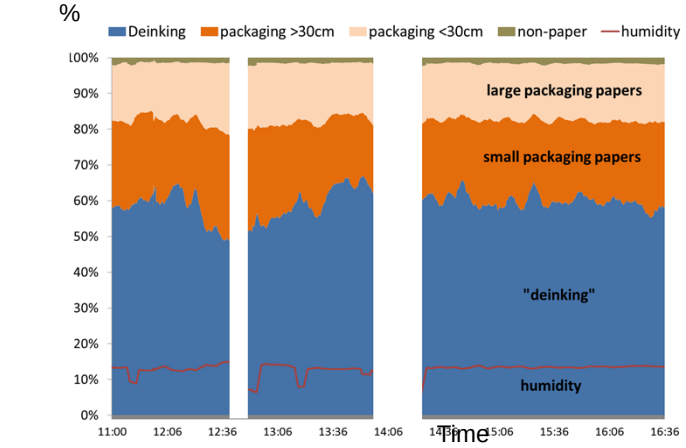
… rise in cost for baling of 1.04

Basis: 1.11.00: `09 62%; `16: 54%; `20: 48%
Sales: 2009: 68% with grade 1.11.00
Price of 1.04.XX 15 € below 1.11.00
Price of 1.02.00 30 € below 1.11.00
Cost: 21% variable cost of sorting
3% for baling

Elaborated in the frame of
IK 130043 Verpackungspapiersortierung

Control of a sorting plant to increase throughput based on a multispectral sensor and models of PfR and the plant

ENTSORGUNGSTECHNIK BAVARIA GmbH

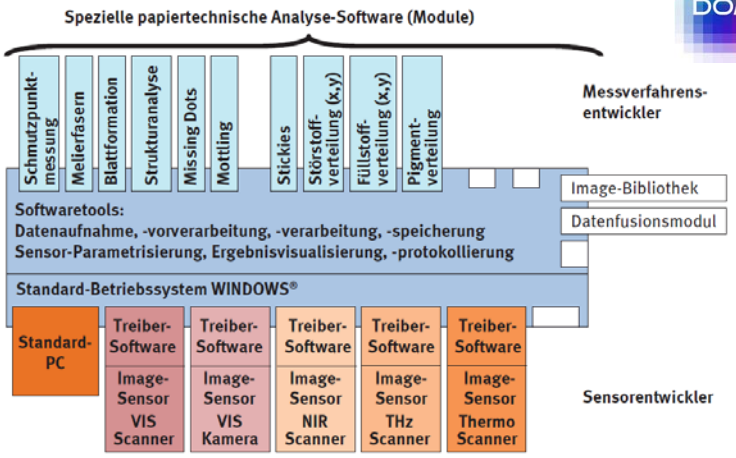


Project:
ZIM SortOptAP

AP-Monitoring – Online assessment of 1.11.00 on the conveyor belt now available

First results/concept in IGF 15905 BG

DOMAS*multispec* – The modular concept provides an open platform to the industry



Elaborated in the frame of IK 100044 MUMAS

DOMAS*multispec* – key advantages

Strong: Modular applications for the assessment of major properties of fibre based materials such as pulp and paper

Handy: Improved user friendliness

Efficient: Capability to execute test series in parallel now available

Instructive: Extended built in reporting functions

A sustainable solution: Operates in a 64-bit Windows Environment

Openness:

Key feature is the modular built

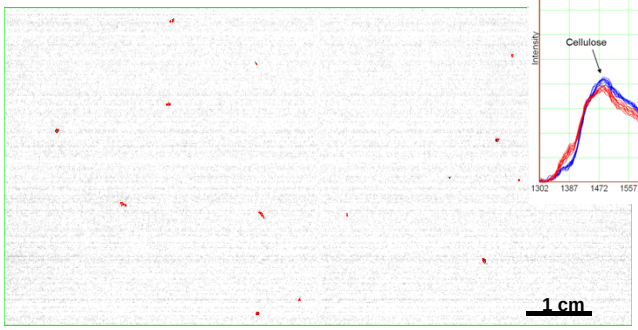
Easy integration of new hardware sensors

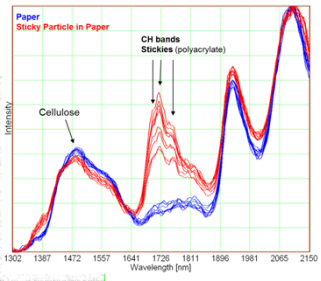
Applications can be developed by third parties both for existing and new sensors

Available in German and English

Making use for the extended range of functions: NIR Image and Image Analysis

NIR gray scale image of paper sample with detected polymer particles





The image analysis of the NIR image was done with the DOMAS image analysis system (PTS) to determine **number** and **area per m²** of the particles.

Ongoing and planned activities

Topics:

- Calculation the “paper makers value” of PfR
- Development of new process steps for a more efficient ink removal
- Improvement of the water management in deinking lines

The presented publicly funded projects and related results may taken as examples of the current activities of PTS in the field of deinking.

Quality of Paper for Recycling - Calculation of the „paper makers value“ of PfR

Consumer

Paper products

News
Magazines
Office
Folding boxes
Corrugated boxes
Compound
…

Waste management industry

Collected paper for recycling

List of Grades EN 643

Collection system
Sorting effort
Composition
No Paper components
Printing ink coverage
…

Paper industry

Secondary fibre stock

Value of fibre stock

Strength
Optical properties
Impurities
Dewaterability
Deinkability
…

Ongoing research

Optimized ink detachment and ink fragmentation by using Cavitational Deinking

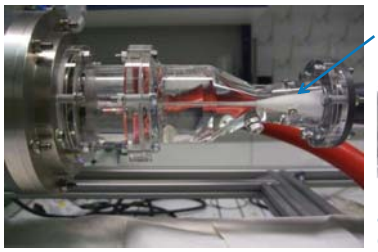
Ultrasound horn

Amplitude **28.4** µm
Intensity **30** W/cm²

- First reported tests in 1955 (Jayme)
- Dramatical reduction in energy consumption by Brenner (PTS, 2013) for refining of recycled fibres

Hydrodynamic Reactor at PTS

Nozzle diameter **8-11** mm
Capacity **7.2** m³/h



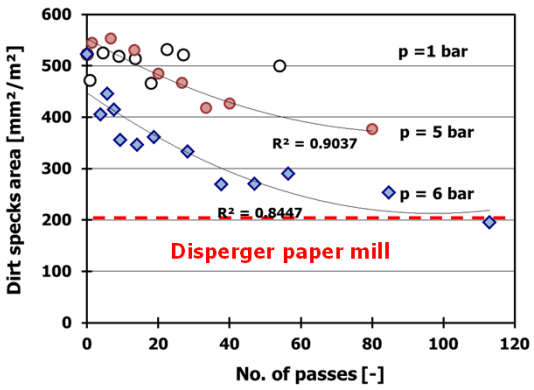
area of cavitation forces

local maximum at bubble collapse:
1.000 bar
1.500 ºC
100 m/s

- Initial works 6-8 years ago (Nippon Paper), but high energy consumption and small diameter ~ 0.2mm
- Patents from Soviet Union in 1970s and several mill installations

Ongoing research

Results: Ink particle reduction (by fragmentation)



Ink fragmentation by a laboratory cavitation nozzle, 8 mm diameter

- Sample from a deinking line = inlet disperger
- With increasing inlet pressure (means higher cavitation intensity) the area of dirt specks were reduced
- Same ink fragmentation like in a conventional disperger was reached

Additional result:
TENSILE-Index were increased by 20 %, <u>without</u> any loss in TEAR-Index.

Assessment of energy consumption

Trials for reaching the same level of paper strength improvement in cavitation as in LC-refining (example):

Lab scale trial (8 mm nozzle):
- 90 passages needed, medium cavitation intensity (26 m/s velocity)
- energy consumption per passage = **44 kWh/t** (at 8 g/l consistency)

Small pilot scale trial in paper mill (11 mm nozzle):
- 1 – 10 passages needed, higher caviation intensity (42 m/s velocity)
- the normal system pressure in paper mill (5-7 bar) could be used as basic level
- energy consumption per passage **= 3.7 kWh/t** (at 35 g/l consistency)

<u>comparision:</u>

• Cavitation nozzle lab scale (calculated for 3.5 % consistency)	905 kWh/t
• Cavitation nozzle pilot scale (5 passes)	**18 kWh/t**
• LC refining	**50 kWh/t**

Research project in preparation – Deinking Process Water

Influence of process water on deinking potential of paper for recycling and measueres to improve quality of deinked pulp

Objectives:

- Improve DIP-Quality and variability through a targeted treatment of process water

Research institutes: PTS Munich (Elisabeth Hanecker) and PMV Darmstadt (Hans Putz)

Background: Results of INGEDE Project 132 10

- Process water properties of different deinking plants can vary significantly
- Process water properties have an significant impact on deinking potential of recovered paper
- No general recommendation for optimum results possible
- Process solutions must be adapted on process water properties

Research project in preparation – Deinking Process Water Results of INGEDE Project 132 10

Impact of process water properties

Water parameter	Range		Influence on	
	min	max	Luminosity	Ink Elimination
COD [mg/l]	1600	4100	↓	↓
Conductivity [mS/cm]	2,1	4,1	↓	↓
Hardness [°dH]	9,5	33	↓	↓
pH	7,3	8,4	↑	↑
Surface tension [mN/m]	40	50	↓	↓

↓: Decrease with increasing value

↑: Increase with increasing value

PTS – Future research focus in deinking

Important areas of future research of PTS will be:

- Quality, availability and sorting of paper for recycling
- (Digital) Print and its interaction with substrates and its impacts on recycling
- Innovative deinking techniques based on the approach of fibre engineering
- Development of sensors (and data/model based) applications for future mill operations

Services and Products for Deinking mills:

- Off- and online analysers
- Product conformity incl. recyclability / deinkability
- Analytical support
- Characterisation of pulps

Contacts

Dr. Elisabeth Hanecker
Tel 089/12146-495
elisabeth.hanecker@ptspaper.de

Dr.-Ing. Johannes Kappen
Tel 089/12146-462
johannes.kappen@ptspaper.de

Förderhinweis zu den Projekten:

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages