

# Influence of digital print products on the deinking behaviour of paper for recycling mixtures in a 2-stage deinking process



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Technische Universität Darmstadt

Paper Technology and Mechanical Process Engineering (PMV)

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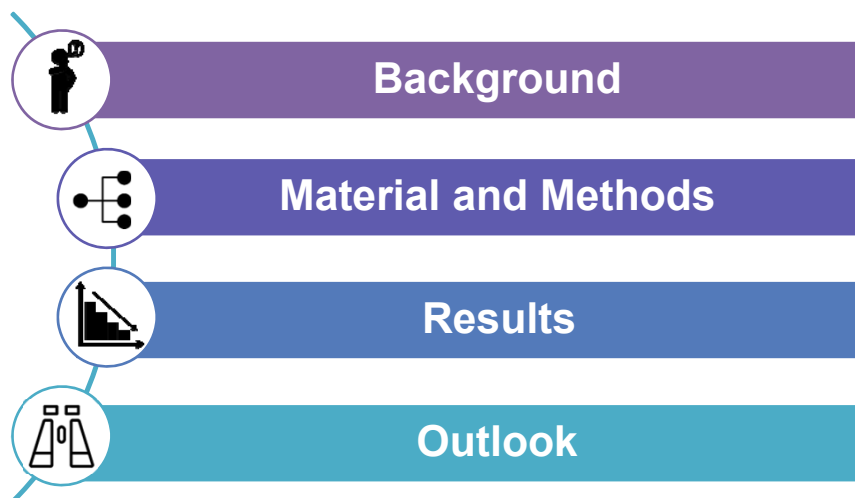


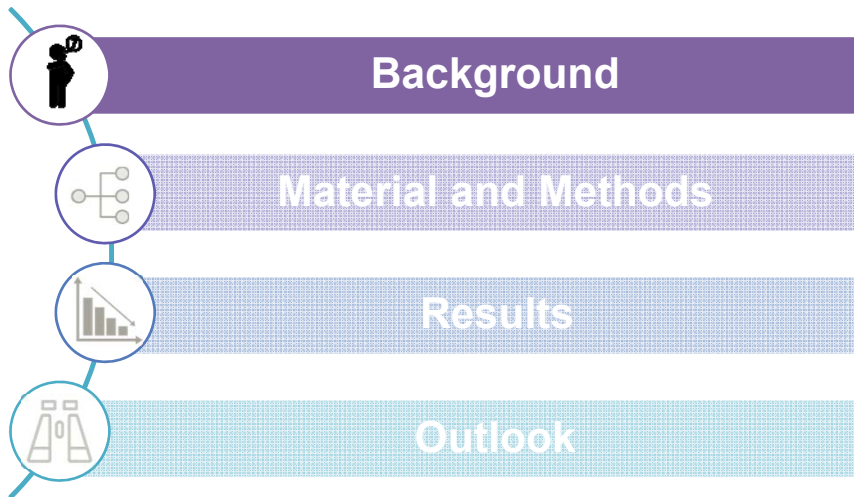
Picture: Krebs, T., PMV

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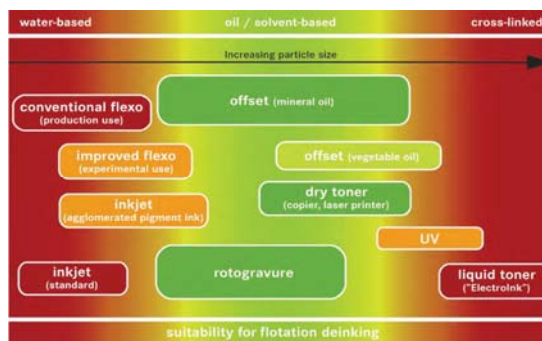


## Outline





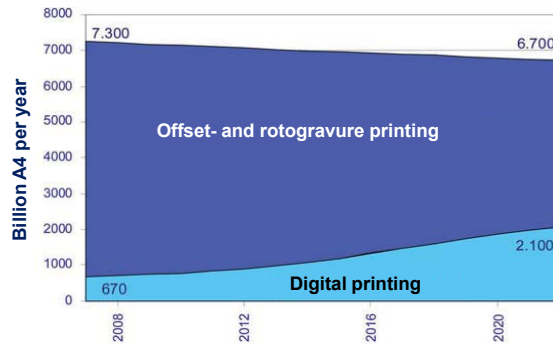
- Currently, a one-stage flotation process is used to evaluate the deinkability of individual printed products in laboratory scale using INGEDE Method 11



Source: Faul, A.: Wie ökologisch ist der Digitaldruck? Presentation at: PrintCongress 2012, 9. Oktober 2012, Stuttgart

- How can a 2-loop process be implemented in laboratory scale?
- How do the deinking result differ between both methods?

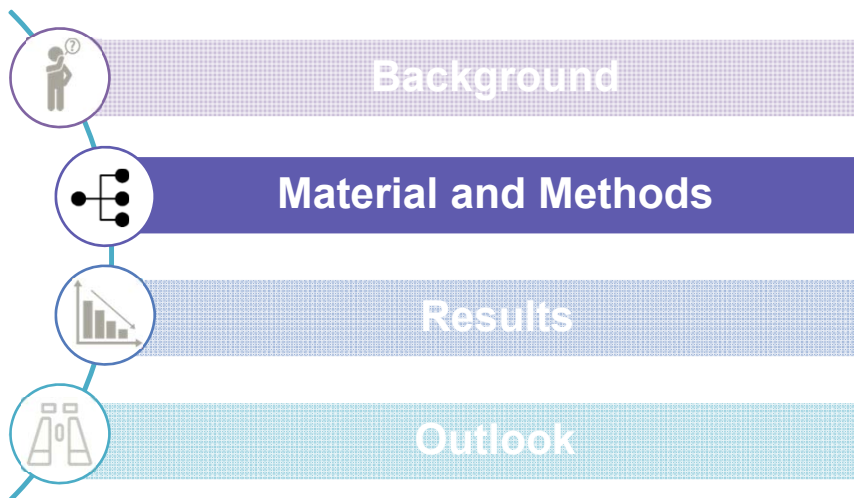
## Trend of printing volume of offset, gravure and digital printing for North America and Western Europe



Source: Paul & Maess: Qualitätsbestimmende Wechselwirkungen im Digitaldruck. In: Wochenblatt für Papierfabrikation 138 (2010) 2

→ What influence has the changing composition of paper for recycling and the increasing amount of difficult or non-deinkable products on the deinking behaviour in a 2-loop process?

## Outline



## Paper for recycling products analysed



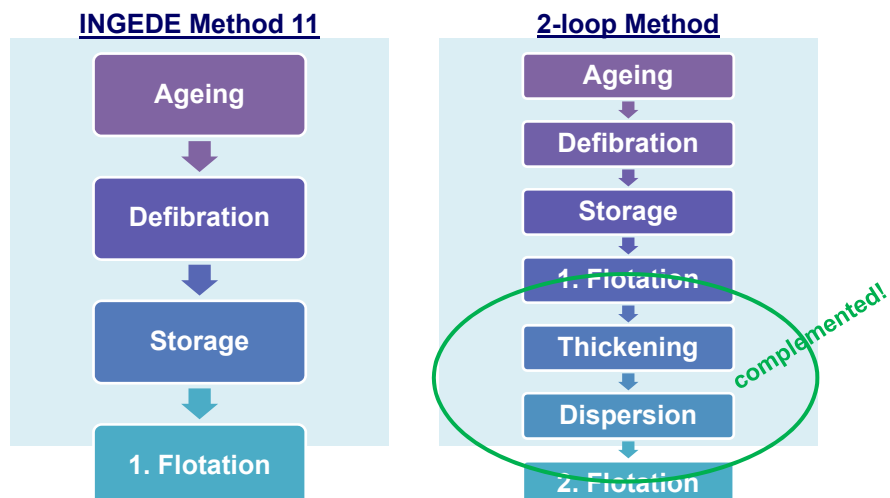
- |                  |                  |                  |               |                   |                |
|------------------|------------------|------------------|---------------|-------------------|----------------|
| ▪ Newspaper      | ▪ Advertising    | ▪ Magazine       | ▪ Magazine    | ▪ Test print      | ▪ Test print   |
| ▪ Offset-coldset | ▪ Offset-heatset | ▪ Offset-heatset | ▪ Rotogravure | ▪ Inkjet, pigment | ▪ Liquid toner |
| ▪ Uncoated       | ▪ Uncoated       | ▪ Coated         | ▪ Uncoated    | ▪ Uncoated        | ▪ Coated       |
| ▪ Two-sided      | ▪ Two-sided      | ▪ Two-sided      | ▪ Two-sided   | ▪ Two-sided       | ▪ Two-sided    |

The deinking behaviour depends on different parameters like

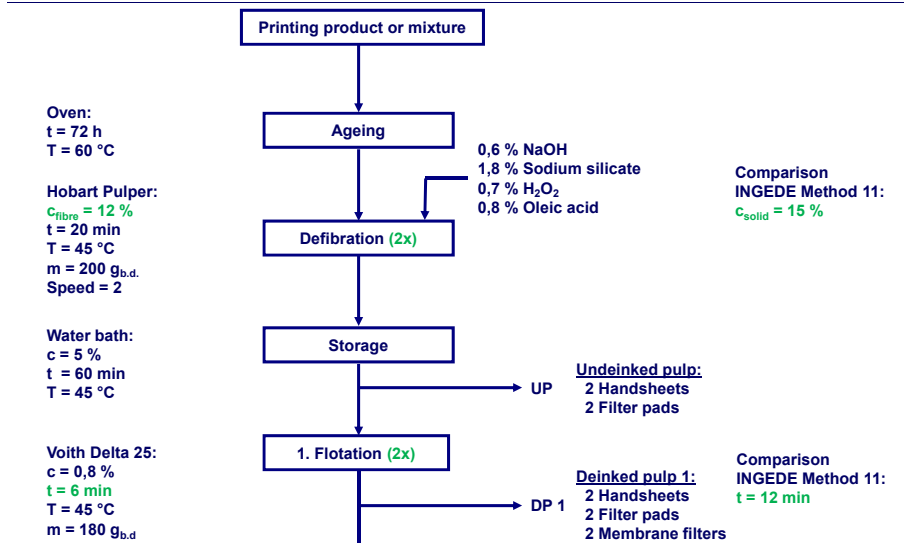
- the printing ink and process,
- the unprinted paper grades,
- ...

→ Thus, the results and conclusions in this presentation are only valid for the products and mixtures analysed

## Rough comparison between INGEDE Method 11 and the newly developed 2-loop deinking process

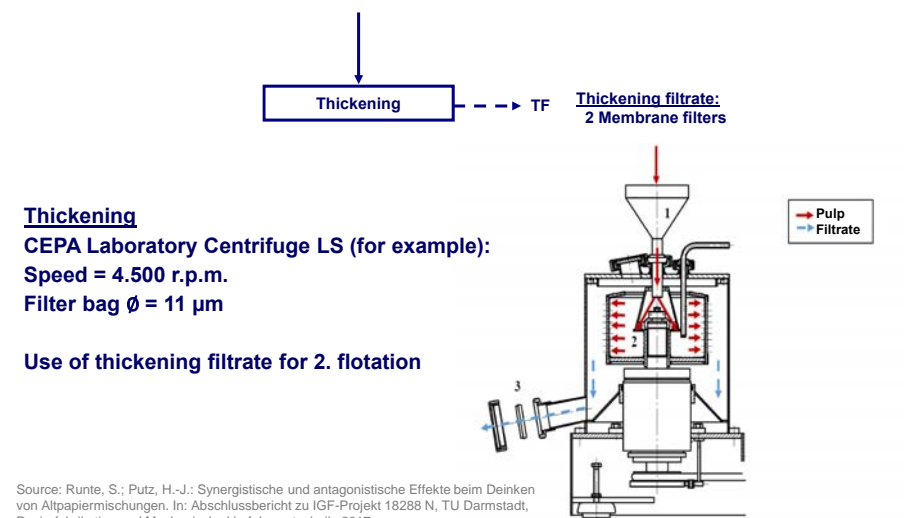


## 2-Loop deinking process in laboratory scale (1)



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## 2-Loop deinking process in laboratory scale (2)



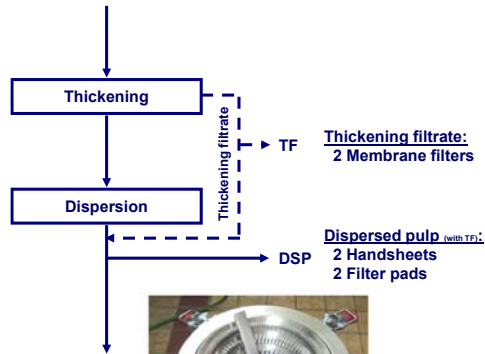
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## 2-Loop deinking process in laboratory scale (2)



CEPA Laboratory  
Centrifuge LS:  
Speed = 4.500 r.p.m.  
Filter bag  $\phi = 11 \mu\text{m}$

Cavimix 1031:  
c = 29 %  
t = 2 min  
T = 70 °C  
m = 200 g<sub>b,d</sub>



**Thickening filtrate:**  
2 Membrane filters

**Dispersed pulp (with TF):**  
2 Handsheets  
2 Filter pads



Source: Schabel, S.: Möglichkeiten und Grenzen der Verwertung von gemischtem Altpapier (1.02) für die Herstellung grafischer Papiere. In: Abschlussbericht zu IGF-Projekt 17299 N, TU Darmstadt, Papierfabrikation und Mechanische Verfahrenstechnik, 2014

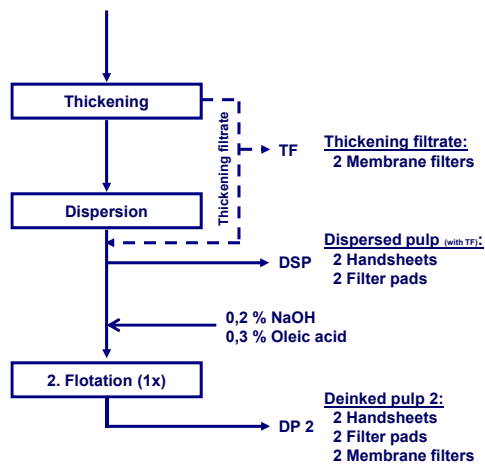
## 2-Loop deinking process in laboratory scale (2)



CEPA Laboratory  
Centrifuge LS:  
Speed = 4.500 r.p.m.  
Filter bag  $\phi = 11 \mu\text{m}$

Cavimix 1031:  
c = 29 %  
t = 2 min  
T = 70 °C  
m = 200 g<sub>b,d</sub>

Voith Delta 25:  
c = 0,8 %  
t = 4 min  
T = 45 °C  
m = 180 g<sub>b,d</sub>



**Thickening filtrate:**  
2 Membrane filters

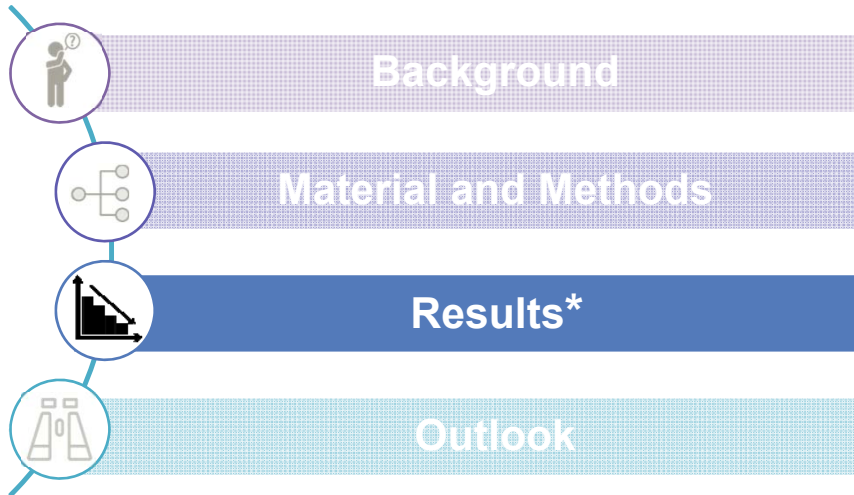
**Dispersed pulp (with TF):**  
2 Handsheets  
2 Filter pads

**Deinked pulp 2:**  
2 Handsheets  
2 Filter pads  
2 Membrane filters



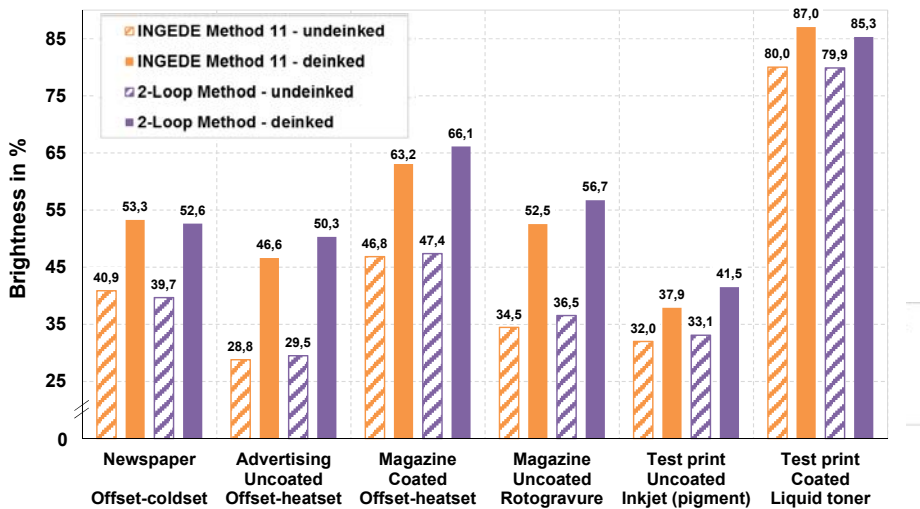
Picture: Krebs, T., PMV

## Outline

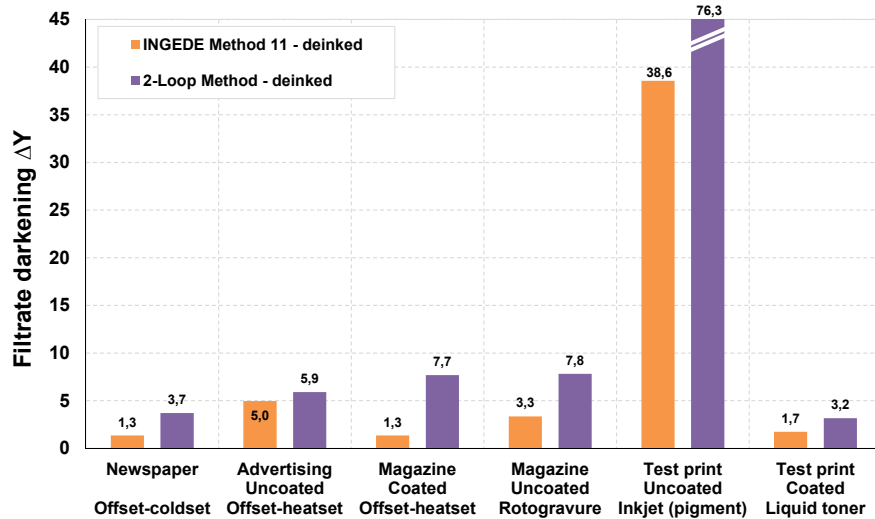


\* Based on: Wali S.: Untersuchung und Modellierung des Deinkingverhaltens von Altpapiermischungen, TU Darmstadt, PMV, Masterarbeit, 2017

## Comparison of brightness after final deinking using INGEDE Method 11 and the 2-loop method

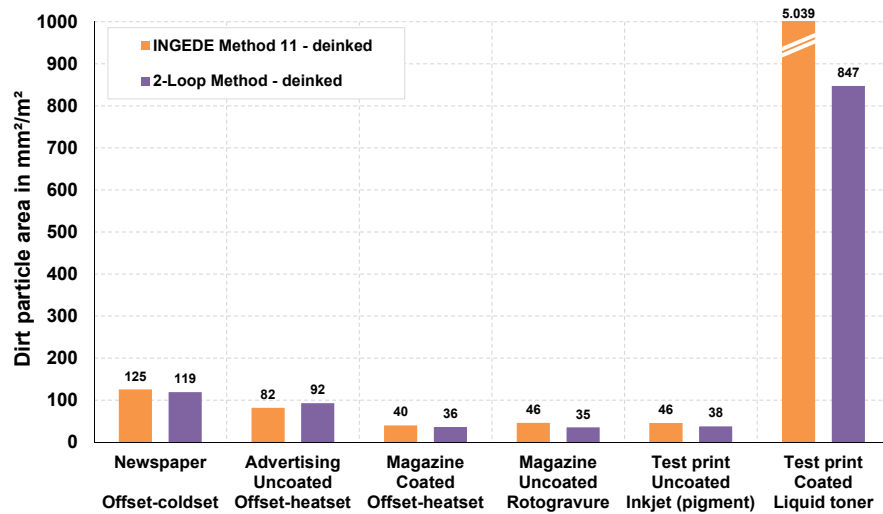


## Comparison of filtrate darkening after final deinking using INGEDE Method 11 and the 2-loop method



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## Comparison of dirt particle area after final deinking using INGEDE Method 11 and the 2-loop method



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## Investigation of the deinking behaviour of paper for recycling mixtures

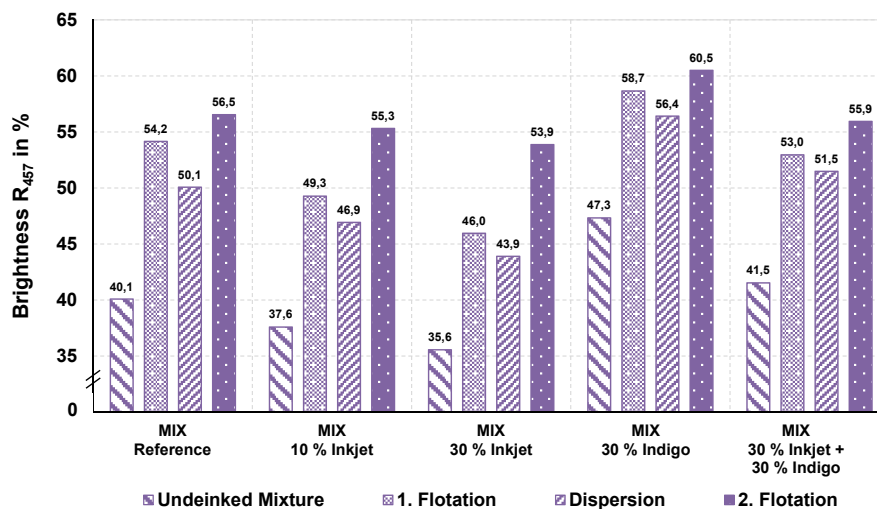


- Starting point is a simplified paper for recycling mixture without digitally printed products
  - Substitution of individual printed products with digital printed test prints

Mixture (MIX) (Quantity share in %)	Newspaper	Advertising	Magazine	Magazine	Test page	Test page
	Offset-coldset Uncoated	Offset-heatset Uncoated	Offset-heatset Coated	Roto-gravure Uncoated	Inkjet, pigment Uncoated	Liquid toner (Indigo) Coated
Reference	40	10	30	20	0	0
10 % Inkjet	30	10	30	20	10	0
30 % Inkjet	10	10	30	20	30	0
30 % Indigo	40	10	0	20	0	30
30 % Inkjet + 30 % Indigo	25	5	5	5	30	30

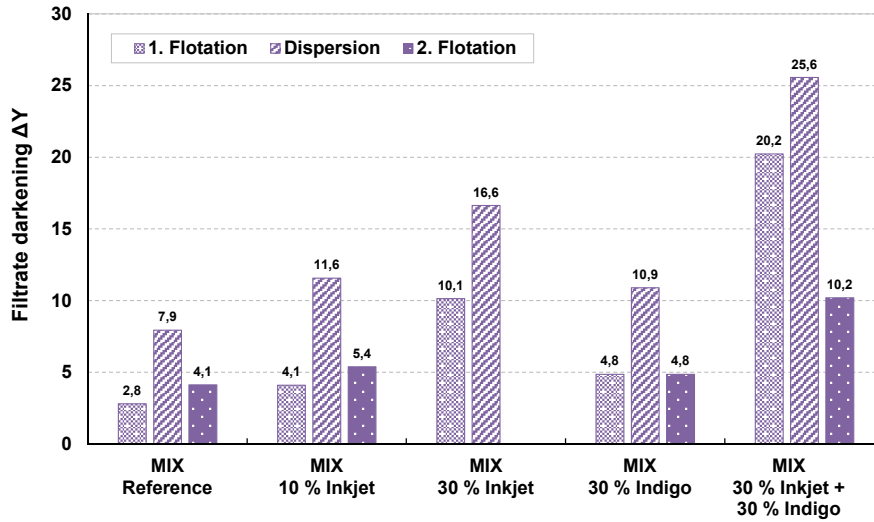
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## Influence of the amount of digitally printed test prints in paper for recycling mixtures on brightness



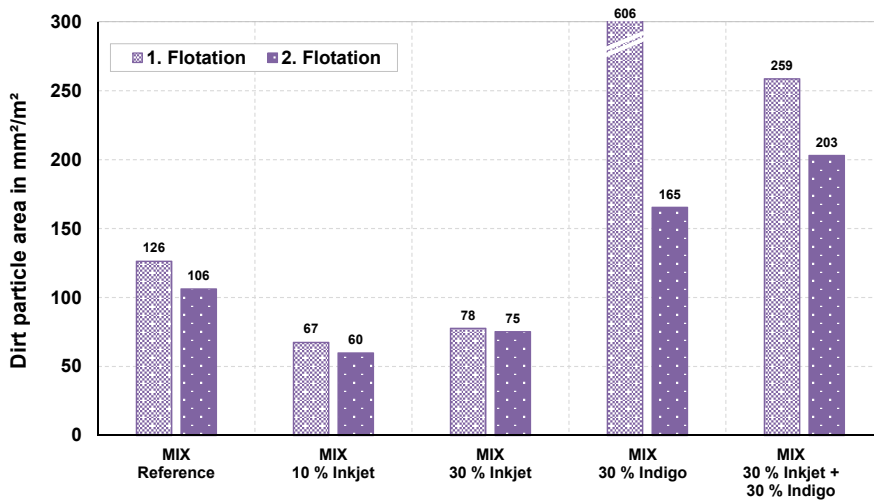
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## Influence of the amount of digitally printed test prints in paper for recycling mixtures on filtrate darkening



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## Influence of the amount of digitally printed test prints in paper for recycling mixtures on dirt particle area



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## Deinking of paper for recycling mixtures



Comparison of optical properties of paper for recycling mixtures after final deinking using the INGEDE Method 11 (I.M. 11) and the 2-loop method (2-loop)

		Mix Reference	Mix 10 % Inkjet	Mix 30 % Inkjet	Mix 30 % Indigo	Mix 30 % Inkjet + 30 % Indigo
<b>Brightness in %</b>	I. M. 11	54,6	49,3	46,4	58,4	53,4
	2-loop	56,5	55,3	53,9	60,5	55,9
<b>Filtrate darkening</b>	I. M. 11	5,0	3,4	7,6	7,2	14,6
	2-loop	4,1	5,4		4,8	10,2
<b>Dirt area in mm<sup>2</sup>/m<sup>2</sup></b>	I. M. 11	126	73	75	556	393
	2-loop	106	60	75	165	203

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## Summary



**At PMV, a 2-loop method was developed to simulate a two-stage deinking process in laboratory scale:**

- In comparison to INGEDE Method 11, the brightness is mostly affected positively and dirt specks were reduced, but the filtrate darkening increases for individual print products

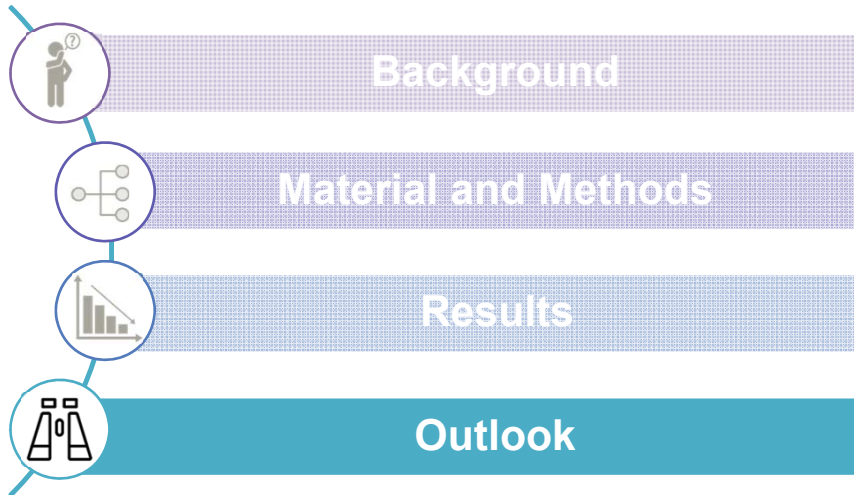
**Paper for recycling mixtures with increasing amounts of digital test prints were analysed:**

- Due to increasing inkjet test prints, the brightness of the paper for recycling mixtures decreases slightly. Adding Indigo test prints to the mixtures, the brightness rises
- The filtrate darkening rises due to an increasing amount of Inkjet test prints
- Dirt specks of the mixtures decrease a little due to an increasing amount of inkjet test prints, but rise if Indigo test prints are added to the mixture

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## Outline



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## Outlook



- **Optimisation of the 2-loop method**
  - Improvement of dispersion step
  - Adjustment of flotation time and flotation chemicals
  
- **Investigation of additional paper for recycling mixtures**
  - Digital print products from the market instead of test prints
  - Further percentage substitutions with digital print products
  
- **Development of a scheme to assess the deinking behavior of paper for recycling mixtures**

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## Thanks for your attention



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