

# Simulating a deinking plant in laboratory scale: Requirements and relevance

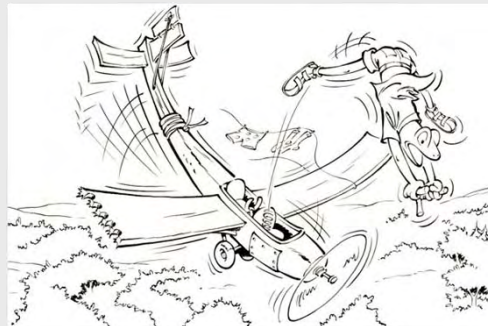
ACS 241<sup>st</sup> National Meeting – Anaheim, CA  
30 March 2011

Andreas Faul, Axel Fischer

Science established simulation ...



... in order to avoid  
undesired situations



## In Deinking ...



- it is not about human lives,
- but about ecology
- and economy
- of an industrial process

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Deinking plants ...



... are either big...

... or complex ...

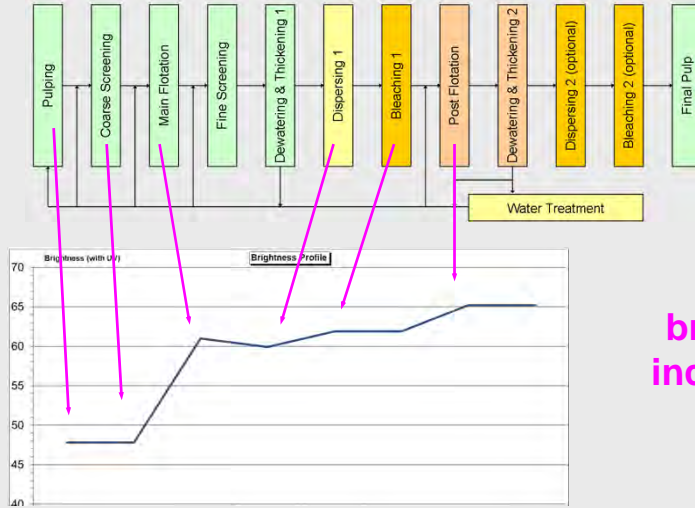


... or both!

ACS 241<sup>st</sup> National Meeting – 30 March 2011



## Typical brightness profile of a deinking plant



Highest brightness increase by main flotation

ACS 241<sup>st</sup> National Meeting – 30 March 2011

Source: PTC

## Dirt speck profile of a deinking pilot plant trial

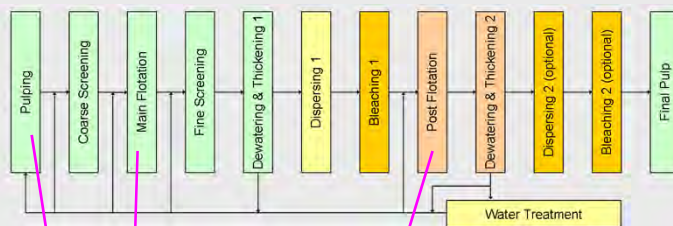
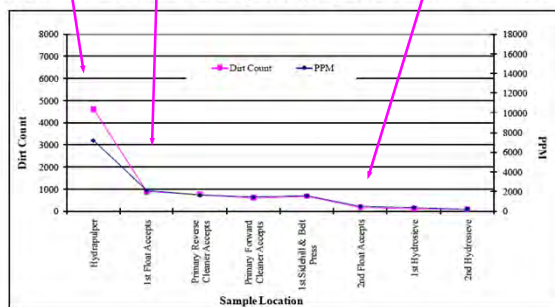


Figure IV. Dirt count as a function of flotation process stage for pilot scale testing of 5% HP ElectroInk 4.0.



Significant reduction of dirt specks by main flotation

AC

Source: Hewlett Packard / PaperCon 2010

## The tasks to setup a deinking simulation



❖ **Simulation of a complete deinking process**

❖ Usually in pilot plant scale

or

❖ **Testing the behaviour of a printed product in a deinking plant – “deinkability test”**

❖ In laboratory scale with focus on key process steps

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Consequence for a deinkability test



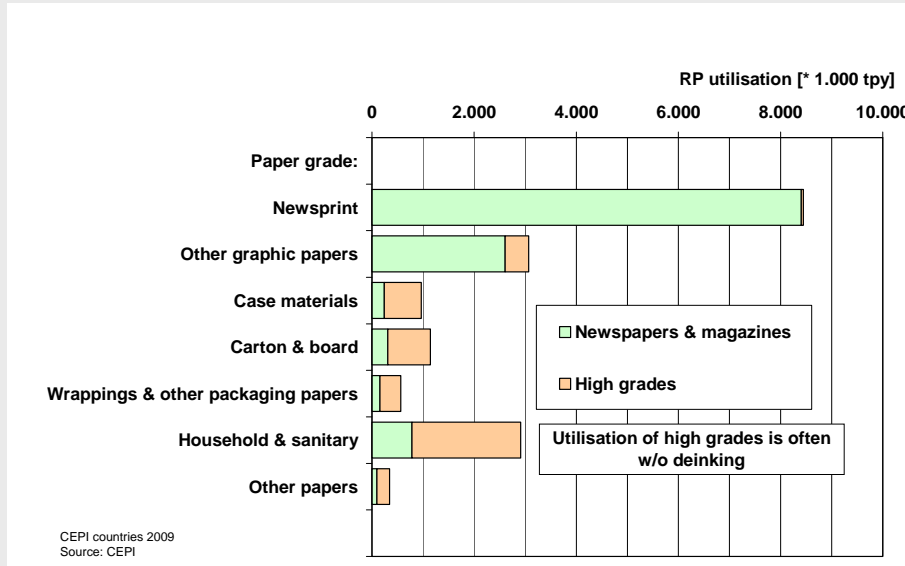
According to the development of pulp quality in the process it is sufficient to limit the test to the **essential process steps**:

**Pulping**  
**Main Flotation**

present in **every** flotation deinking plant and responsible for the **major increase** in quality

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Utilization of white recovered paper in paper production in Europe



## Typical flotation deinking process and quality data



Parameter	Single loop standard NP	Two-loop standard NP	Two-loop improved grades
Pulping pH	about 9,5	8,0 to 10,0	8,0 to 9,5
Flotation pH (main flot.)	8,5 to 9,0	7,8 to 8,7	7,5 to 8,8
Yield [%]	80 to 87	76 to 84	70 to 82
Final pulp brightness w/o UV	59 to 63	57 to 63	up to 74

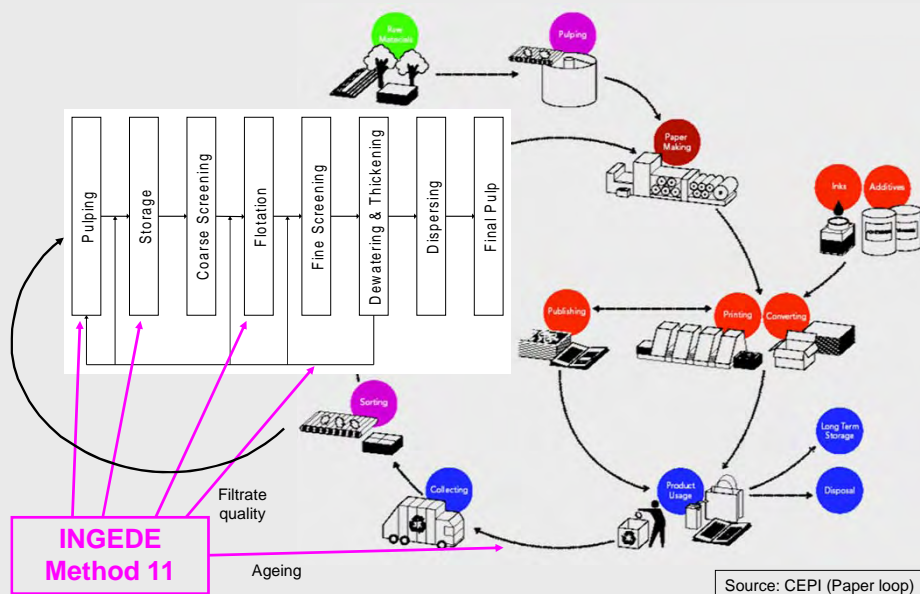
## Deinking facts



- The predominant raw material is mechanical pulp based – old newspapers and old magazines
- The predominant technology for ink removal is flotation
- The typical deinking process is under alkaline conditions
- These statements are based on European figures and data of INGEDE members but also valid globally

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Deinking in the paper loop



## INGEDE Method 11: Simulation of industrial deinking process (1)



	Parameter	Remarks
-	Raw material	Individual print products; mix is not feasible
✓	Ageing	
✓	Pulping consistency	A little lower than usual
✓	Pulping time and temperature	Pulping time longer due to equipment
✓	Pulping chemistry and pH	
-	Process water	n/a; hardness defined
✓	Reaction time and temperature	

ACS 241st National Meeting – 30 March 2011

## INGEDE Method 11: Simulation of industrial deinking process (2)



	Parameter	Remarks
-	Screening and cleaning	Not relevant for deinking
✓	(Main) Flotation	Hyperflotation (= removes all ink that can be floated)
-	Dewatering and thickening	Not relevant for deinking result
-	Dispersing	Not essential for standard products
-	Post flotation	Not necessary for standard products
-	Bleaching	Not in general use

ACS 241st National Meeting – 30 March 2011



## Key characteristics of INGEDE Method 11



Parameter	Definition	Remarks
Sample	One specific print product	Not a mix of different products
Accelerated ageing	Drying oven, 3 days, 60 °C (140 °F)	
Pulping	Device and settings exactly defined	Rotor speed, pulping time, temperature, consistency
Pulper chemistry	Chemicals and dosage rates exactly defined	Sodium hydroxide, sodium silicate, hydrogen peroxide, oleic acid
pH	9,5 ± 0,5 after pulping; ≥ 7,5 before flotation	If not reached, new test with adapted chemistry
Flotation	Hyperflotation	Settings defined for Voith Delta 25 and PTS cell; other cells allowed

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## INGEDE Method 11



Oven:  
t = 72 h  
T = 60 °C

Hobart pulper:  
c = 15 %  
t = 20 min  
T = 45 °C  
m = 200 g  
Speed = 2

Water bath:  
c = 5 %  
t = 60 min  
T = 45 °C

Resintegrator:  
c = 4 %  
t = 1 min

Flotation cell:  
Delta as example  
c = 0,8 %  
t = 12 min  
T = 45 °C  
m = 180 g



Print product

Ageing

Defibrination

Storage

Homogenisation (optional)

Flotation



ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Adaptation of deinkability testing over time according to typical deinking conditions



- Ageing period of samples
- Pulping consistency
- Deinking chemistry / pH
  
- Utilisation of most suitable laboratory equipment

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Assessment of deinkability



Results delivered by INGEDE Method 11:

Objectives	Evaluated Parameters
High Reflection	Luminosity Y of Deinked Pulp
High Optical Cleanliness	Dirt Area A* of Deinked Pulp
No Color Shade	a* Value of Deinked Pulp
High Ink Removal	Ink Elimination IE
No Discoloration of White Water	Filtrate Darkening $\Delta Y$

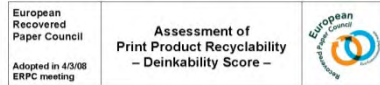
Quality Parameters (applies to the first three rows)

Process Parameters (applies to the last two rows)

Conversion of the results to a score system

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Deinkability Scorecard (1)

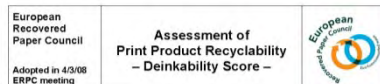


### Motivation:

- ❖ Display of the results of the individual parameters as one score
- ❖ Easier cross-comparison between printed products of different categories
- ❖ Weighting of the results of the individual parameters
- ❖ Suitable for a broad audience; also non-technical

ACS 241st National Meeting – 30 March 2011

## Deinkability Scorecard (2)



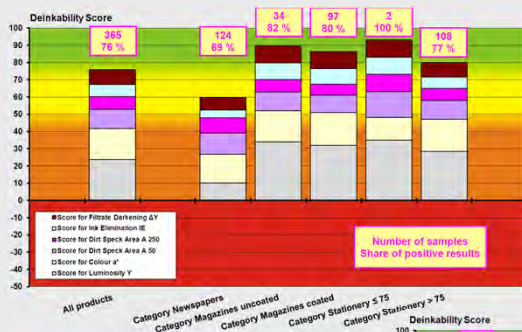
1 Purpose and scope of application  
This ERPC document provides an assessment of the deinkability of a printed product by evaluating results of a laboratory deinking test procedure. It is applicable to all kinds of printed products on white

- ❖ Target values are significantly less demanding than deinked pulp specifications (due to focus on key process steps)
- ❖ More sophisticated process steps in the assessment scheme will also require more demanding targets to match when rating the results

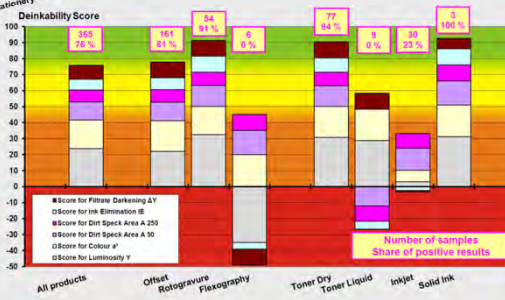
Laboratory retention should be at least 80% in case of uncoated papers and 70% in case of coated papers. For the determination of IE the parameter  $R_{10}$  has to be used with the term  $\left(\frac{1-R_{10,app}}{R_{10,app}}\right)^2$  set to 0. For the image analysis, DOMAS or Simpatic are allowed.

ACS 241st National Meeting – 30 March 2011

## Deinkability Scores



ACS 241st National Meeting – 30 March 2011



## Summary and conclusions (1)



- ❖ Complete and realistic deinking plant simulation as of today is **only** possible in pilot plant scale
- ❖ Water system equilibrium requires rather long pilot operation
- ❖ Work is in progress for simulation
  - ❖ in laboratory scale
  - ❖ by computer

ACS 241st National Meeting – 30 March 2011

## Summary and conclusions (2)



- ❖ Deinkability testing has to use an **individual printed product**
- ❖ Pilot plant scale is therefore only feasible in exceptional cases
- ❖ A laboratory scale assessment can – but also has to – concentrate on the **essential process steps**
  - ❖ which are present in **every** flotation deinking plant
  - ❖ which provide the **major increase** in pulp quality
- ❖ Allows to **rate** and **compare** the challenge of a printed product for the industrial process

ACS 241<sup>st</sup> National Meeting – 30 March 2011

## Summary and conclusions (3)



**INGEDE Method 11 is a**

- **reliable**
- **proven**
- **significant**
- **sufficient**
- **and living**

**test method to rate the deinkability behaviour of a printed product.**

ACS 241<sup>st</sup> National Meeting – 30 March 2011



**Thank you for your attention!**

**INGEDE**  
**International Association of the**  
**Deinking Industry**

**INGEDE Office**

Gerokstr. 40  
74321 Bietigheim-Bissingen  
Germany

Phone +49 7142 7742-81  
Fax +49 7142 7742-80  
Mail [office@ingede.org](mailto:office@ingede.org)

**Public Relations**

Oetztaler Str. 5 B  
81373 München  
Germany

Phone +49 89 769-2332  
Fax +49 89 769-2338  
Mail [info@ingede.org](mailto:info@ingede.org)

[www.ingede.org](http://www.ingede.org)