Deinking Potential of Recovered Paper depending of Water Circuit Quality

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Content

- Aim
- Approach
- Investigation
  - Sample Composition and Process Water
  - Procedure
- Results
  - Influence of Difficult Deinkable Print Products
  - Influence of Different Process Water Samples
- Short Summary

Aim

- Systematic study of the impact of water based inks on water circuit and deinking process
- Investigations of the influence of different process water qualities on optical parameters developement in the deinking process
- Possible solutions to improve deinking results depending on process water quality

Approach

1. Bibliography (CTP/PMV/PTS)
   - Effect of water closure, process water cleaning and recovered paper quality
2. Mill trial (CTP)
   - Comparision of deinking process with closed loop / with fresh water
3. Impact of recovered paper quality (PMV/PTS)
   - Impact of increasing content of water based inks
4. Impact of process water quality (PMV/PTS)
   - Determination of process water parameters influencing the deinking process

Approach

1. Bibliography (CTP/PMV/PTS)
   - Effect of water closure, proces… cleaning and recovered paper quality

Much information…

2. Mill trial (CTP)
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CTP Presentation INGEDE Symposium 2011

3. Impact of recovered paper quality (PMV/PTS)
   - Impact of increasing content of water based inks
4. Impact of process water quality (PMV/PTS)
   - Determination of process water parameters influencing the deinking process

Work Package 3 Impact of Recovered Paper Quality (PMV, PTS)

Investigation of the impact of various percentages of difficult deinkable paper grades (Flexo/Inkjet) on DIP quality of standard RCP mixture:

Standard paper mixture (50 % offset news, 30 % coated offset magazines, 20 % coated rotogravure magazines)

→ substituting offset newspaper by flexo prints

→ substituting offset magazines by inkjet prints

Deinkability Tests with different water qualities:

- Tap Water
- Process Water

→ Lab flotation (IfP Cell / PMV and Voith Cell / PTS)

→ Measurement of DIP quality parameters and process water quality

→ Benchmark with average calculated from INGEDE database (Mixture of 50 % Offset-NP, 30 % Offset-LWC and 20 % Rotogravure-LWC)

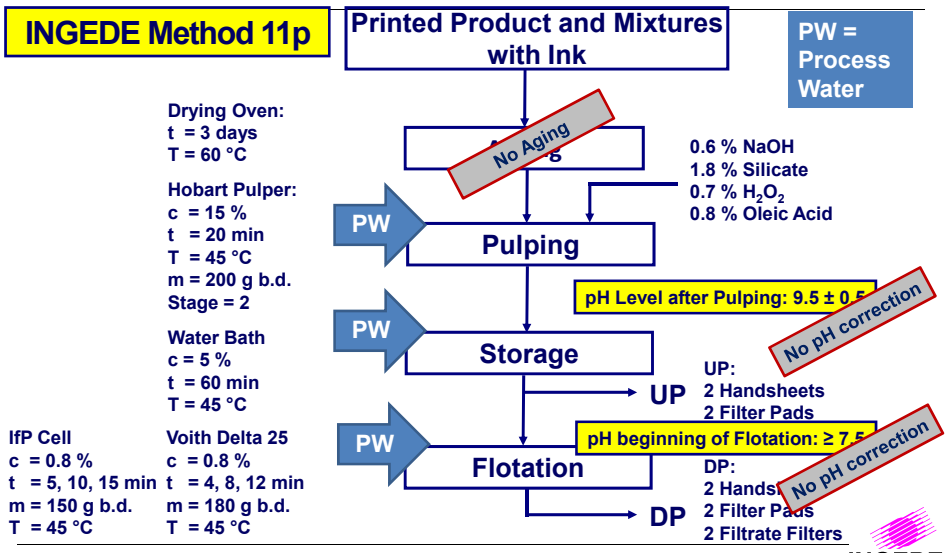
Sample Composition and Used Process Water

Sample Composition in %:

Sample No	Standard	Flexo-NP 10	Flexo-NP 20	Flexo-NP30	Inkjet-TB 10	Inkjet-TB 20	Inkjet-TB 30	Inkjet-TB 10 Flexo-NP 10	Flexo-NP 15 Inkjet-TB 15
Offset-NP (6)	50	40	30	20	50	50	50	40	35
Offset-LWC (5)	30	30	30	30	20	10	0	20	15
Rotogravure-LWC (3)	10	10	10	10	10	10	10	10	10
Rotogravure-LWC (4)	10	10	10	10	10	10	10	10	10
Flexo-NP (9)	0	**10**	**20**	**30**	0	0	0	10	15
Inkjet-TB (10)	0	0	0	0	**10**	**20**	**30**	10	15

Flexo-NP: Commercial coloured newspaper (NP) on standard newsprint
Inkjet-TB: Coloured textbook (TB) on woodfree paper (printed both sides)

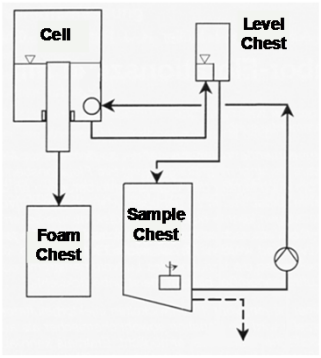
Lab Procedere for Deinkability Test of Printed Products



Lab Flotation Cells

IfP Cell
Sample: 150 g oven-dry
Consistency: 0,8 %
Flotation Time: 0, 5, 10, 15 min
Deinking Result as f(t)

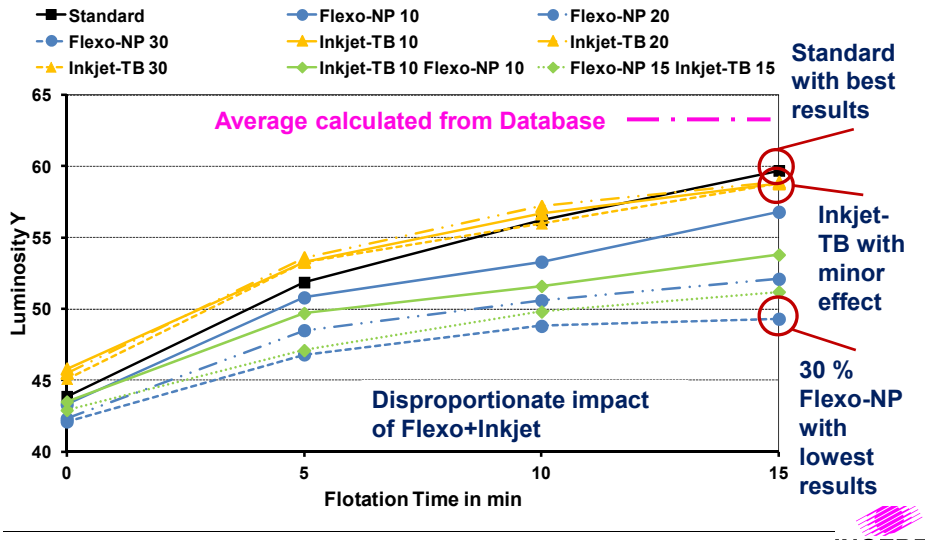
Voith Delta 25
Sample: 180 g oven-dry
Consistency: 0,8 %
Flotation Time: 0, 4, 8, 12 min
Deinking Result as f(t)



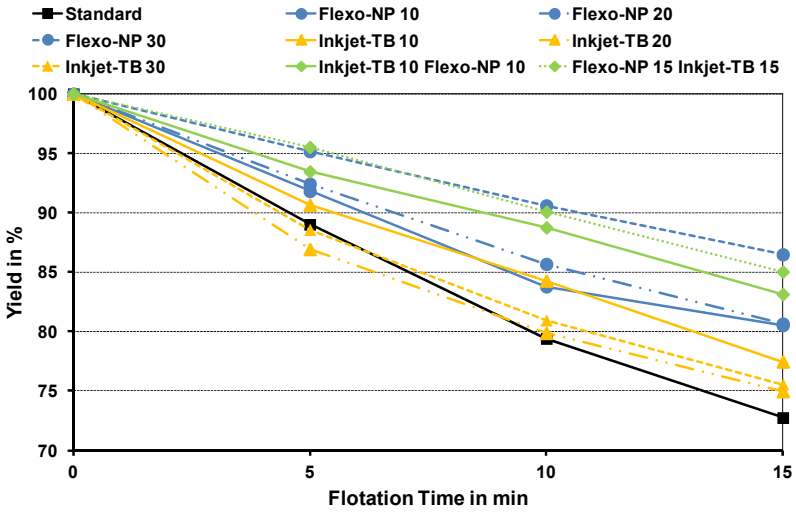
Standard Flotation Recipe (INGEDE Method 11p):

Chemical	Dosage [%]
Sodium hydroxide	0,6 (100 %)
Sodium silicate	1,8 (1,3 - 1,4 g/cm³)
Hydrogen peroxide	0,7 (100 %)
Oleic acid	0,8 (extra pure)

Influence of Difficult Deinkable Print Products
Luminosity Y_{DP} for Darmstadt Tap Water

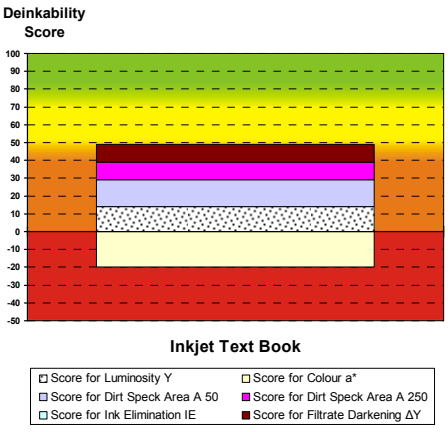


Influence of Difficult Deinkable Print Products
Yield for Darmstadt Tap Water

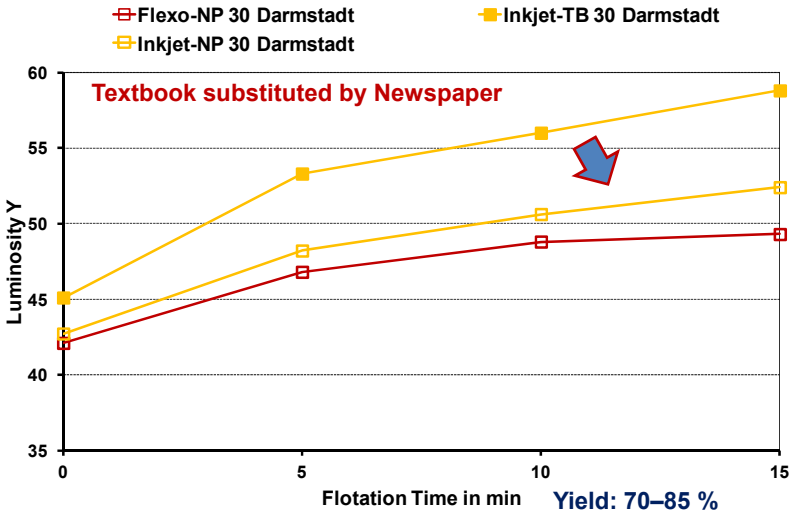


Reasons for Minor Effect of Inkjet-TB

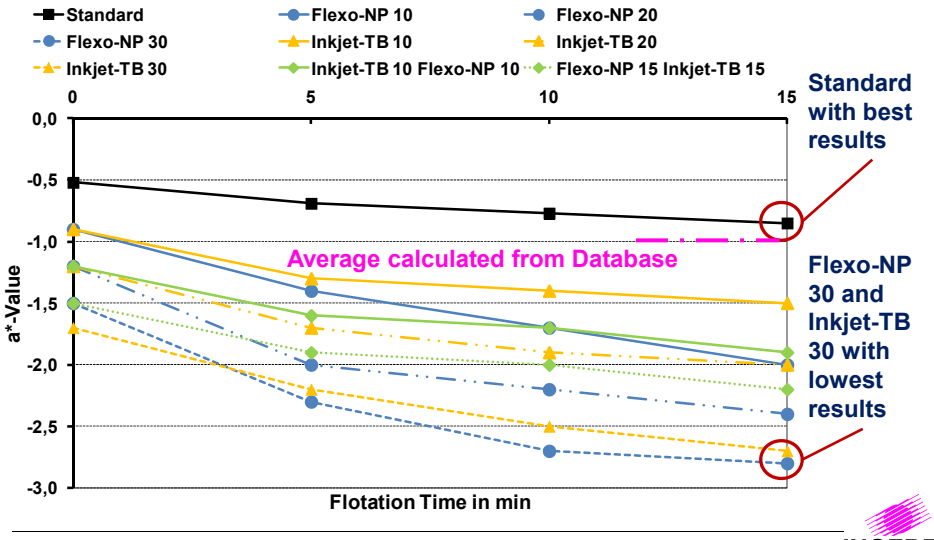
- **Lower impact of inkjet textbook due to difference in paper grade (specially coated)**
- **Deinkability assessment: not suitable for deinking**
  - Score for Colour a*: negative
  - Score for IE: 0
  - Luminosity Y of DP = 63,6
- **→ Comparative Trials with an inkjet newsprint (Commercial coloured newspaper (NP) on standard newsprint)**



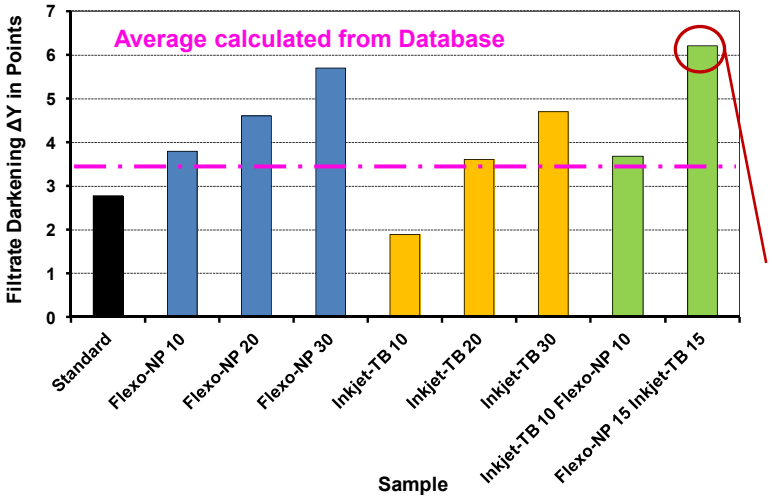
Influence of Difficult Deinkable Print Products
Reasons for Minor Effect of Inkjet-TB



Influence of Difficult Deinkable Print Products
Colour Value a^*_{DP} for Darmstadt Tap Water



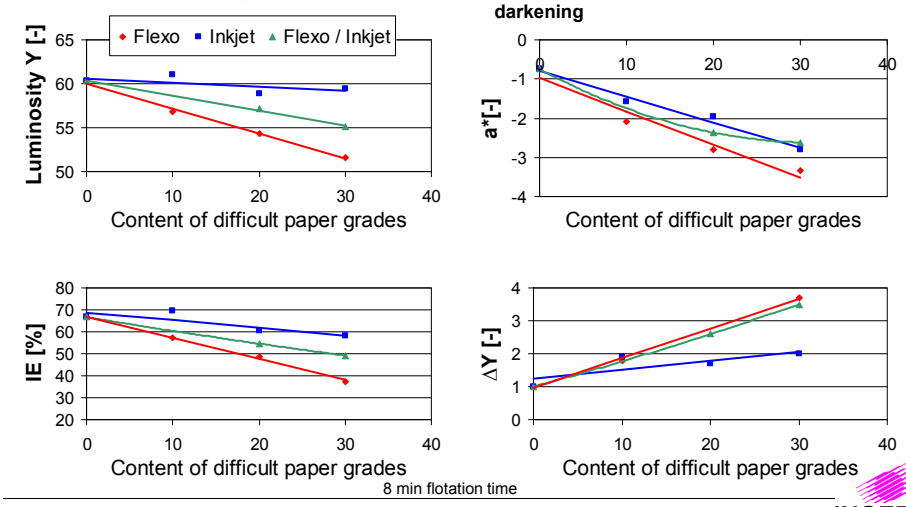
Influence of Difficult Deinkable Print Products
Filtrate Darkening ΔY (after 15 min flotation)



Flexo-NP 15 Inkjet-TB 15 with poorest results

Conclusions:
Impact of Difficult Paper Grades on Deinking Potential (Munich Tap Water)

- **Reduction in luminosity and ink elimination**
- **Increase in discolouration and filtrate darkening**



8 min flotation time

Influence of Difficult Deinkable Print Products on DIP quality Influence of Flexo vs. Inkjet

- Flexo-NP has in this investigation a stronger impact than Inkjet-TB (different print products, different paper grades)
- Inkjet-NP reaches similar bad results as Flexo-NP

Influence of Different Process Water Samples on Deinking Results

Water Samples:

- Darmstadt Tap Water
- Tissue
- Newsprint Mill A
- Newsprint Mill B, DIP 2 Plant
- Newsprint Mill B, DIP 1 Plant

Characterisation of Process Water Regarding Several Parameters, e.g.

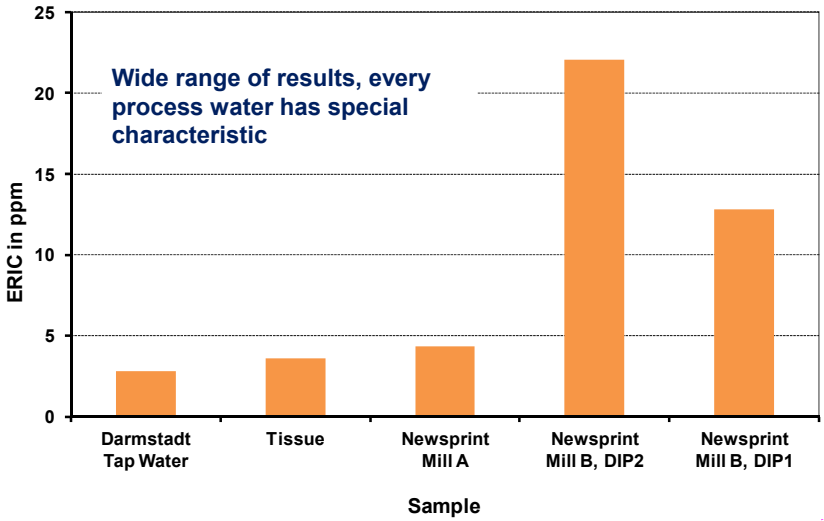
- pH, hardness, solid content, residual ink, surface tension

Water Sample Analysis Summary

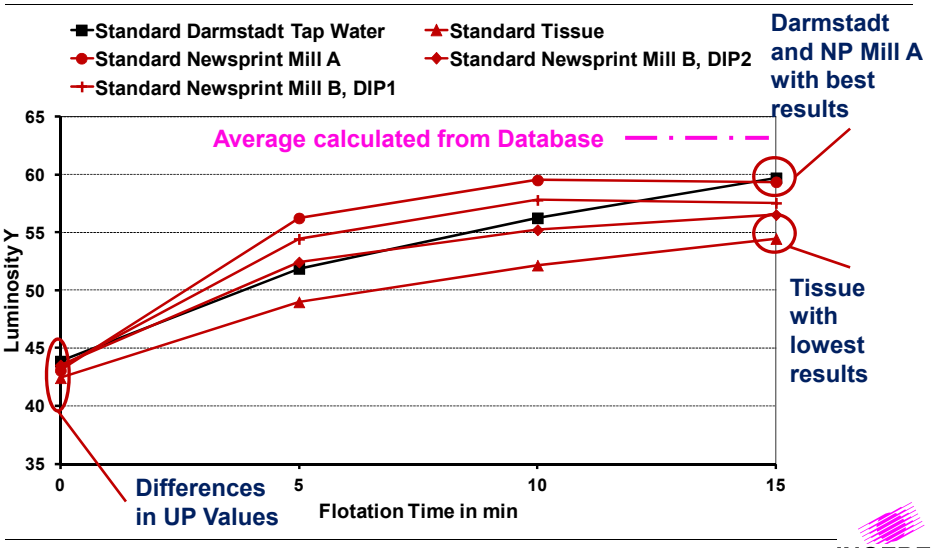
Name	pH	Hardness (centrifuged)	Solid Content 105 °C	Annealing Residue 550 °C	COD	Conductivity	Surface Tension
	-	°dH	g/l	g/l	mg/l	mS/cm	mN/m
Darmstadt Tap Water	7,2	19	0,0	0,36	0	0,68	n.a.
Newsprint Mill A	7,7	11	0,6	2,57	2840	2,92	50,5
Tissue	6,7	49	0,1	2,64	2800	3,54	50,9
Tissue after softening	8,1	17	0,2	3,31	2910	4,37	41,2
Tissue (Cloudy Filtrate)	6,9	54	2,4	4,31	3990	3,60	40,1

- **Also Measured:**
  - **Evaporation residue, cationic demand, foaming behaviour**
- **Optical Water Properties:**
  - **15 ml sample are filtered with membrane filter (0,45 µm pore size)**

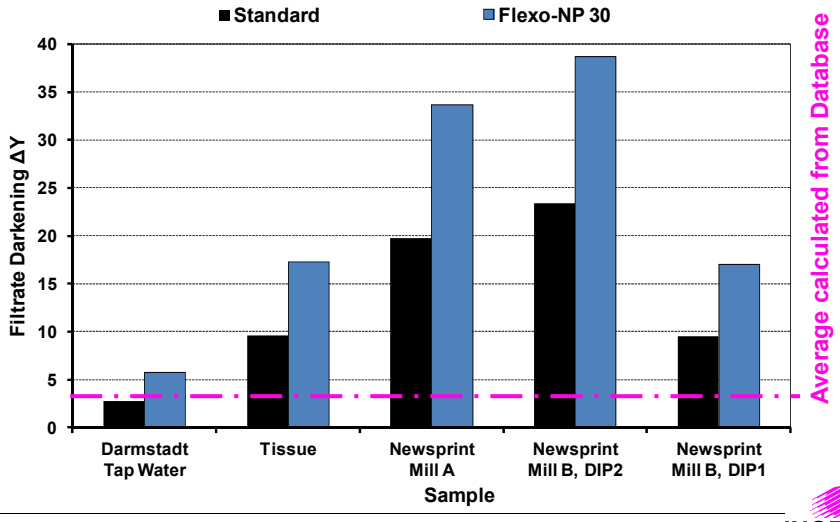
Influence of Different Process Water Samples on Deinking results ERIC Values of Membrane Filters



Influence of Different Process Water Samples on Deinking Results
Luminosity Y_{DP} of Standard Mixture



Influence of Different Process Water Samples on Deinking Results
Filtrate Darkening ΔY



Conclusions: Influence of Process Water on Flotation Results

- Decrease in DP luminosity Y
- Lower ink elimination IE
- Increase in filtrate darkening ΔY
- Minor influence on ash content
- Influence on yield (between 70 and 85 %), in the majority of cases a reduction of yield
- Influence on total dirt speck area (but all < 200 mm^2/m^2)

Conclusions: Influence of Process Water on Flotation Results

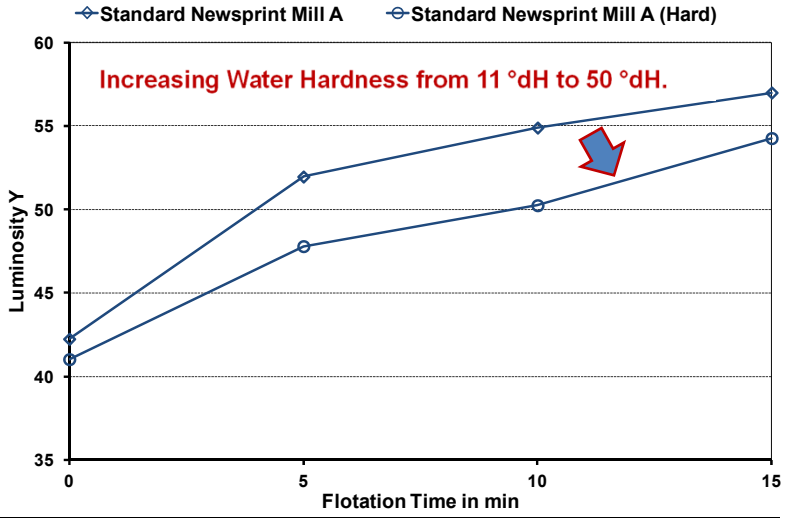
Process water quality influences the flotation results

→ But which water parameter is relevant?

→ What should be improved?

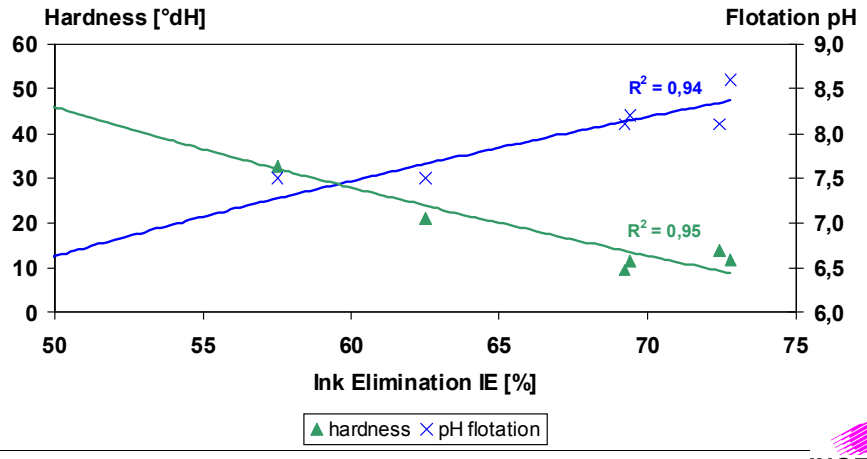
- **Deinkability tests with standard mixture and Flexo-NP 30 mixture regarding the impact of**
  - **Solid content**
  - **Surface tension**
  - **Water hardness**
  - **pH**
  - **Water flotation as cleaning measure (softening, reduction of surface tension)**

Influence of Different Process Water Samples on Deinking Results Detection of Important Water Parameters



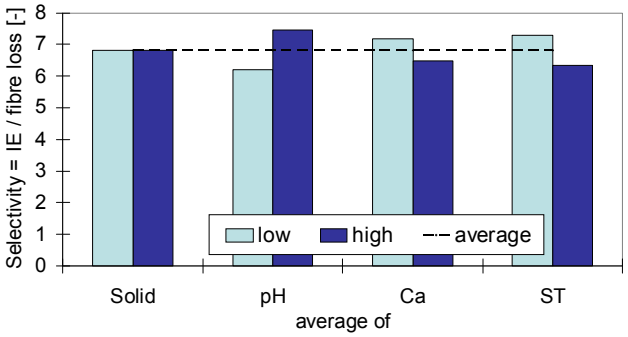
Trends Regarding the Impact of Process Water (Standard RCP)

- No correlation with solid content, COD and cationic demand of process water



Impact of Process Water Parameter on Selectivity

- Increase in selectivity with increasing flotation pH
- Decrease in selectivity with increasing hardness
- At lower pH of process water higher impact of Ca^{2+} and surface tension (interaction effect)



Solid = solid content, pH = flotation pH, Ca = hardness, ST = surface tension

Conclusions Important Water Parameters

- Process water properties of different deinking plants can vary significantly
- Process water properties have an significant impact on deinking potential of recovered paper
- Trends
  - Negative effect of increased hardness
  - Higher selectivity for standard RCP mxiture with increasing flotation pH
  - Good results for standard RCP mixture with low hardness, low surface tension and higher pH
  - Slightly improved results for Flexo-NP mixture with low hardness, low surface tension and low pH
- No general recommendation for optimum results possible
- Process solutions must be adapted on process water properties

Short Summary

- Higher content of water based inks influences the deinking results and process water quality in a negative way
- Process water of different mills vary significantly
- Important parameters are
  - Hardness
  - pH
  - Surface Tension
- Good results for standard RCP mixtures with low hardness, low surface tension and higher pH
- Process solutions must be adapted for each process water

Thank You!

Thank you for your attention

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Please feel free to let us know your comments and questions.

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