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Simulating a deinking plant in laboratory scale: Requirements and relevance

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Science established simulation …

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… in order to avoid undesired situations

Sources: DLR and Dietwald Doblies

In Deinking …

- **it is not about human lives,**

- **but about ecology**
- **and economy**
- **of an industrial process**

Deinking plants …

… are either big…

… or complex …

… or both!

Deinking plants do not run straight

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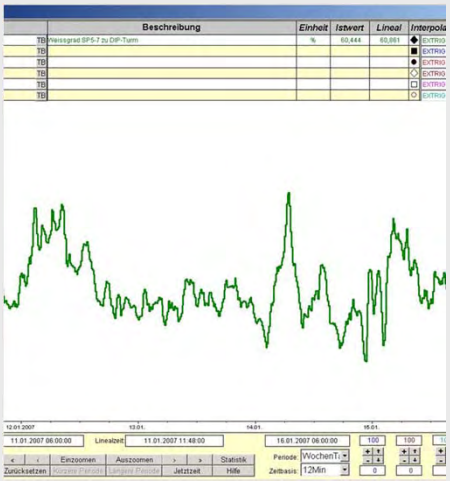

- **Brightness trend in a deinking plant for standard newsprint**
- **Time: four days**
- **Range: about 5 points** (58 to 63 points of brightness)

Main reason for variation:
Different behaviour of raw material

Source: INGEDE member mill A

The deinking process

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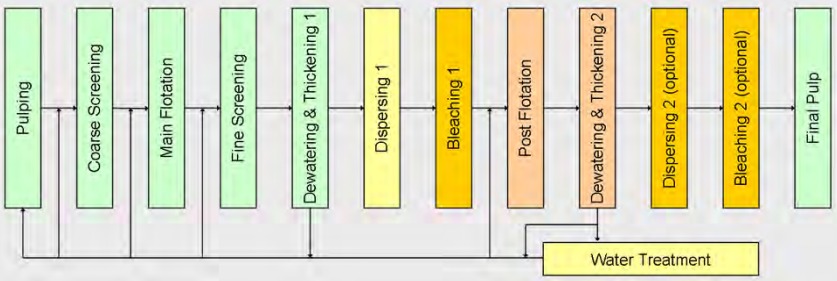

- **Green**: **Essential** process steps in flotation deinking plants
- **Yellow**: **Existing** in most deinking plants
- **Brown**: **Common** process design
- **Orange**: **Options** for higher qualities

Source: PTC

Typical brightness profile of a deinking plant

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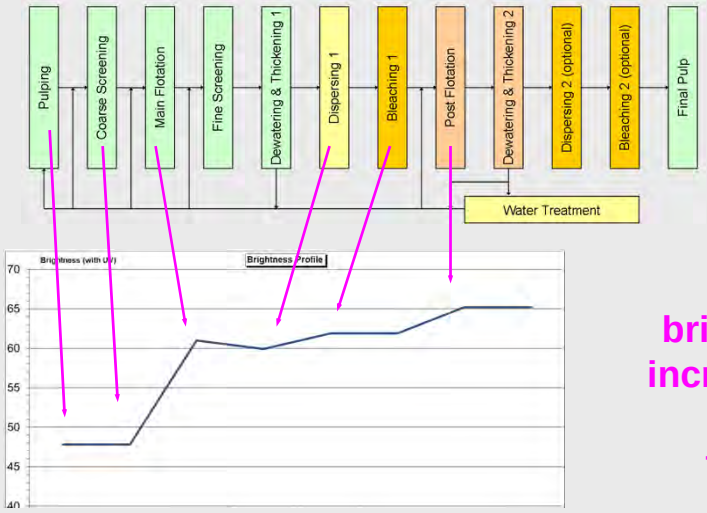

Highest brightness increase by main flotation

Source: PTC

Dirt speck profile of a deinking pilot plant trial

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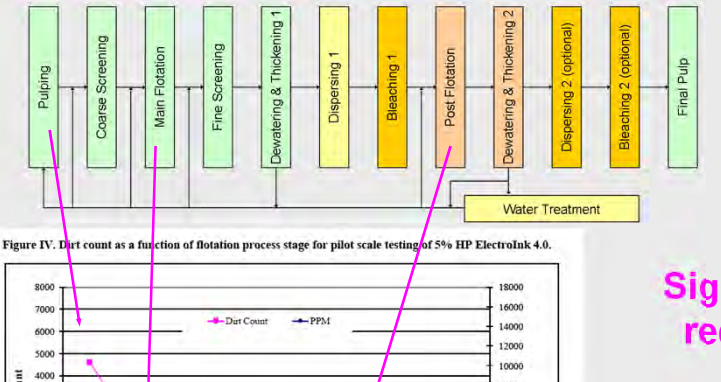

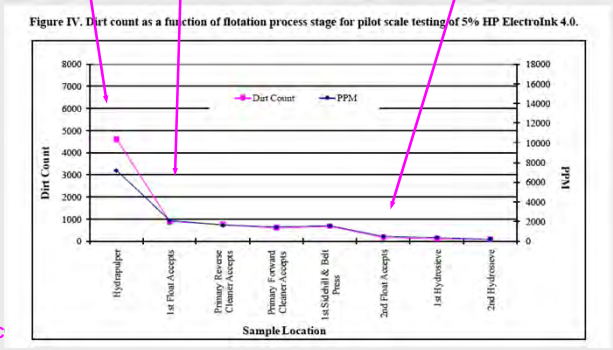

Significant reduction of dirt specks by main flotation

Source: Hewlett Packard / PaperCon 2010

The tasks to setup a deinking simulation

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- **Simulation of a complete deinking process**

  or

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

- Usually in pilot plant scale

- In laboratory scale with focus on key process steps

Consequence for a deinkability test

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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

Utilization of white recovered paper in paper production in Europe

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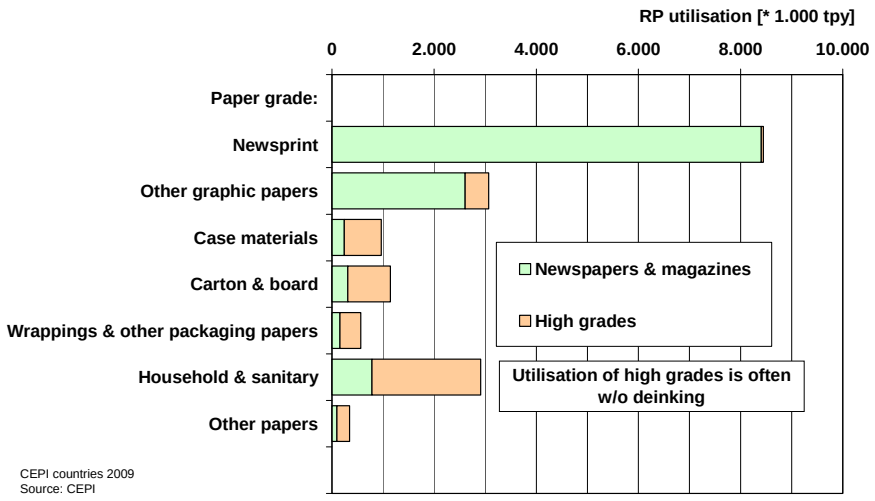

CEPI countries 2009
Source: CEPI

Typical flotation deinking process and quality data

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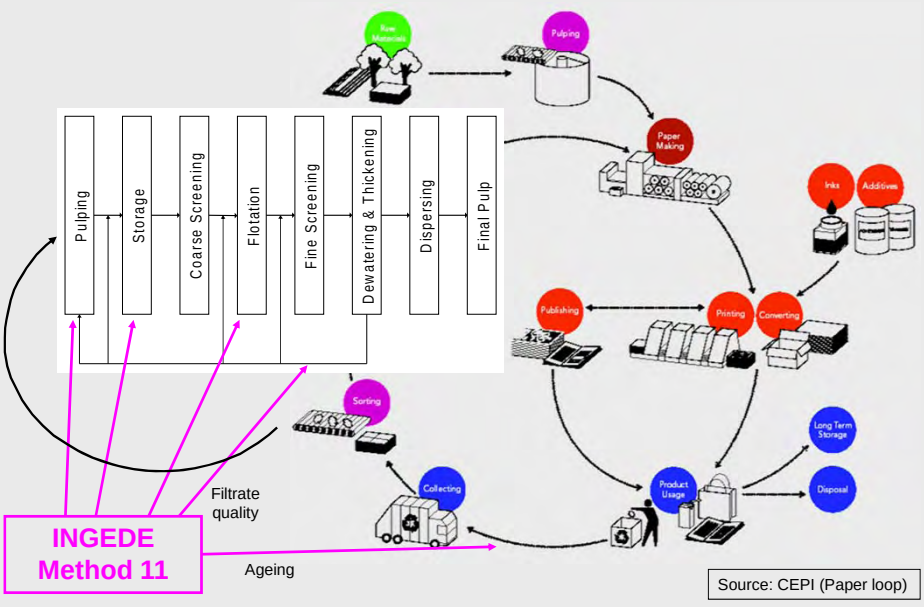
Parameter	Single loop standard NP	Two-loop standard NP	Two-loop improved grades
Pulping pH	about 9,5	8,0 to 10,0	8,0 to 9,5
Flotation pH (main flot.)	8,5 to 9,0	7,8 to 8,7	7,5 to 8,8
Yield [%]	80 to 87	76 to 84	70 to 82
Final pulp brightness w/o UV	59 to 63	57 to 63	up to 74

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

Deinking in the paper loop



Source: CEPI (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	

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

Key characteristics of INGEDE Method 11

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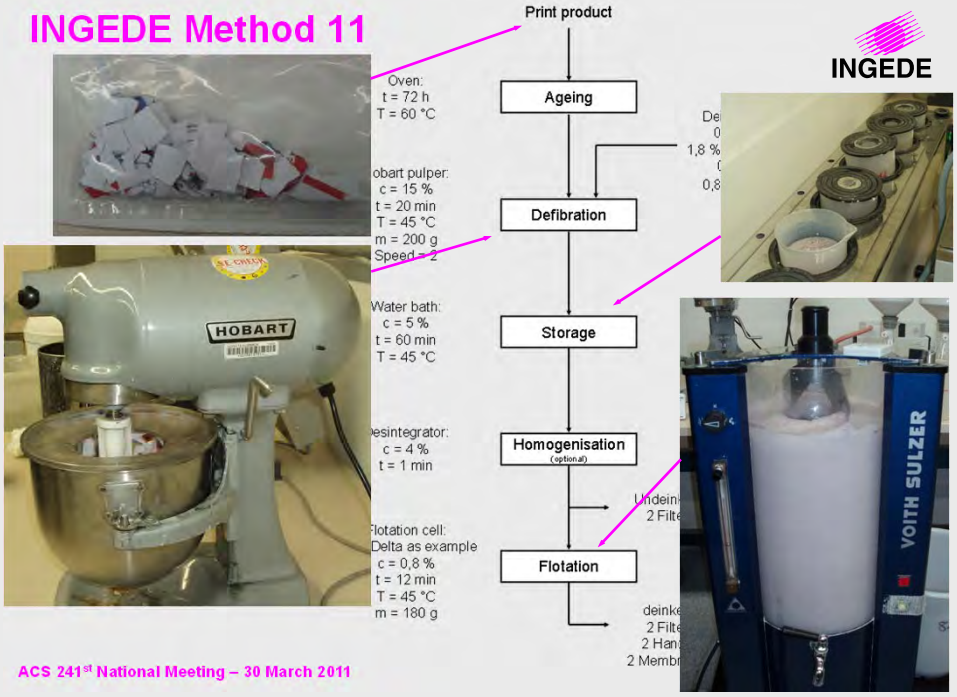
Parameter	Definition	Remarks
Sample	One specific print product	Not a mix of different products
Accelerated ageing	Drying oven, 3 days, 60 °C (140 °F)	
Pulping	Device and settings exactly defined	Rotor speed, pulping time, temperature, consistency
Pulper chemistry	Chemicals and dosage rates exactly defined	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

INGEDE Method 11



Adaptation of deinkability testing over time according to typical deinking conditions

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- **Ageing period of samples**
- **Pulping consistency**
- **Deinking chemistry / pH**

- **Utilisation of most suitable laboratory equipment**

Assessment of deinkability

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Results delivered by INGEDE Method 11:

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

Conversion of the results to a score system

Deinkability Scorecard (1)

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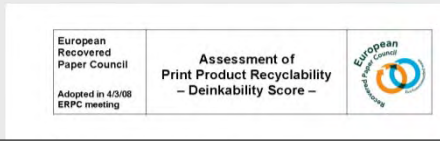
European Recovered Paper Council
Adopted in 4/3/08 ERPC meeting
Assessment of Print Product Recyclability – Deinkability Score –

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

Deinkability Scorecard (2)

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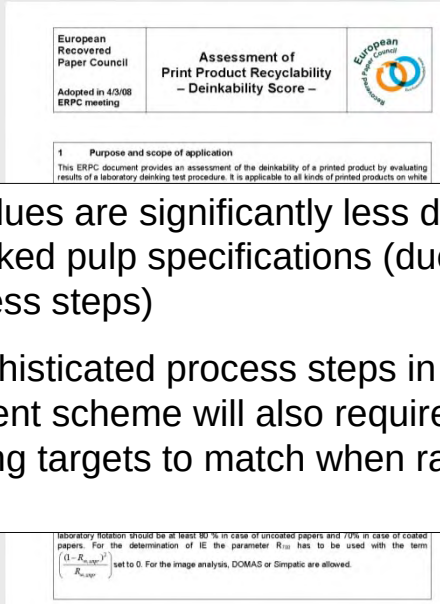
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Assessment of Print Product Recyclability – Deinkability Score –

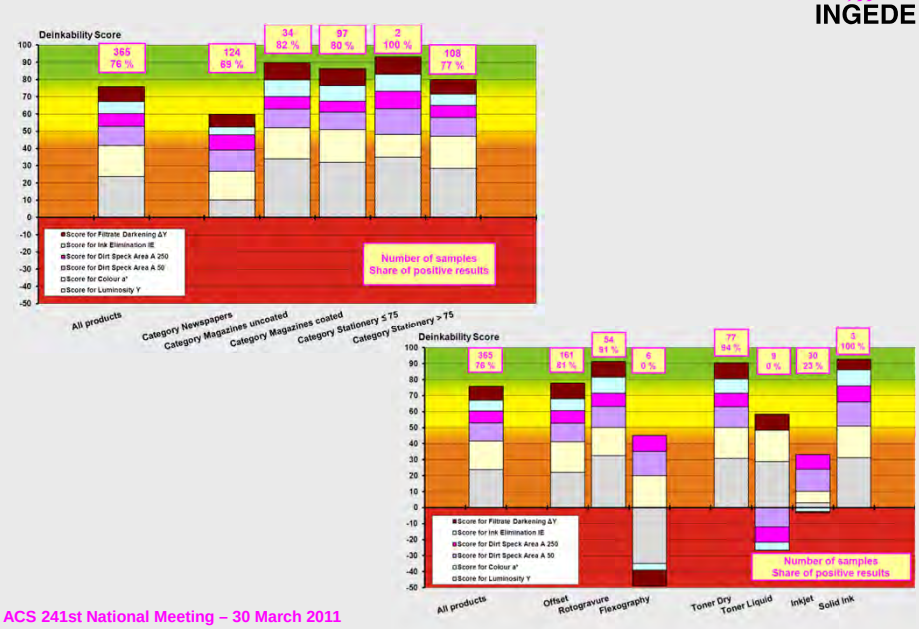
1 Purpose and scope of application

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 flotation 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_{ISO} has to be used with the term $\left(\frac{(1-R_{\infty,corr})^2}{R_{\infty,corr}}\right)$ set to 0. For the image analysis, DOMAS or Simpatic are allowed.

Deinkability Scores



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

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

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.

Thank you for your attention!

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