Results of the MSc Thesis on Brownstock Washing Control and Optimization at Kaukas Pulp Mill

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K-PATENTS
PROCESS INSTRUMENTS

Results of the MSc Thesis on real time Refractive Index measurement in washing process optimization and control

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Contents of the presentation

1. Objectives of the thesis
2. Washing line
3. Installed equipment
4. Results
5. Conclusions

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Objectives of the thesis

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1. Put into service the upper level control system and the refractometers in the washing line
2. Determine the optimal values for operational parameters such as dilution factor and drum torque
3. Assess the economic viability of the investment in upper level control system and refractometers
4. Compare refractometers and conductivity meters as wash loss measuring devices

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Objectives of the thesis

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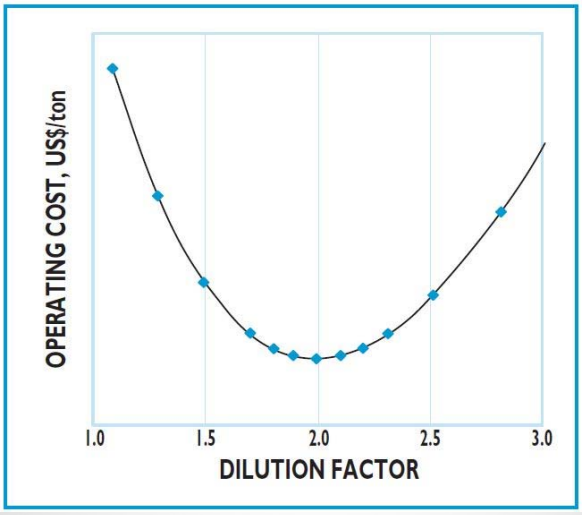

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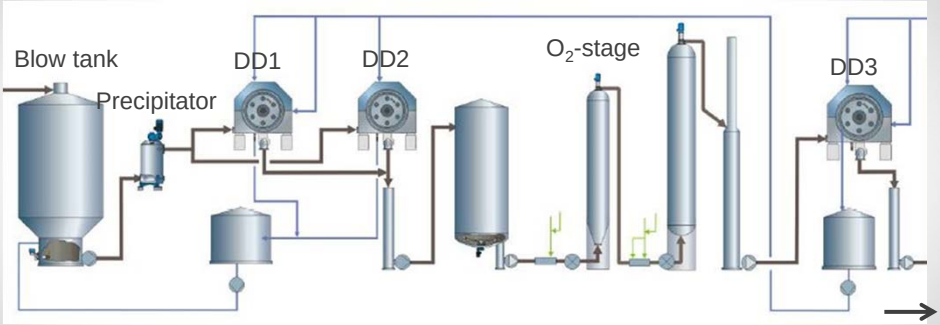
Washing line



- Precipitator
- Three DD-washers
- Two-stage Oxygen delignification

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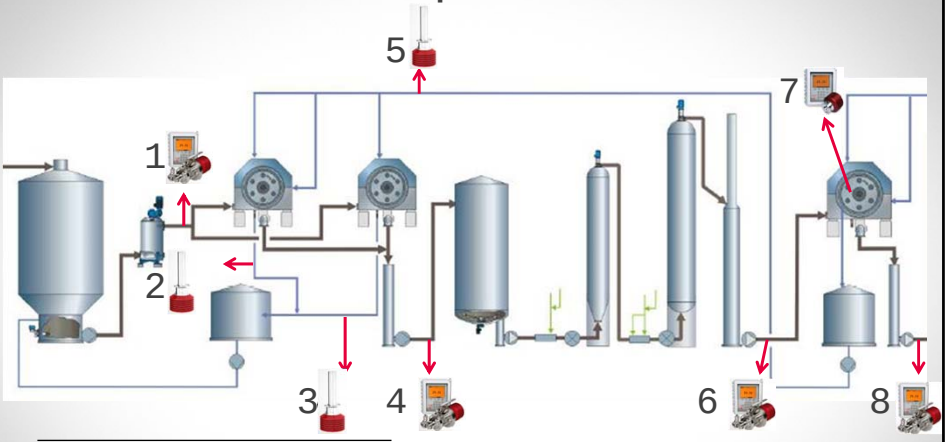
Refractometer installation points



Installation point	*Number*
DD1 & DD2, pulp in	1
DD1, wash filtrate	2
DD2, wash filtrate	3
DD1 & DD2, pulp out	4
DD3, pulp in	5
DD3, wash filtrate	6
DD3, wash liquor from vacuum tank	7
DD3, pulp out	8

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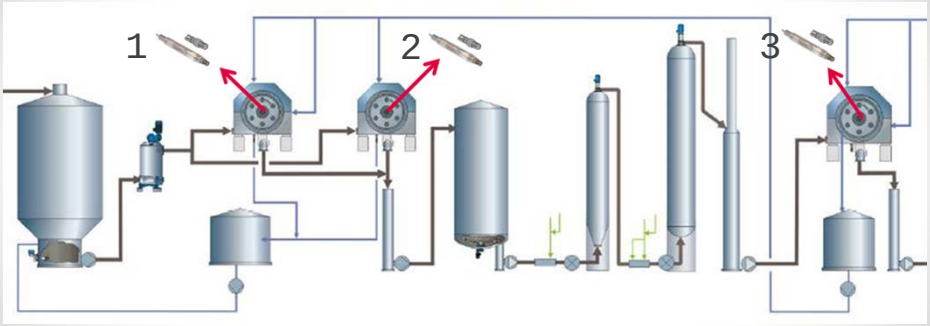
Conductivity installation sites



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Upper level control system

- Dilution factor control
  - Optimization of wash water usage
- Drum rotation speed control
  - Enhanced wash result by using torque to control the rotation peed
- Real time E-value to monitor the washing efficiency

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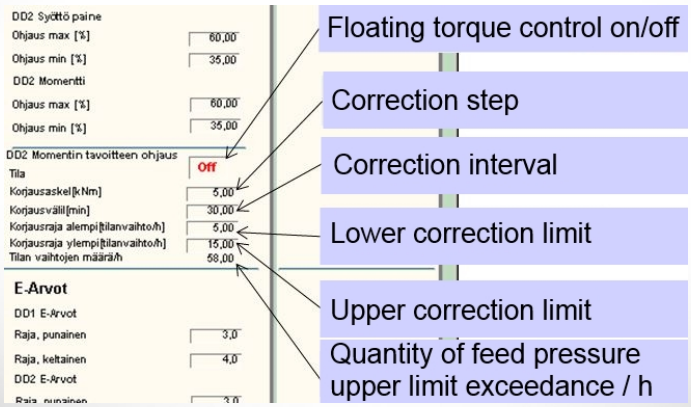
Automatic set point for torque

- Target value for torque changed automatically depending on pulp properties



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Contents of results

1. Liquor analysis and in-line measurements assessment
2. Performance of the installed equipment
3. Reasons for enhanced performance
4. Effect of dilution factor on wash loss
5. Effect of production rate on wash loss
6. Effect of drum torque on wash loss
7. Investment payback time

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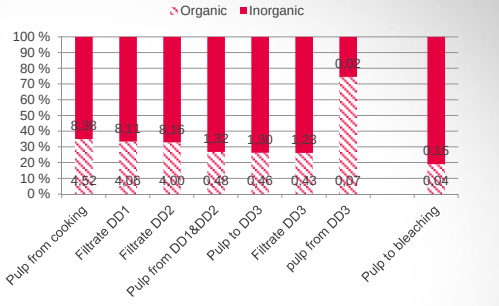
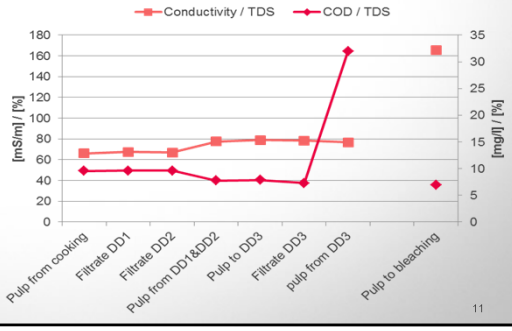
Liquor analysis

- Organic portion of the liquor decreases with the concentration



- Conductivity expresses the inorganic portion, while COD indicates the organic content



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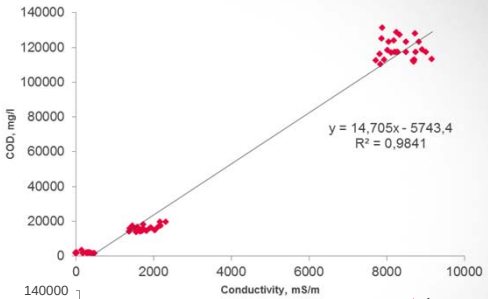
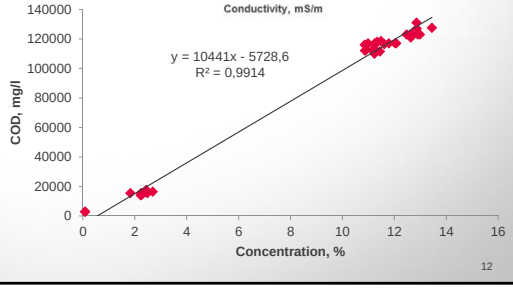
Correlation of COD and real time measurements in a wide concentration scale (14%)

- Conductivity



- TDS measured with a refractometer



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Correlation of COD and real time measurements in a narrow concentration scale (3%)

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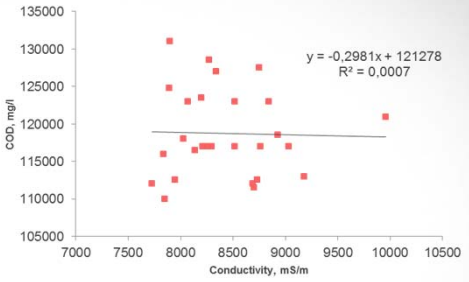
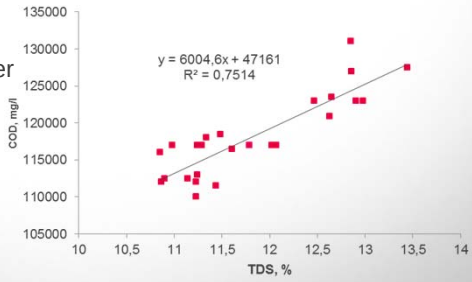
- Conductivity



- TDS measured with a refractometer



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Performance of the installed equipment

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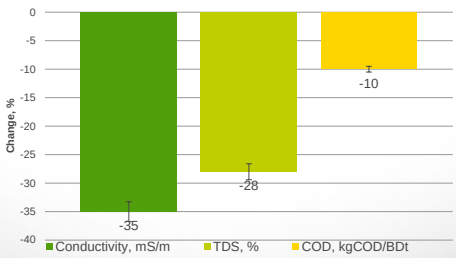
Control system	Conventional	Upper level
Production Adt/h	40,7	40,7
Dilution factor m^3/Bdt	3,87	3,77
TDS from liquor leaving the washing line, %	~14,5	+ 0,4
Wash loss to bleaching, kgCOD/BDt	18,1	16,2



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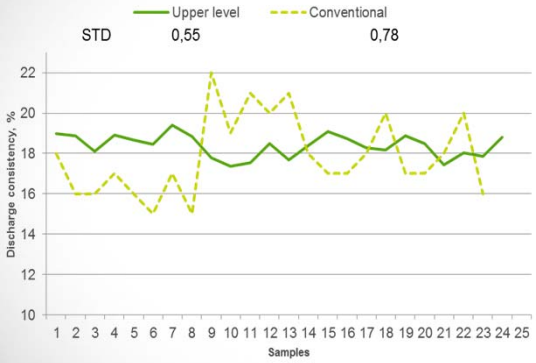
Reasons for enhanced performance
Discharge consistency



- In conventional control the drum discharge consistency changes significantly
- During the upper level control the consistency was steadier
- Believed to be the result of
  - drum torque control
  - control of dilution factor

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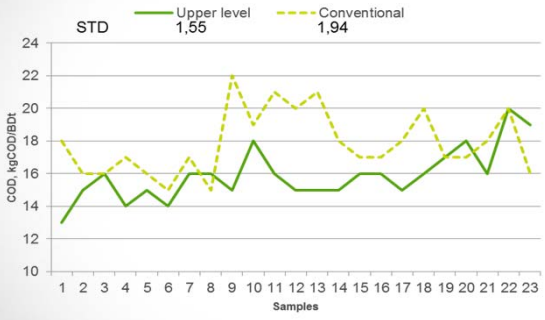
Reasons for enhanced performance
COD wash loss



- Wash loss measured as kgCOD/BDt was lower and steadier

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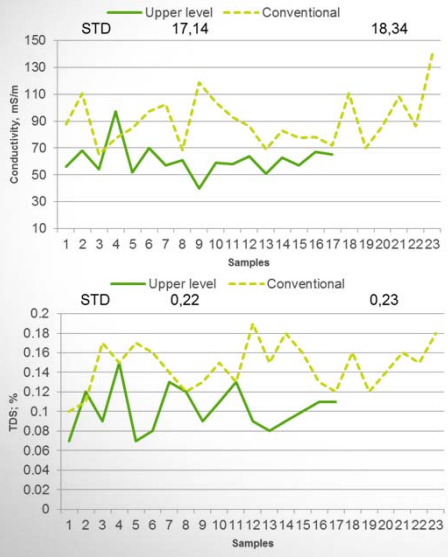
Reasons for enhanced performance Conductivity and TDS



- Wash loss measured in conductivity and TDS results steadier as well

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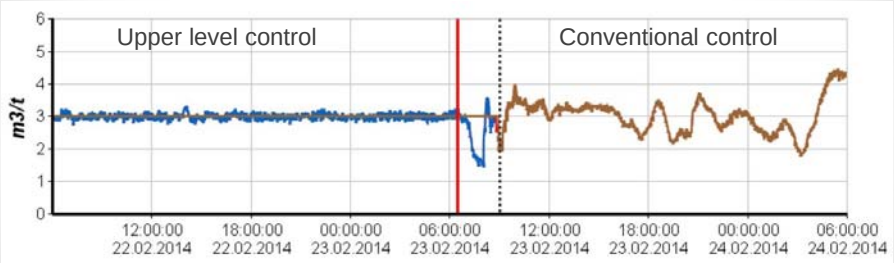
Effect of dilution factor control on measured dilution factor



- The dilution factor control evened out the dilution factor

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Effect of dilution factor on wash loss

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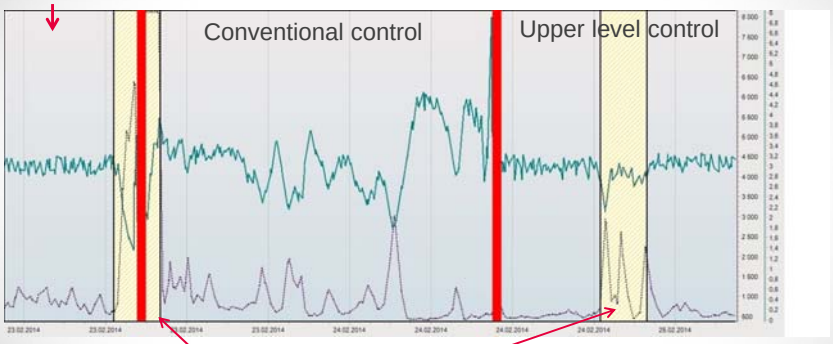
Upper level control



Process disturbances

- Steady dilution factor helps to cut off detrimental peaks in wash loss

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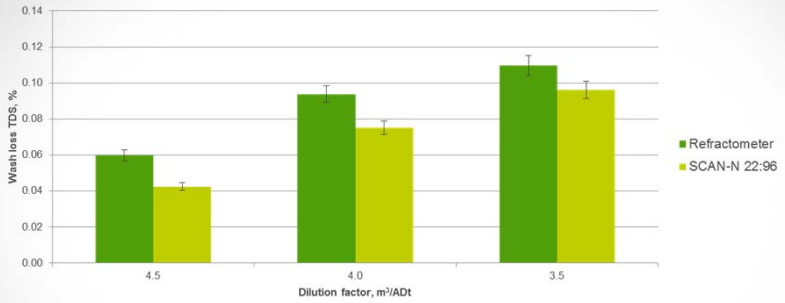
Effect of dilution factor on wash loss

K-PATENTS PROCESS INSTRUMENTS



- The results show up to 50 % change in wash loss when dilution factor was changed
- Wash loss measured with a refractometer and standard method correlate strongly, even in low consistency
- The level change between the two methods is due to different sampling points

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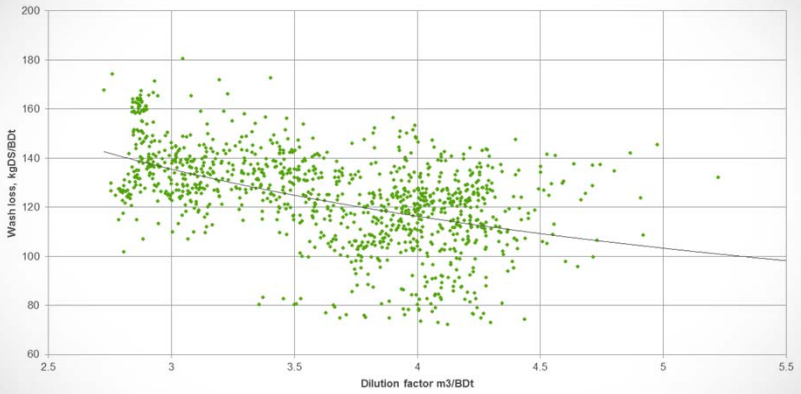
Effect of dilution factor on wash loss DD1 & DD2



- Increase in dilution factor lowered wash loss

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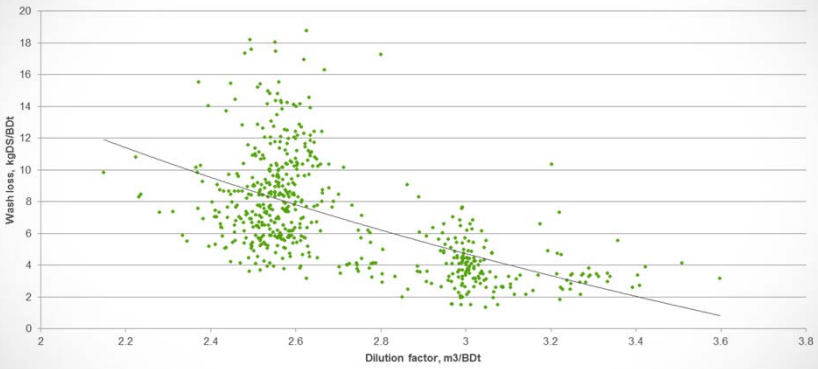
Effect of dilution factor on wash loss DD3



- Increase in dilution factor lowered wash loss
- Effect of dilution factor higher than in DD1 and DD3

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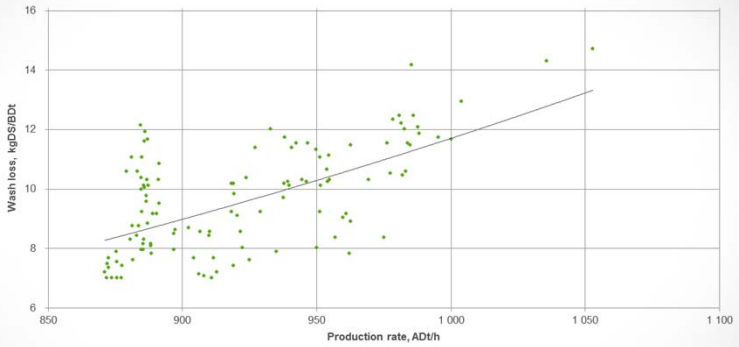
Effect of production rate on wash loss



- Higher production rate increased wash loss

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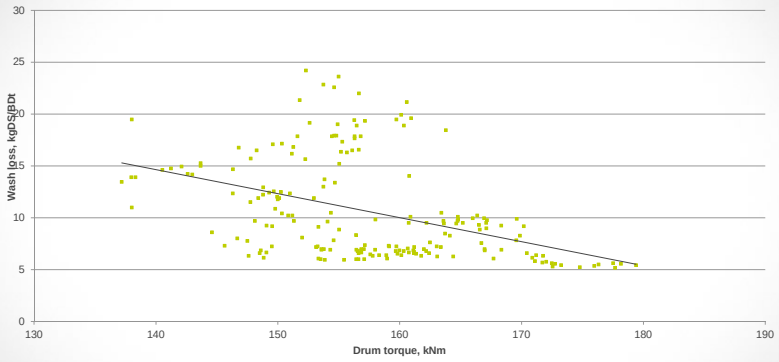
Effect of drum torque on wash loss



- Higher torque level delivers higher and more stable wash loss
- Torque under certain limit collapsed the washing result (here 160 kNm)

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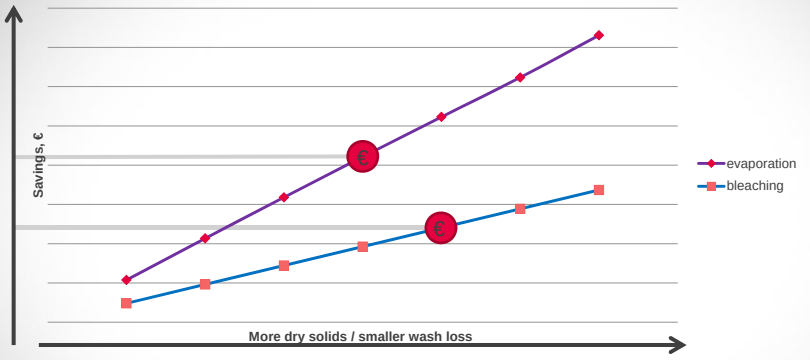
Investment payback time



- Engineering and hardware for upper level control system
- 8 refractometers
- Payback time according to performance trial was ~3 months

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Upper level control system. Conclusions

- By using an upper level control system to control the dilution factor of the washing line, by real time wash loss measurements as control feedback and by torque control of the washers it is possible to reduce the amount of wash loss and simultaneously decrease the amount of used wash water
- The control of the liquor balance enabled effective utilization of all wash water fed to the washing line
- The production feed forward and real time wash loss feedback for the dilution factor control proved the ability to maintain the wash loss on a desired level

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Wash loss measurements. Conclusions

- The refractometer measurement correlated significantly with COD, even in narrow concentration range. In the same range conductivity did not have correlation with COD
- The benefits of conductivity are quite a simple measuring device and minor capital cost. Refractometer has higher capital cost, but no maintenance costs and a longer lifecycle
- Refractometer provides the possibility to use performance parameters such as the E-value and the displacement ratio to continuously monitor and develop washing efficiency
- The possibility to carry out the measurement in pulp line is a unique advantage of the refractometer

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Thank you for your attention!

Any questions?

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