Washing Advanced Process Control Solutions
Pekka Tervola, Andritz Oy

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Washing Advanced Process Control Solutions

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ANDRITZ Automation Solutions

•Engineered Systems

•Advanced Process Control

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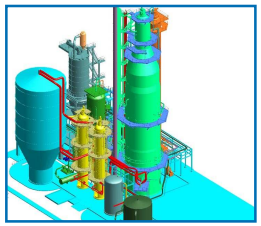
•Instruments



•Simulation

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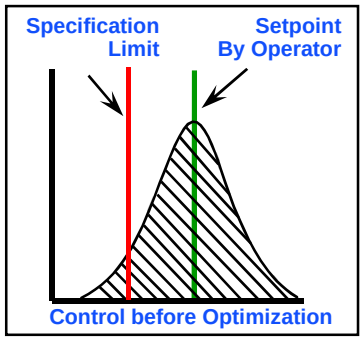
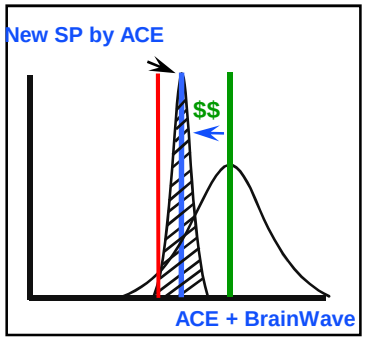
Advanced Process Control Solutions to Reduce Energy and Chemical Consumption in Brown Stock Washing

Automation

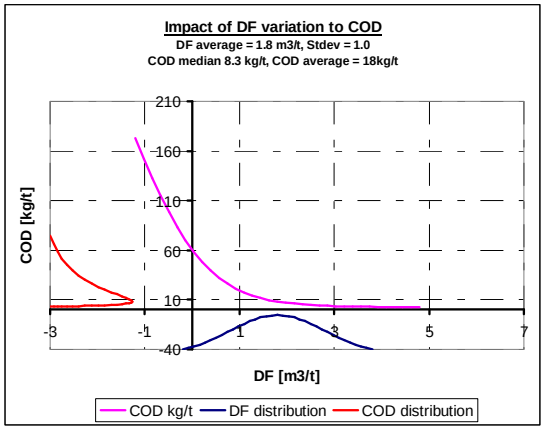
Impact of the process stabilization to decrease costs

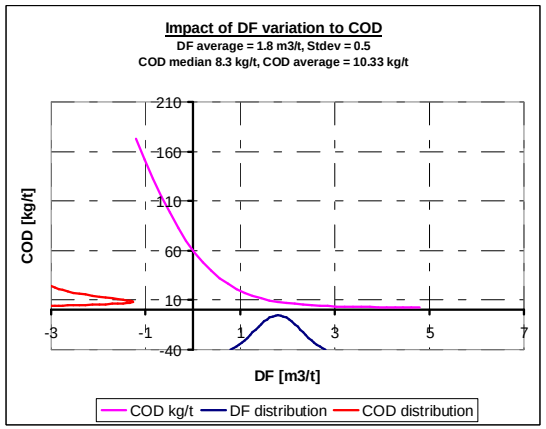
1. With lower standard deviation the setpoint can be moved closer to specification limit (less safety margin).





2. With nonlinear processes controls can reduce costs even without moving setpoint closer to specification limit.





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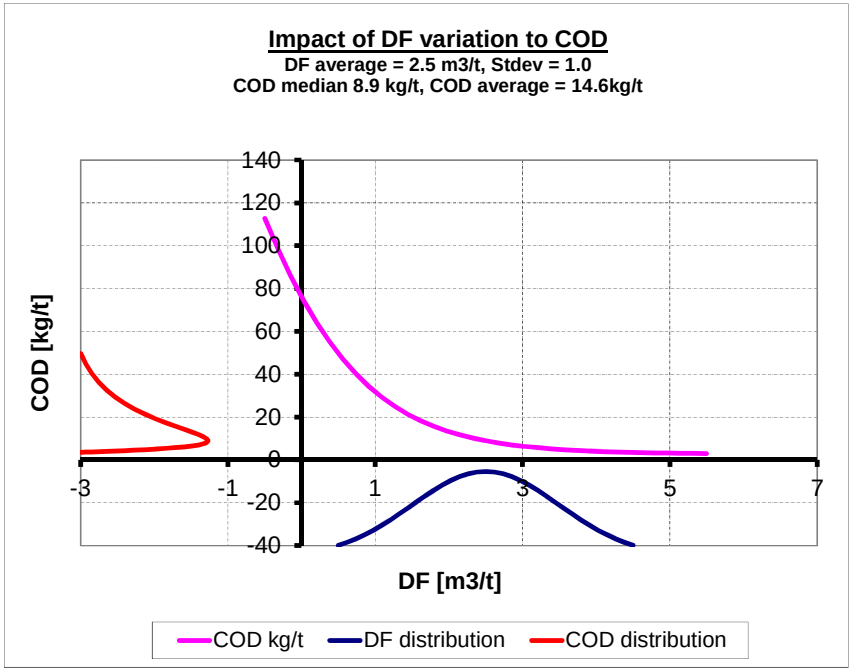
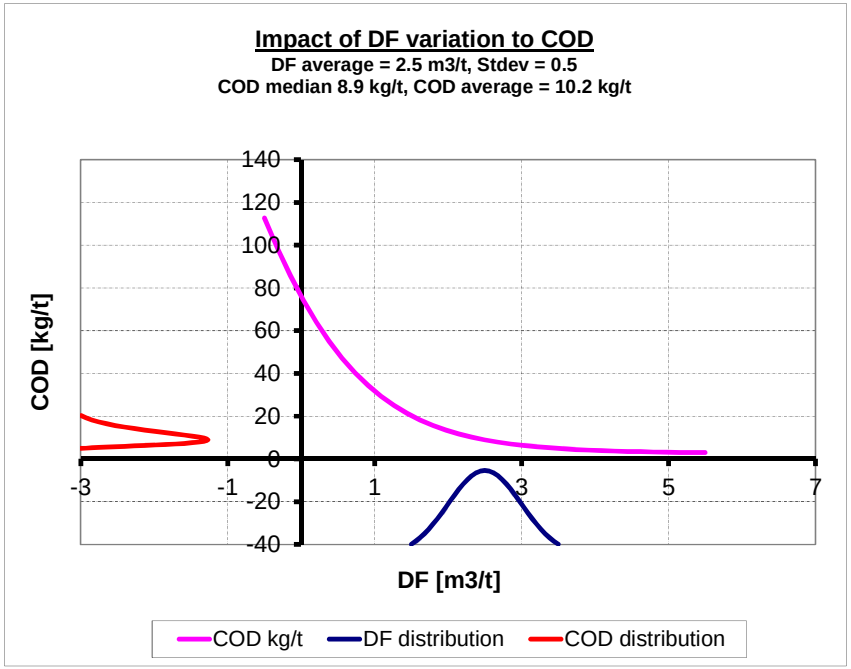
Effect of variation in nonlinear processes to costs

Benefits without moving setpoint closer to specification limit

- Balance calculation gives a median value of the controlled variable that is rarely same than average with nonlinear process like washing, bleaching or even consistency control.
- Calculated example from washing where stdev has been decreased to half.
  - Assumed that E10 after the digester would be 14.
  - Clearly COD average is lower with lower DF variation





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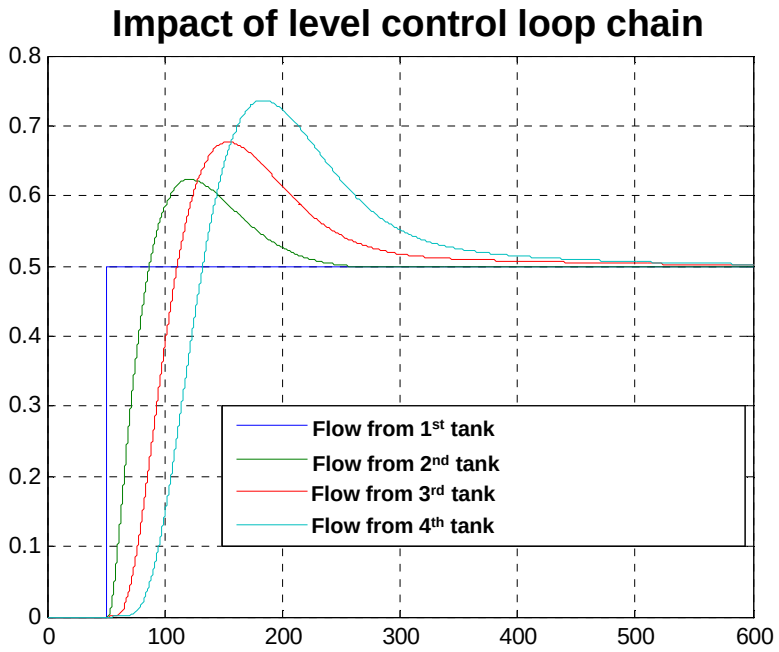
Washing filtrate tank level control strategy

- PI control will always try to reach to it's setpoint.
- In level control this will mean that if the level decreases the flow controlling the level should go over the equillibrium to drive level back to the setpoint.
- This will mean that in the level control chain the standard deviation always increases going further away from the point that dictates the average flow through put.
- Level control with the integrating term (usually PI control) will increase the standard deviation of the dilution factor in the level control chain.
- Better result can be achieved by using multivariable MPC control with the penalty when moving the flow setpoint.
  - MPC will calculate a control trajectory so that the Flow setpoint changes are minimized.



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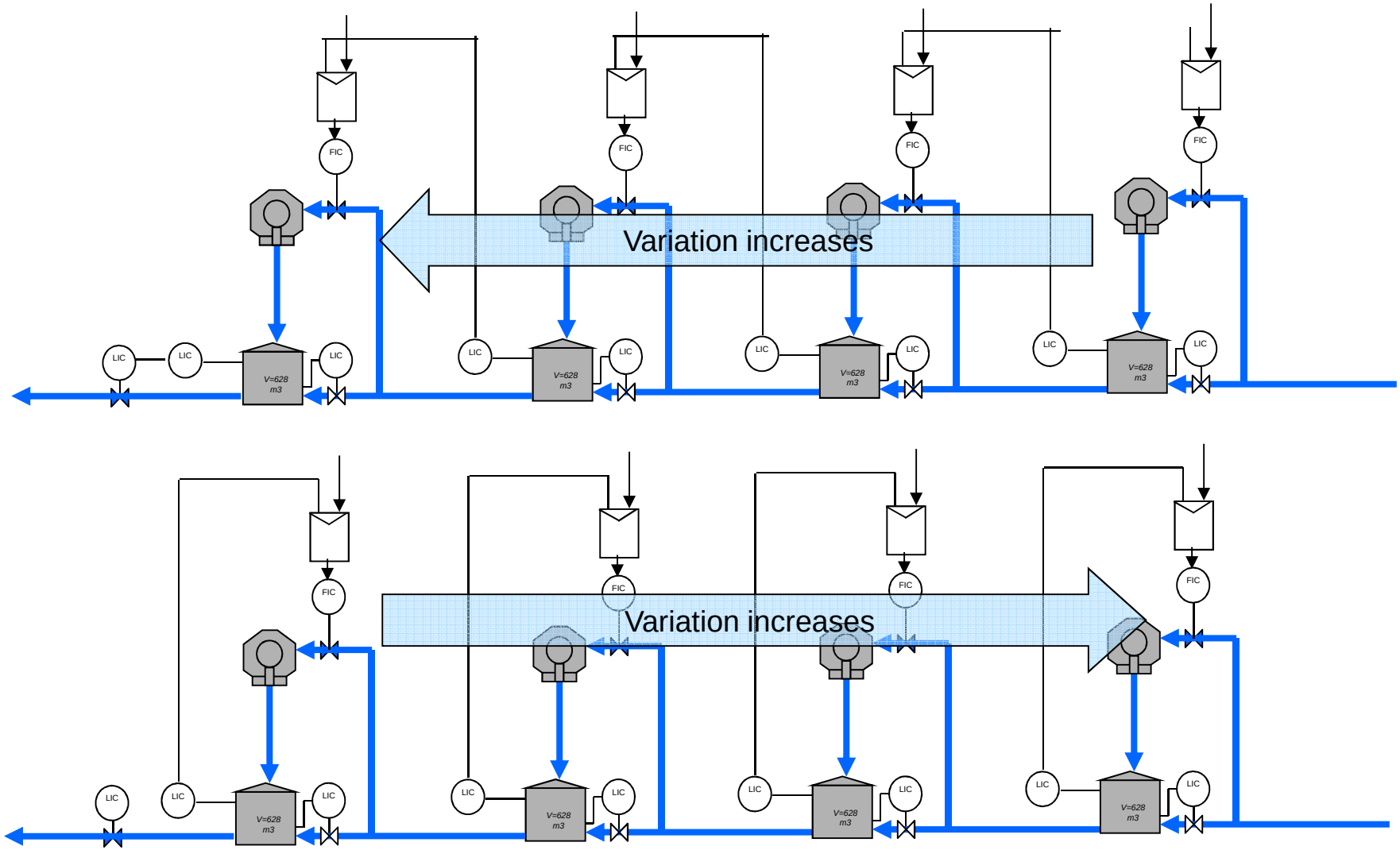
Level controls in washing



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BrainWave & ACE for Brown Stock Washing

- Brownstock ACE & Brainwave controls can be divided to
  - Single equipment advanced controls
  - Washline advanced controls.

BrainWave®

- Examples of single equipment advanced controls:
  - Diffuser washer load controls
  - DD washer rotational speed controls
  - Wash press torque controls
  - Screening consistency optimization
  - Pressure thickener controls
  - Intermediate tank level controls
  - Consistency controls
  - ...

- Wash line advanced control:
  - Filtrate balance controls
  - COD and dry solids to evaporator controls.
  - Wash line DF optimization.

ACE ®

- Both of these utilize Brainwave + ACE functionality.

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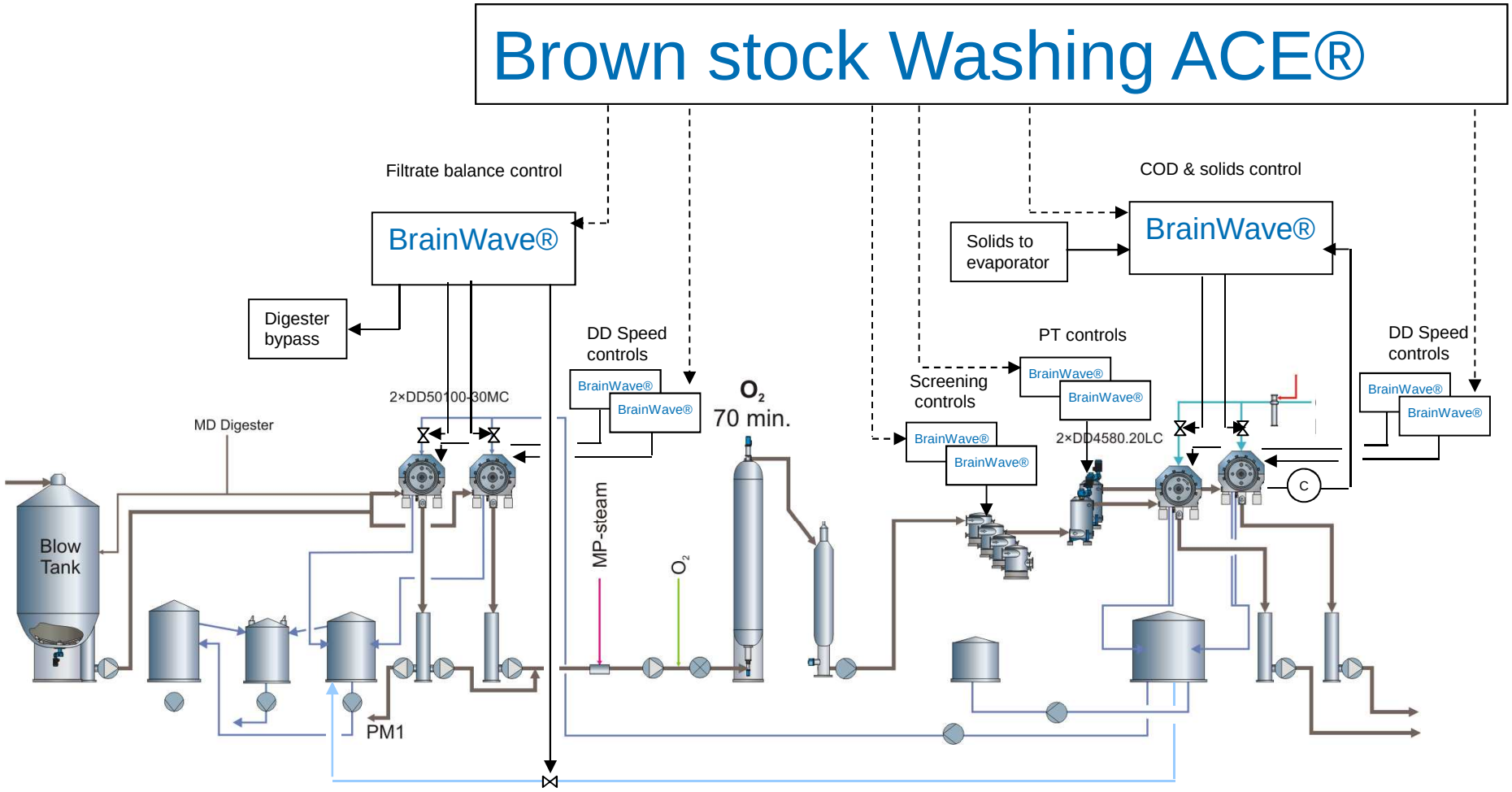
BrainWave & ACE for Brown Stock Washing

BrainWave & ACE Controls



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Single equipment Advanced controls

- Often Advanced control is considered only as higher level controls and operation of equipments are not optimized.
  - With complicated brownstock line some disturbances can have so big impact that even good higher level control can be in troubles if equipments in disturbances are not operated well.
- Example from screening could be that knotter motor load goes high and operator decreases the inlet consistency setpoint.
  - Consistency setpoint will stay low usually much longer time than it is needed. This might lead to poor washing and unusually high carry over to bleaching.
  - This can be improved by first improving consistency control then changing setpoint so that the disturbances are taken account
- Common to all single equipment ACE controls are that they are designed to
  - stabilize the process → get rid of the variation.
  - Try to run close as possible to constraint by taking account the performance of process (or control).
  - Manage disturbances → during disturbance give extra safety margin and when disturbance is gone reduce safety margin. Operators tends to leave big safety margin for a long time.

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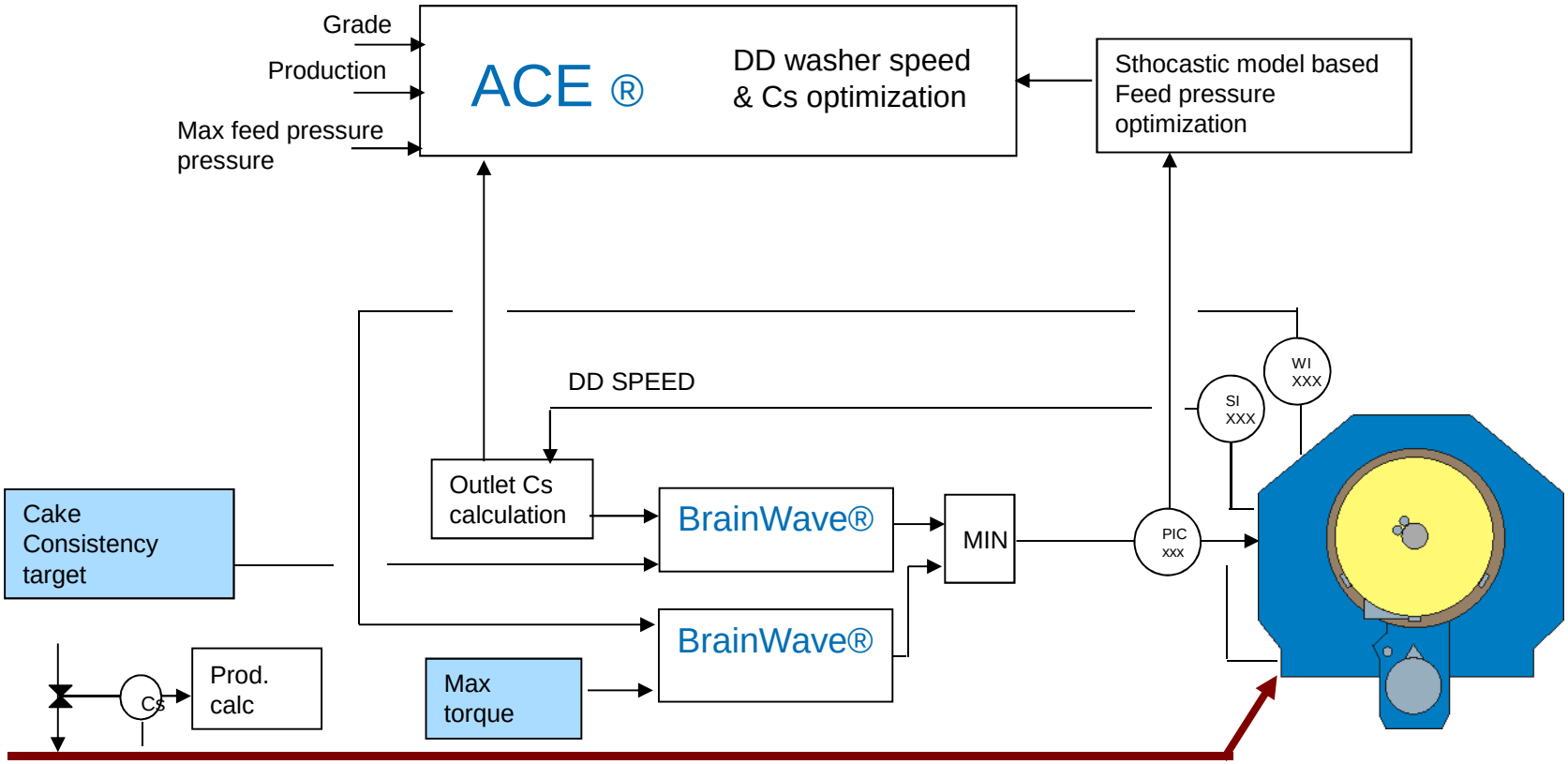
single equipment advanced control, Washer specific control, DD speed control example



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Examples of the benefits got from single equipment advanced controls

- Diffuser load control
  - Average Consistency +1%-units
- DD Washer rotational speed control
  - Average Consistency +1%-units - +3%-units
- Washpress torque control
  - Average Consistency +3%-units
- Screening consistency optimization
  - Knotter interlocking frequency -80%
  - Screening feed consistency +0.5%-units
- Pressure thickener controls
  - Average outlet consistency 6.5% -> 8.2%
  - Average outlet consistency 4.5% -> 5.7%

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Wash line controls Targets

- Main targets
  - Stabilize filtrate balance
  - Stabilize the Carry over (COD, sodium) from washing to the following O_2-stage or bleaching stage
  - Stabilize Weak Black Liquor Solids
  - Help minimizing the use of wash water
- Measurements
  - Normal wash liquid flow measurements,
  - Buffer and filtrate tank level measurements, and
  - Refractometers (COD) or Conductivity measurements
- Controlled variables
  - Total Dilution Factor in all washers [m3/ADt]
  - Washer bypass amounts

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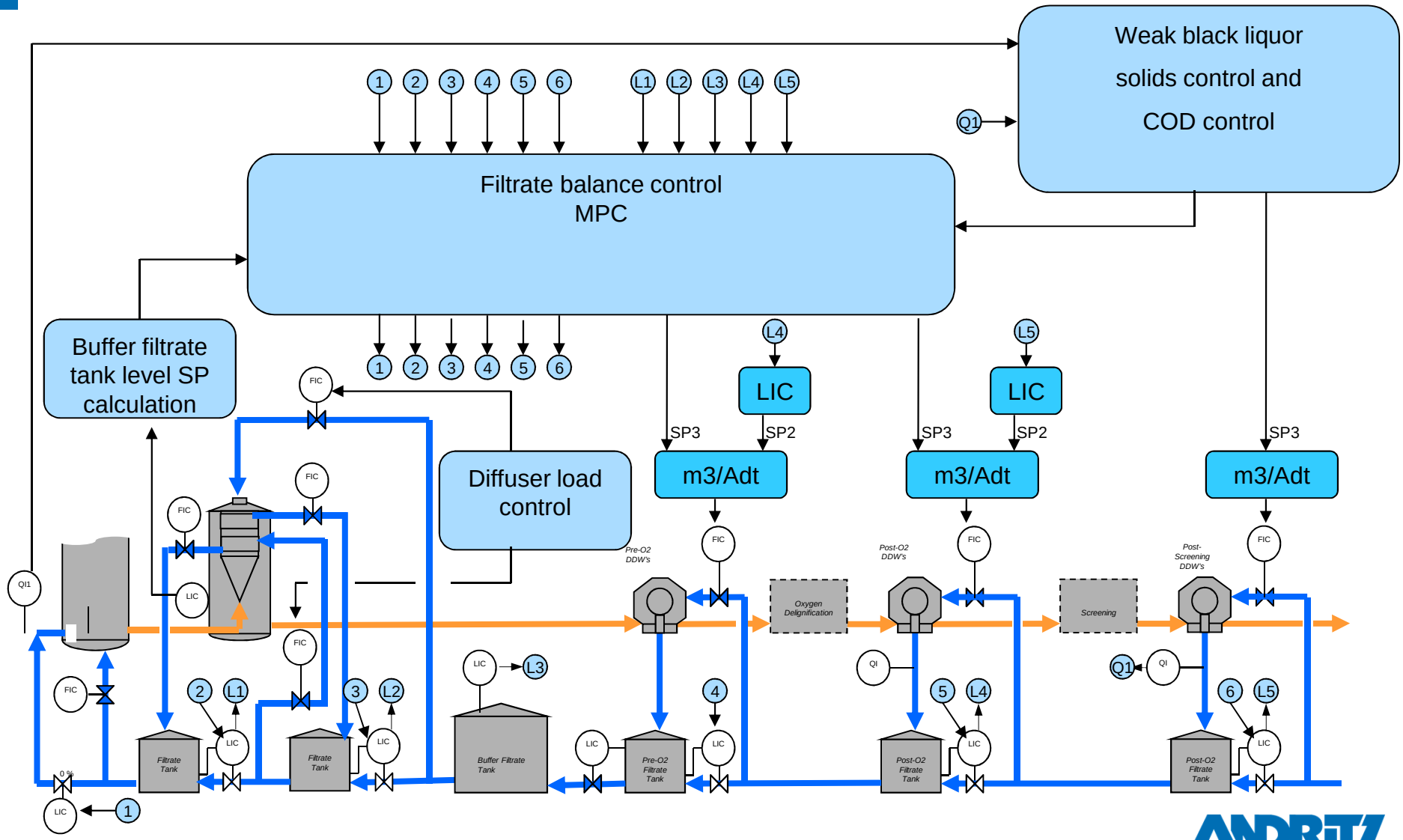
Washing ACE, example of wash water controls



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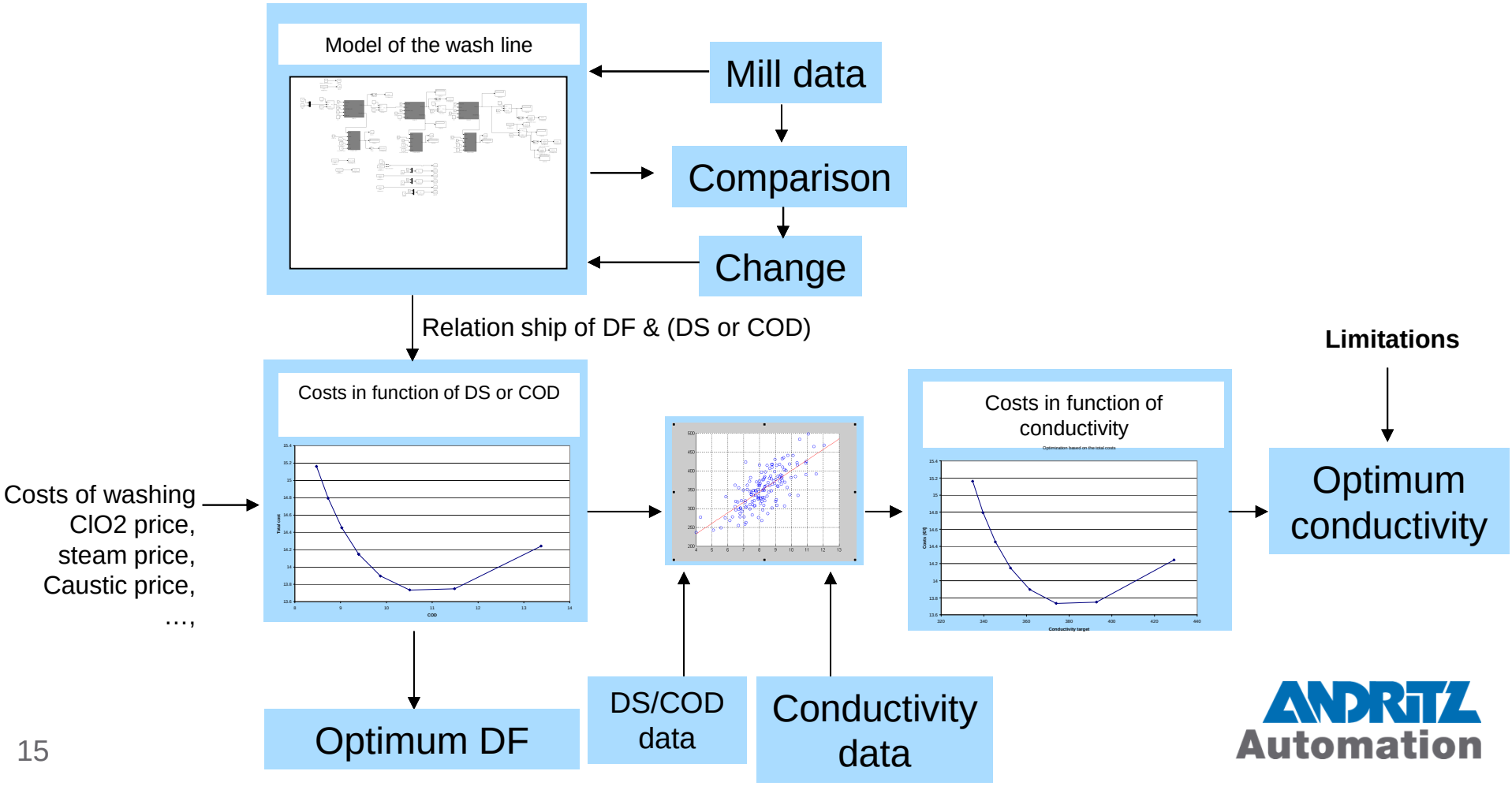
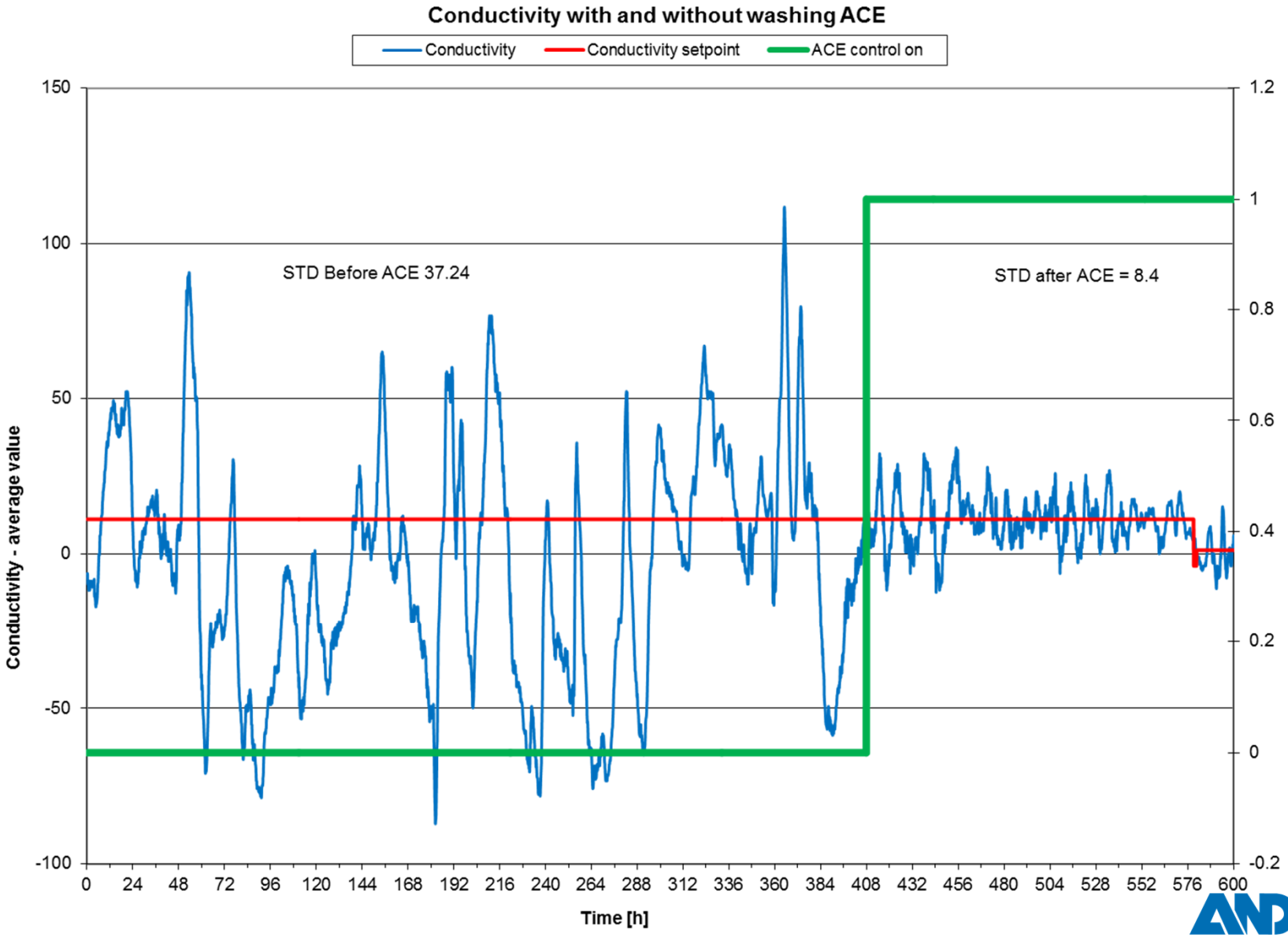
Washing COD / conductivity target optimization

COD kustannus optimointi

- DS or COD Target optimization is used to drive process to lowest costs



BrainWave & ACE for Brown Stock Washing



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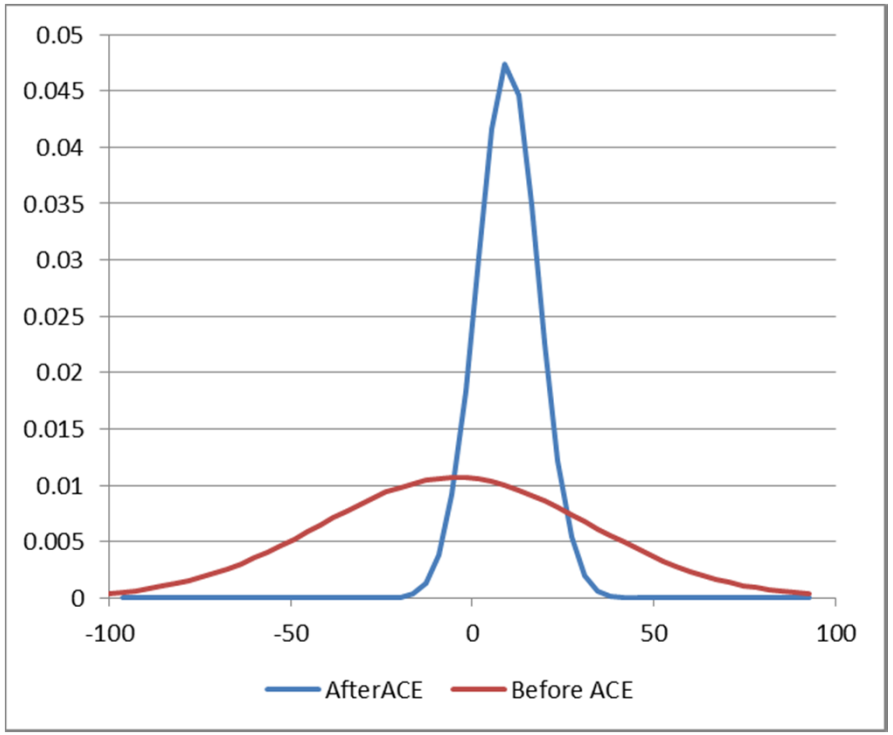
BrainWave & ACE for Brown Stock Washing

- About 75% standard deviation decrease in this application.

Normal distribution of conductivity



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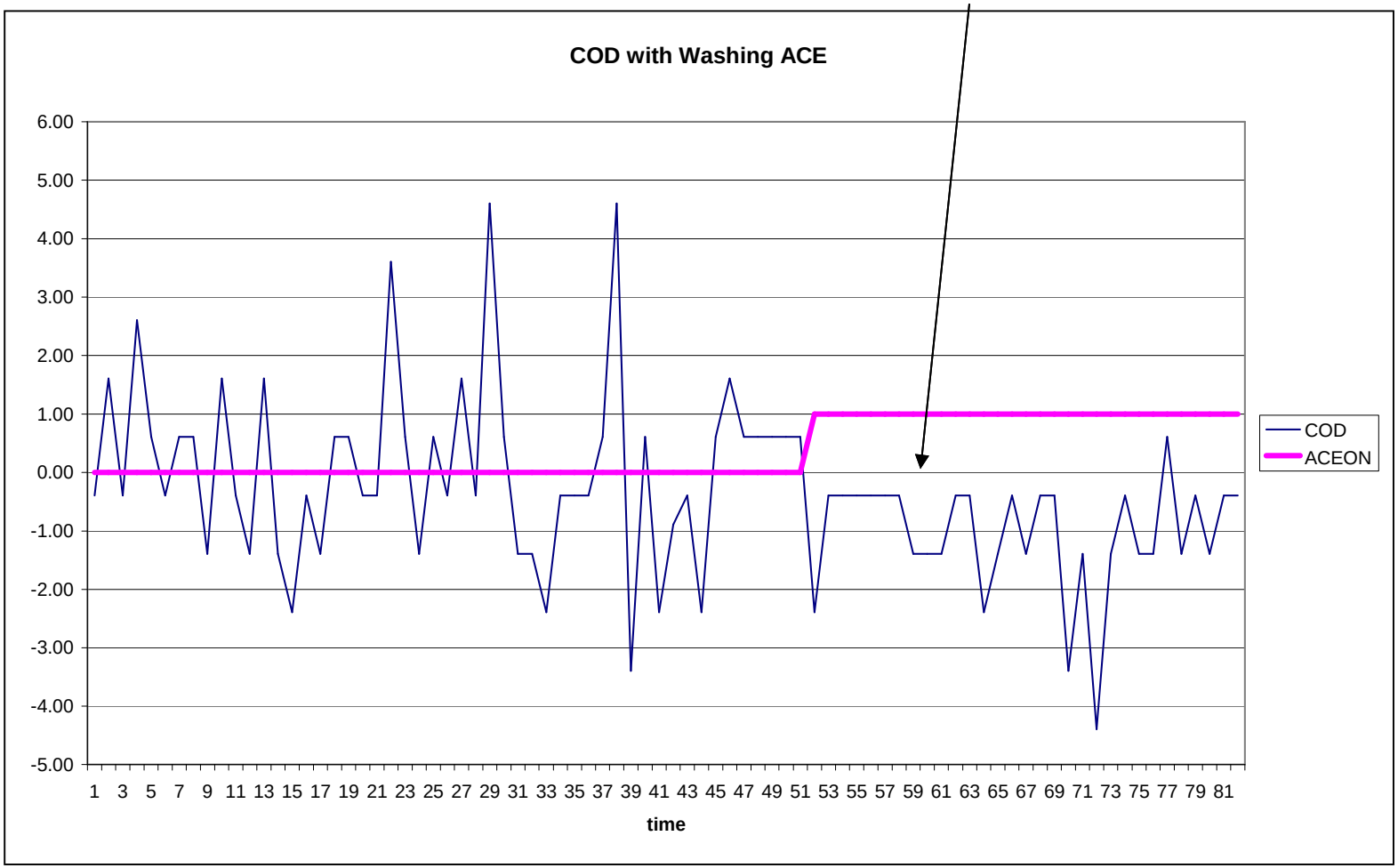
BrainWave & ACE for Brown Stock Washing

WashingACE Results – Pulp Mill Finland

Carryover reduced 20%



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Washing ACE results in mill X

- 600 000 t/a mill
- Solids to evaporator increased 0.6%-units in solids%
- Fresh water usage reduced 10%.
- Evaporator steam yearly savings 270k€

- COD std decrease 79%
- COD average decrease 20%
- Savings from the bleaching chemicals 169k€
- Savings from the sodium losts 47k€
- Savings from lost of organic fuel 70k€
- Savings from lost of urea savings in waste water treatment 10k€

- Total yearly savings = 567k€

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We accept the challenge!

Thank you for your attention!

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