# Valmet SDO, Automated Optimization of Centrifuge Dewatering Process Fountain Valley, CA

Tony Guerra – Regional Manager, West Coast/Mexico

Tony.guerra@valmet.com

Shirley Johnson – Regional Manager, Midwest/South

Shirley.Johnson@valmet.com

July 18, 2019

# Valmet in brief

MEMBER OF
Dow Jones
Sustainability Indices
In Collaboration with RobecoSAM

- We are the leading global developer and supplier of technologies, automation and services for the pulp, paper, energy and process industries. Valmet's vision is to become the global champion in serving its customers.
- We have over 13,000 professionals around the world working close to our customers.
- Net sales in 2018 were approximately EUR 3.3 billion. Valmet's objective is to become the global champion in serving its customers.


Valmet

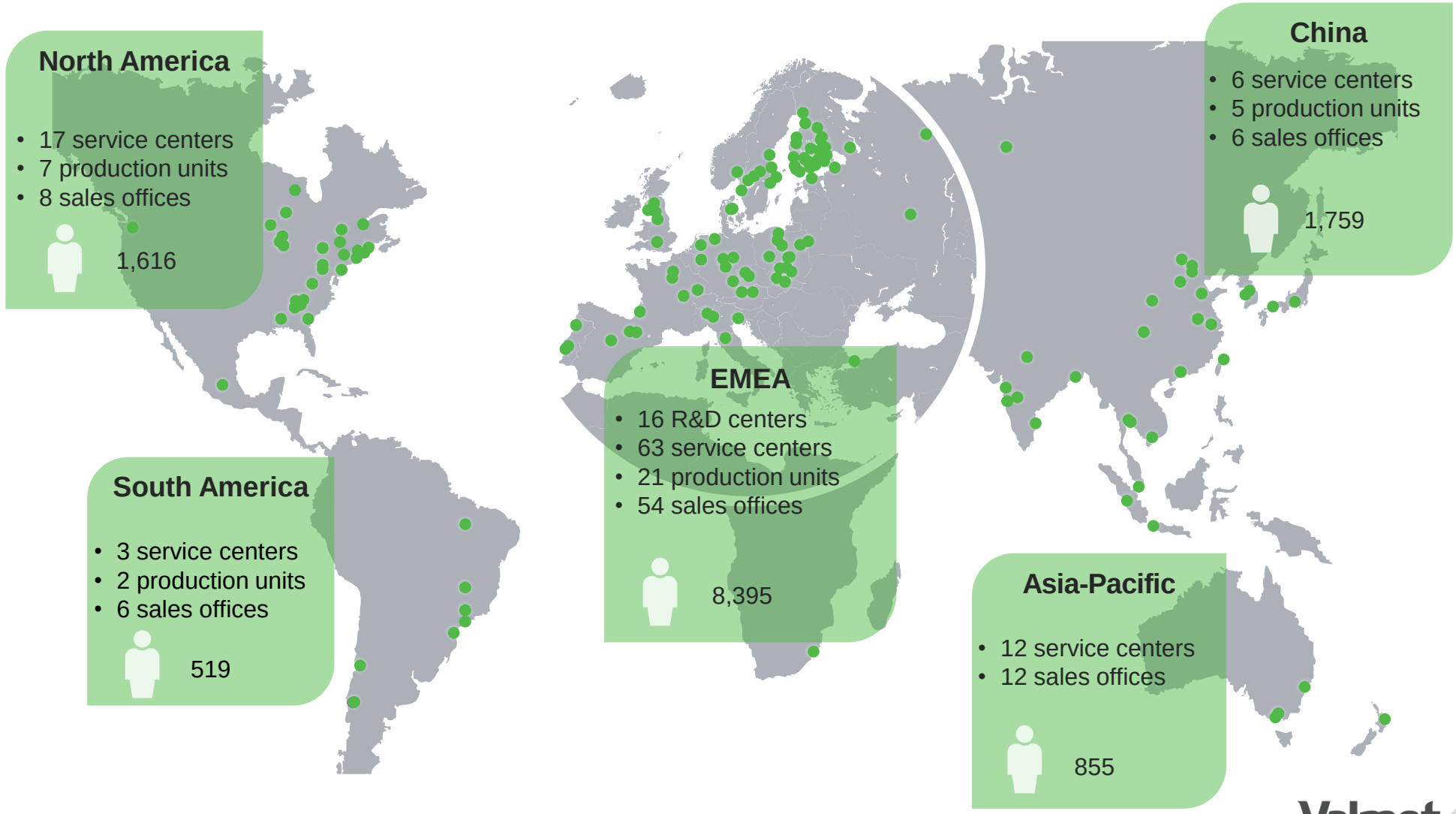
# Strong, global presence is a good platform for growth

## Over 100 service centers, 85 sales offices, 35 production units, 16 R&D centers

**Wastewater Partners globally**

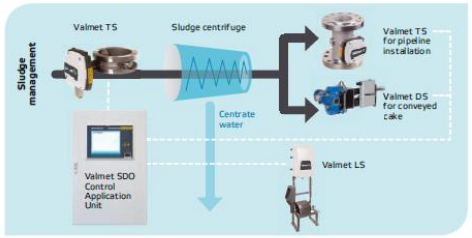
***In Southern Cal Valmet partners with CP Crowley Company***

**In USA, all engineering, inventory and support based in Atlanta GA with over 30 service technicians spread around the country.**



# Valmet offering for wastewater management

## Advanced measurement technology and controls for municipal & industrial wastewater dry solids management

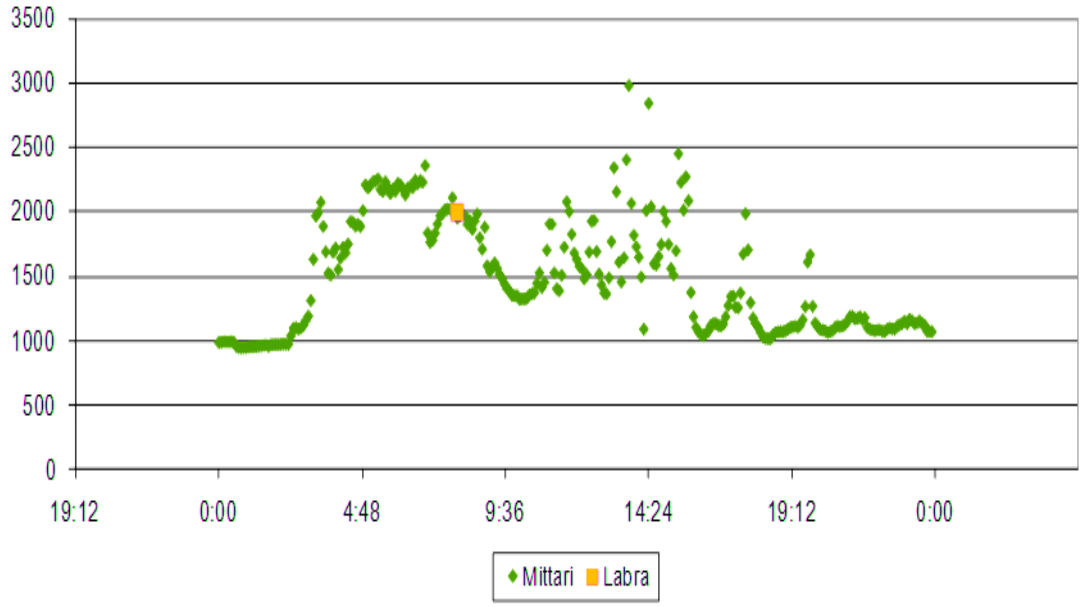



- Valmet Total Solids Transmitter (Valmet TS)
- Valmet Low Solids Measurement (Valmet LS)
- Valmet Dry Solids Measurements (Valmet DS)
- Valmet Nove, Nove H samplers
- Valmet SDO, Sludge Dewatering Optimizer
- Valmet DNA automation system

# Challenge the way to optimize

- The current way to provide data to operators is typically based on grab samples which only provide a “snapshot” of what the process is doing at a specific point in time.
- Old generation sensors like optical devices tend to have minimal usefulness due to high maintenance needs, difficult calibrations and low of measurement volume, loosing operator confidence.
- First time is complete automation system is available with all measurements and controls proven in the field.



# Valmet Sludge Dewatering Optimizer (Valmet SDO) and associated measurements

## Valmet Solids Measurement Technology

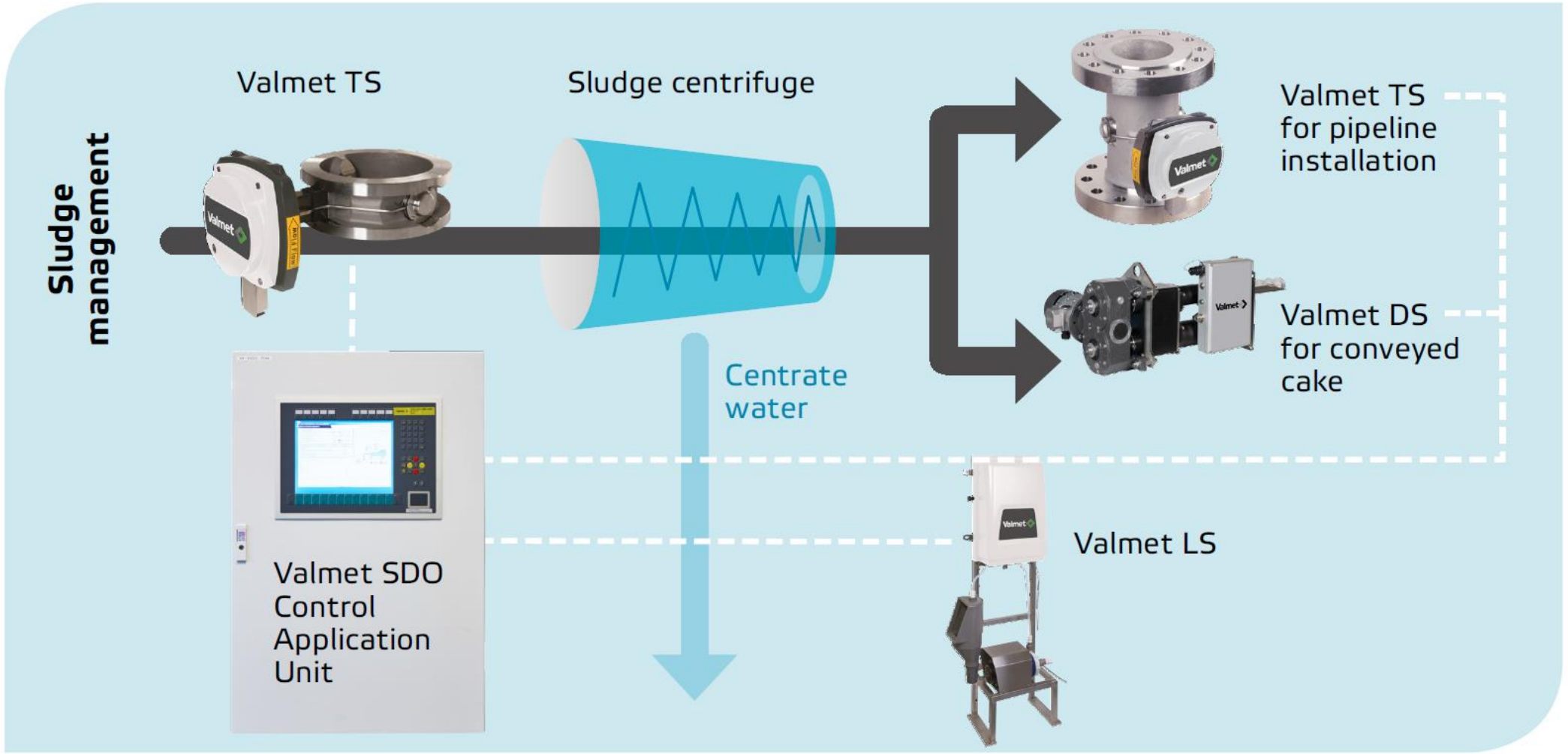
- Proven Technology
- All centrifuge solids measurements covered
- 40 years experience of industrial solids measurements
- Reliable real-time results

## Valmet Sludge Dewatering Optimizer

- Multivariable Controls
- Reliable hardware
- Application developed with customer involvement
- 24/7 Optimization

Valmet's combination of Multivariable Control together with accurate and reliable real-time measurements is unique to the wastewater industry

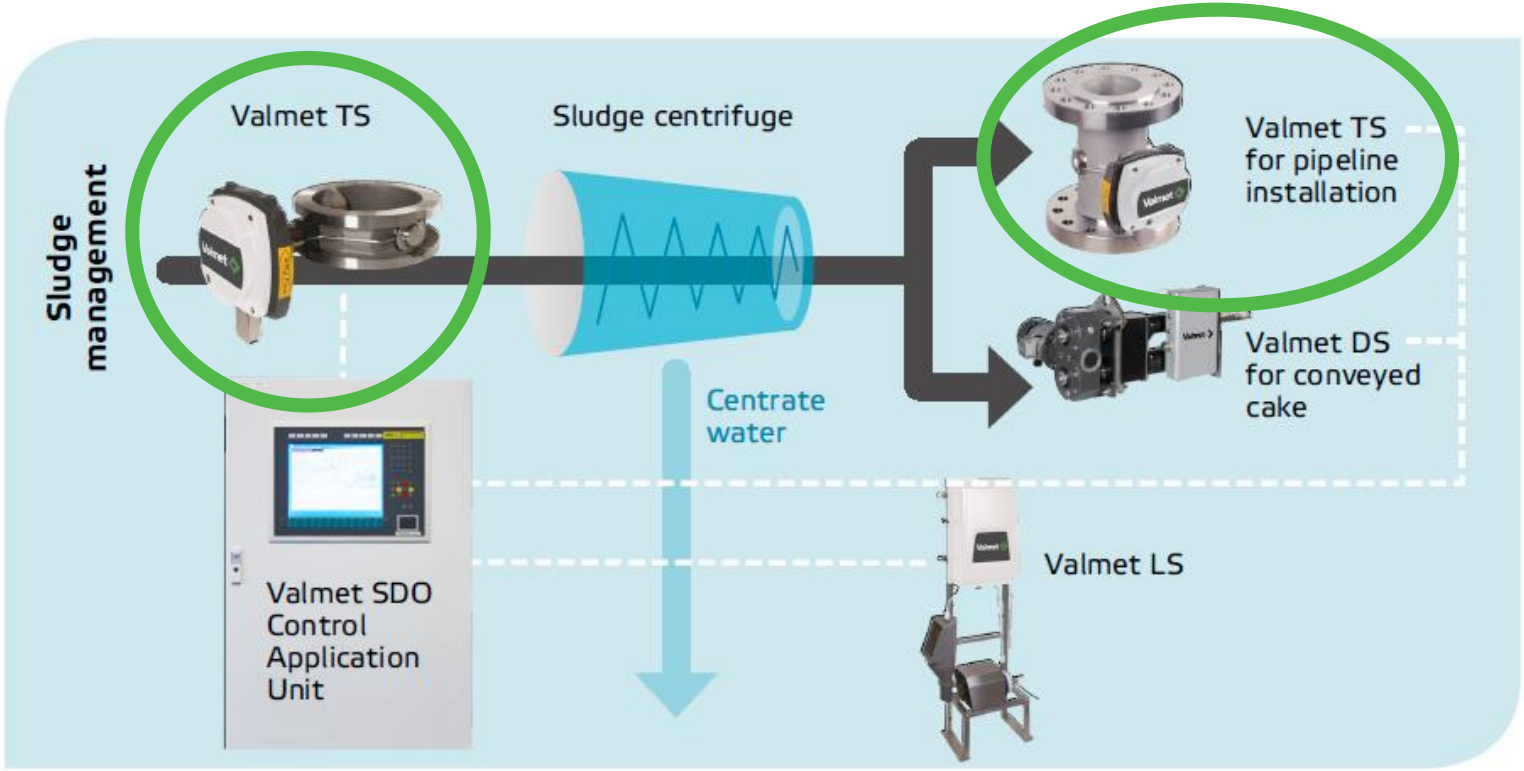
# Valmet Sludge Dewatering Optimizer (Valmet SDO) and associated measurements



# Valmet TS

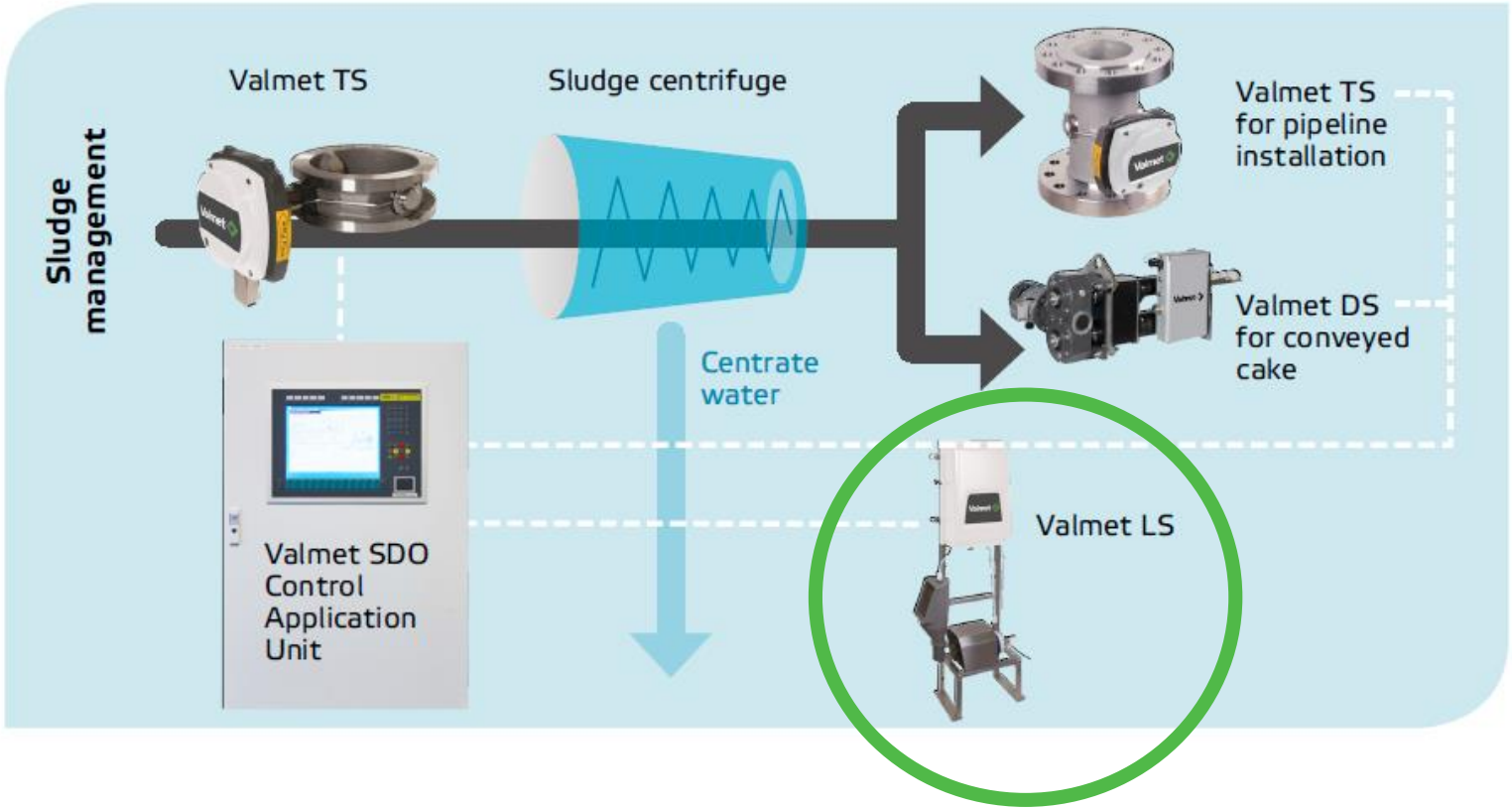
Microwave Total Solids Transmitter


- Measuring Total solids 0…40 %TS
- Real-time measurement
- Wide Application Range
- Flow Through Design
- Minimal Maintenance
  - No Moving Parts
  - Single Point Calibration
- ATEX certification
- Glass Lined Version Available
- High Pressure PN100 available
- Communication 4-20mA, HART, Profibus PA



# Valmet LS

Low Solids Measurement

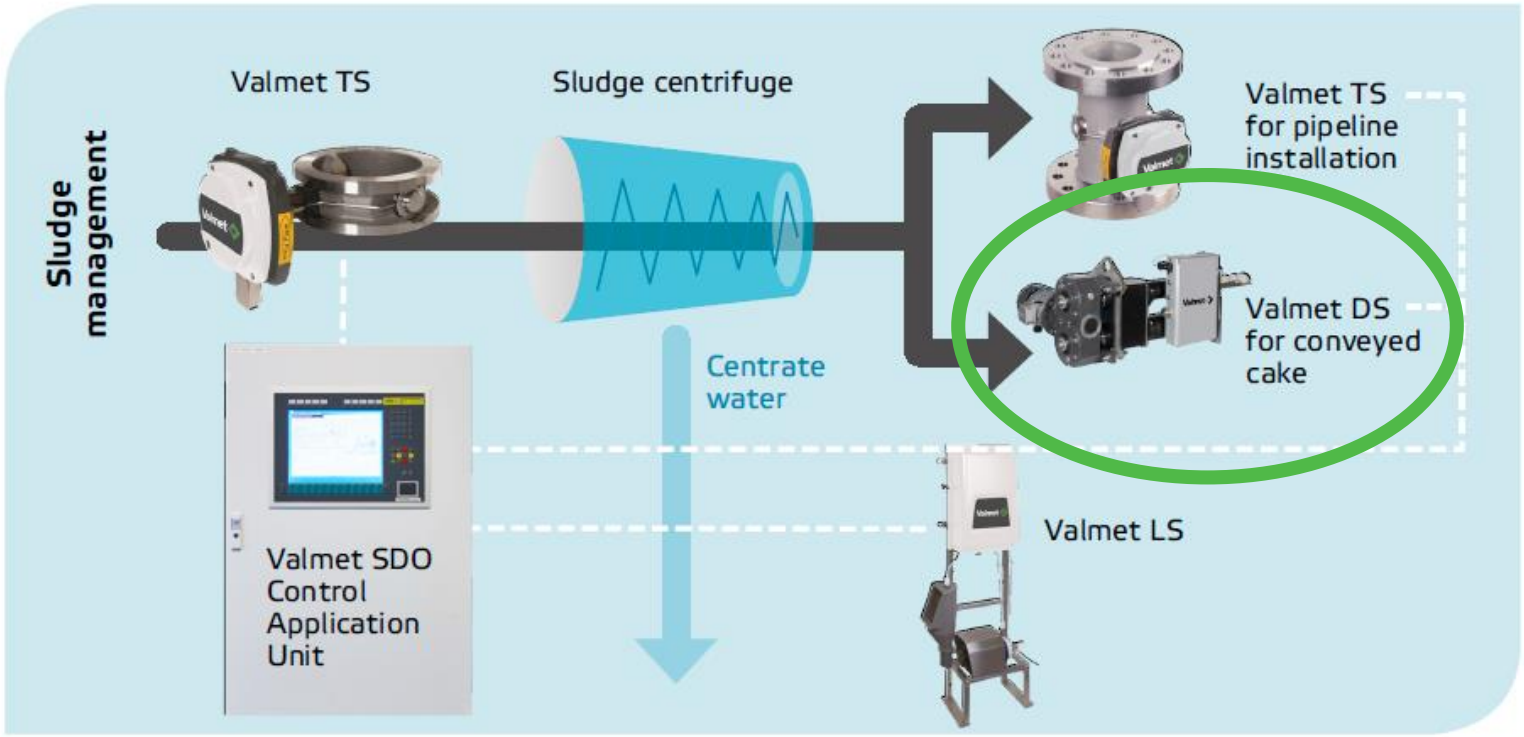



- Measuring Total solids 0 – 0.5%
- Designed for centrate real-time measurement
- 2 LED Light Sources
- De-Aeration, Screening included
- Automated flushing and chemical cleaning included
- Diagnostic and verification with clean water
- Communication 4-20mA, HART

# Valmet DS

Dry Solids Measurement


- Measuring Total solids 15% TS and above
- Designed for Waste Water Treatment plants
- Real-time measurement
- Falling Cake Flow
- Communication 4-20mA



# Centrate TSS Dry Cake TS interactions

Difficult to control with separate loops but easy with Valmet SDO MPC technology


**Manipulated variables**

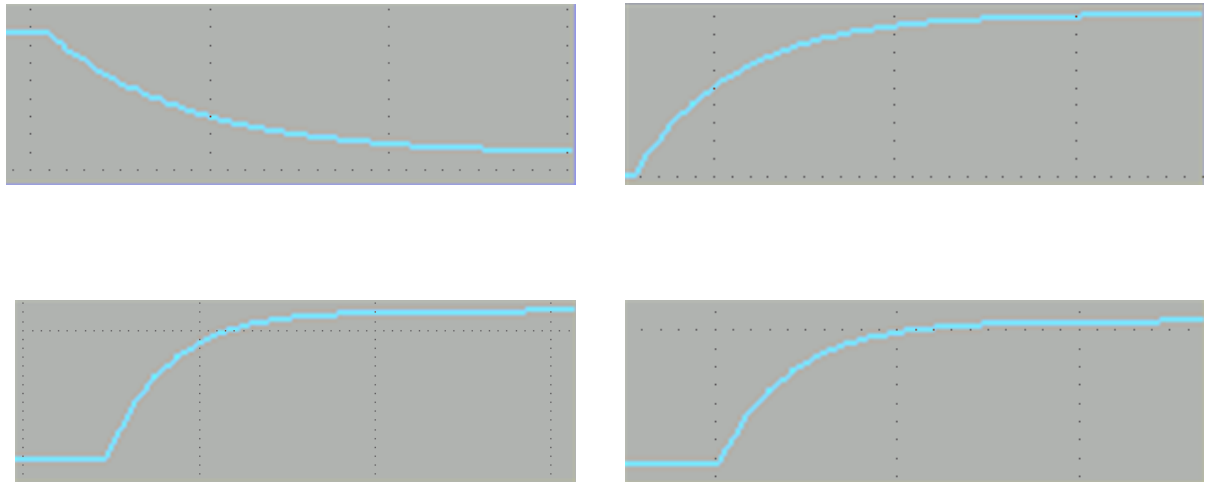
Polymer

Torque

**Controlled variables**

Centrate TSS

Dry Cake TS



# Modular application structure

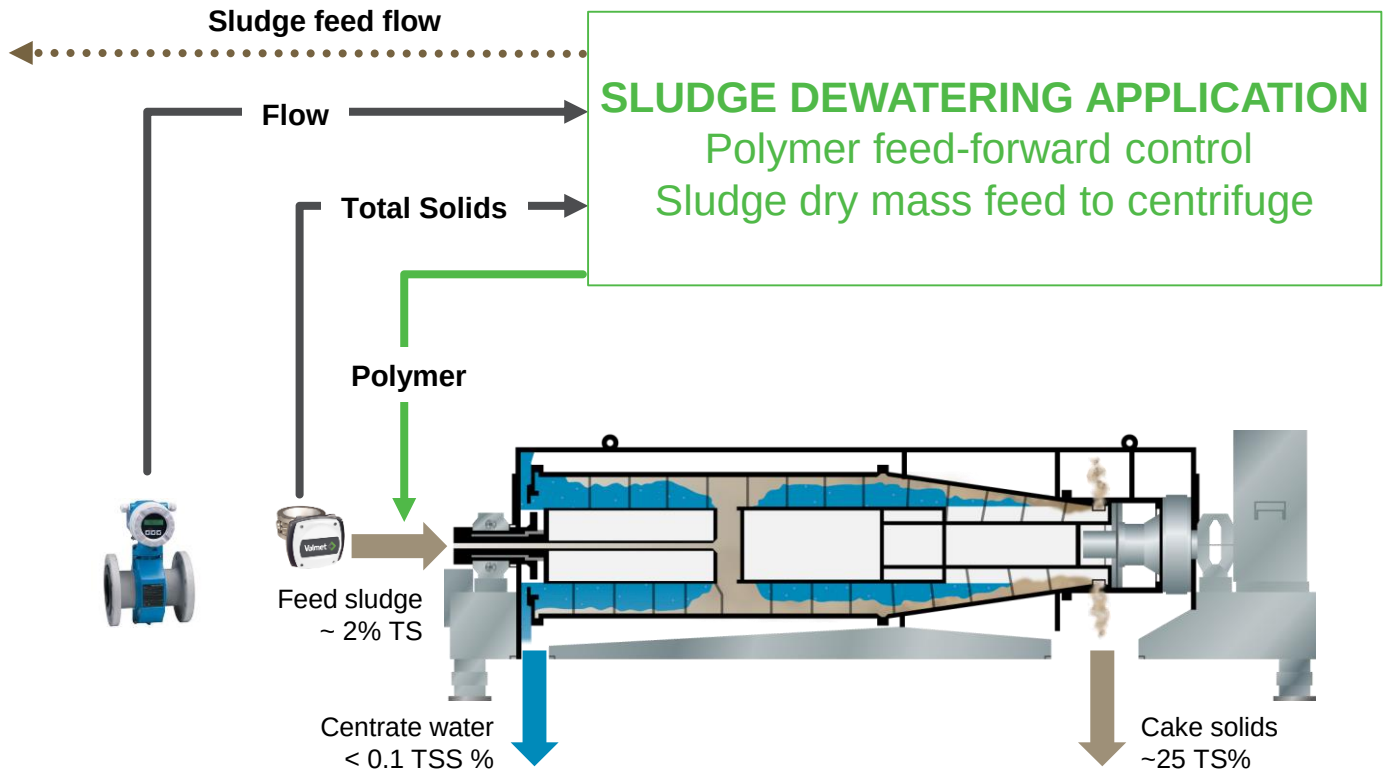
## First step

### Input Values

- Valmet TS before the centrifuge
- Flow measurement before the centrifuge

### Output values

- Polymer setpoint
- Sludge feed flow setpoint



# Modular application structure

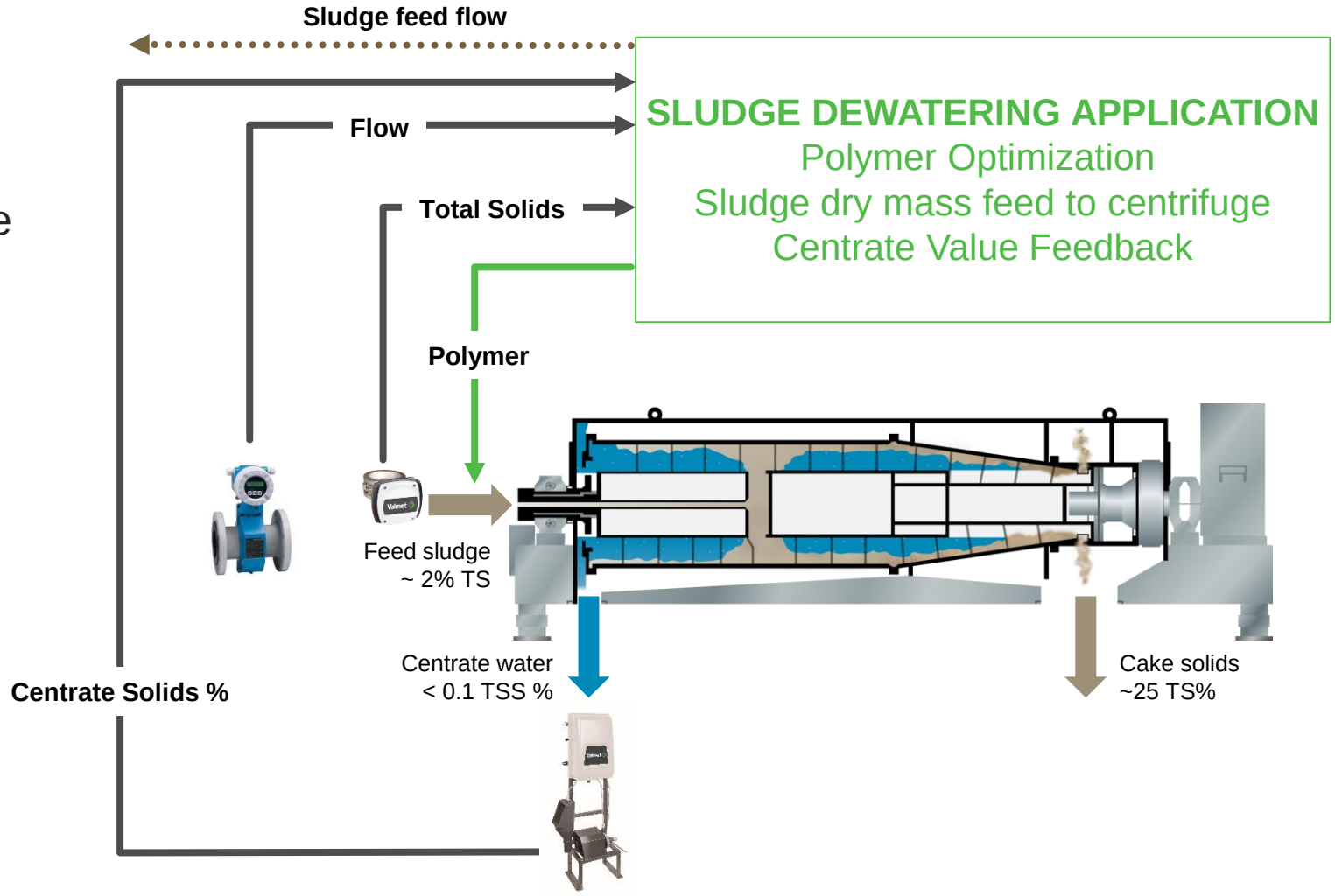
## Second step with option #1

### Input Values

- Valmet TS before the centrifuge
- Flow measurement before the centrifuge
- Valmet LS Measuring Centrate Solids %

### Output values

- Polymer setpoint
- Sludge feed flow setpoint



# Modular application structure

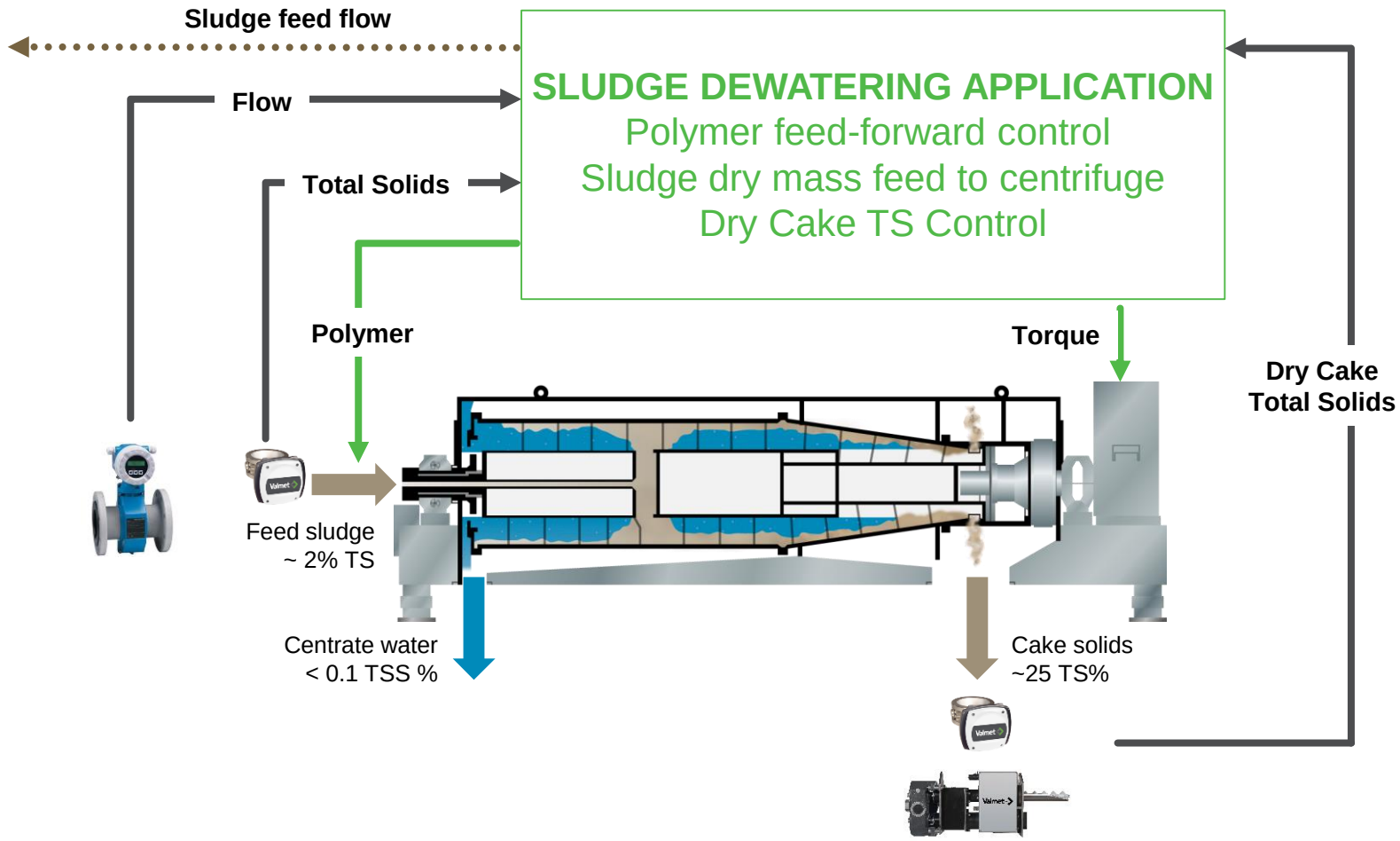
## Second step with option #2

### Input Values

- Valmet TS before the centrifuge
- Flow measurement before the centrifuge
- Valmet TS or DS Measuring Dry Cake Solids %

### Output values

- Polymer setpoint
- Sludge feed flow setpoint
- Centrifuge torque setpoint



# Modular application structure

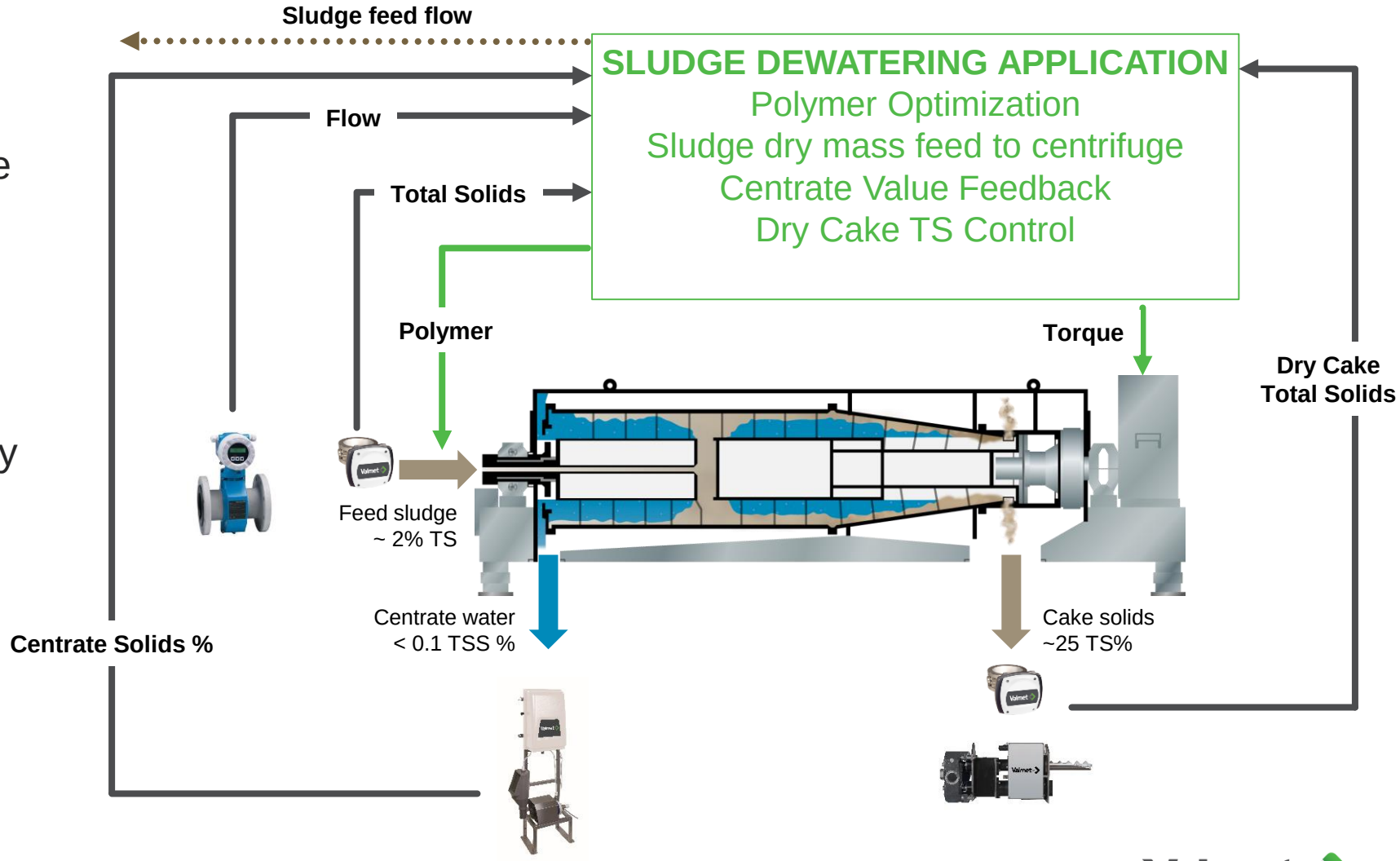
## Third step

### Input Values

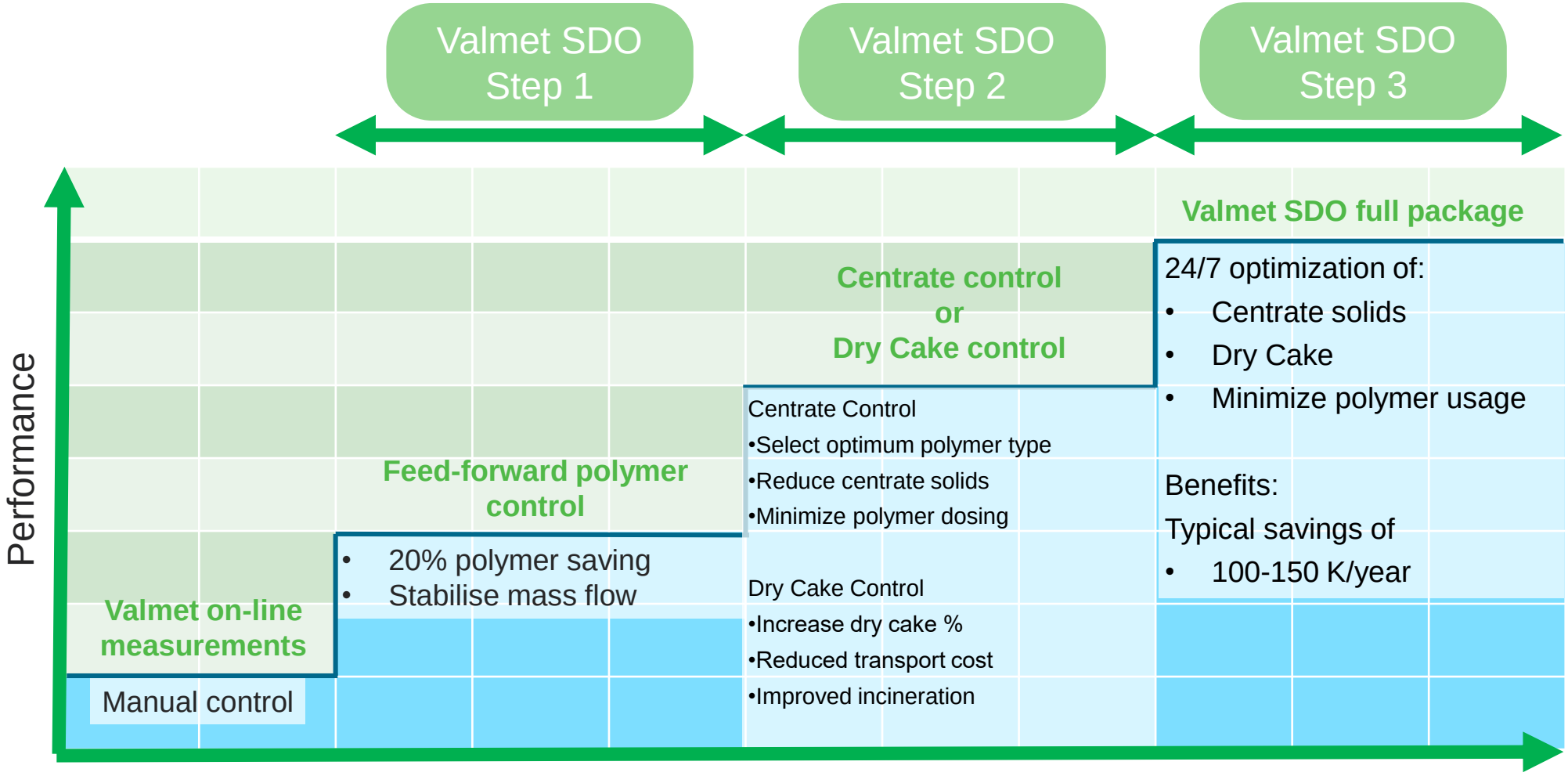
- Valmet TS before the centrifuge
- Flow measurement before the centrifuge
- Valmet LS Measuring Centrate Solids %
- Valmet TS or DS Measuring Dry Cake Solids %

### Output values

- Polymer setpoint
- Sludge feed flow setpoint
- Centrifuge torque setpoint



# Maximizing performance with the modular Valmet SDO



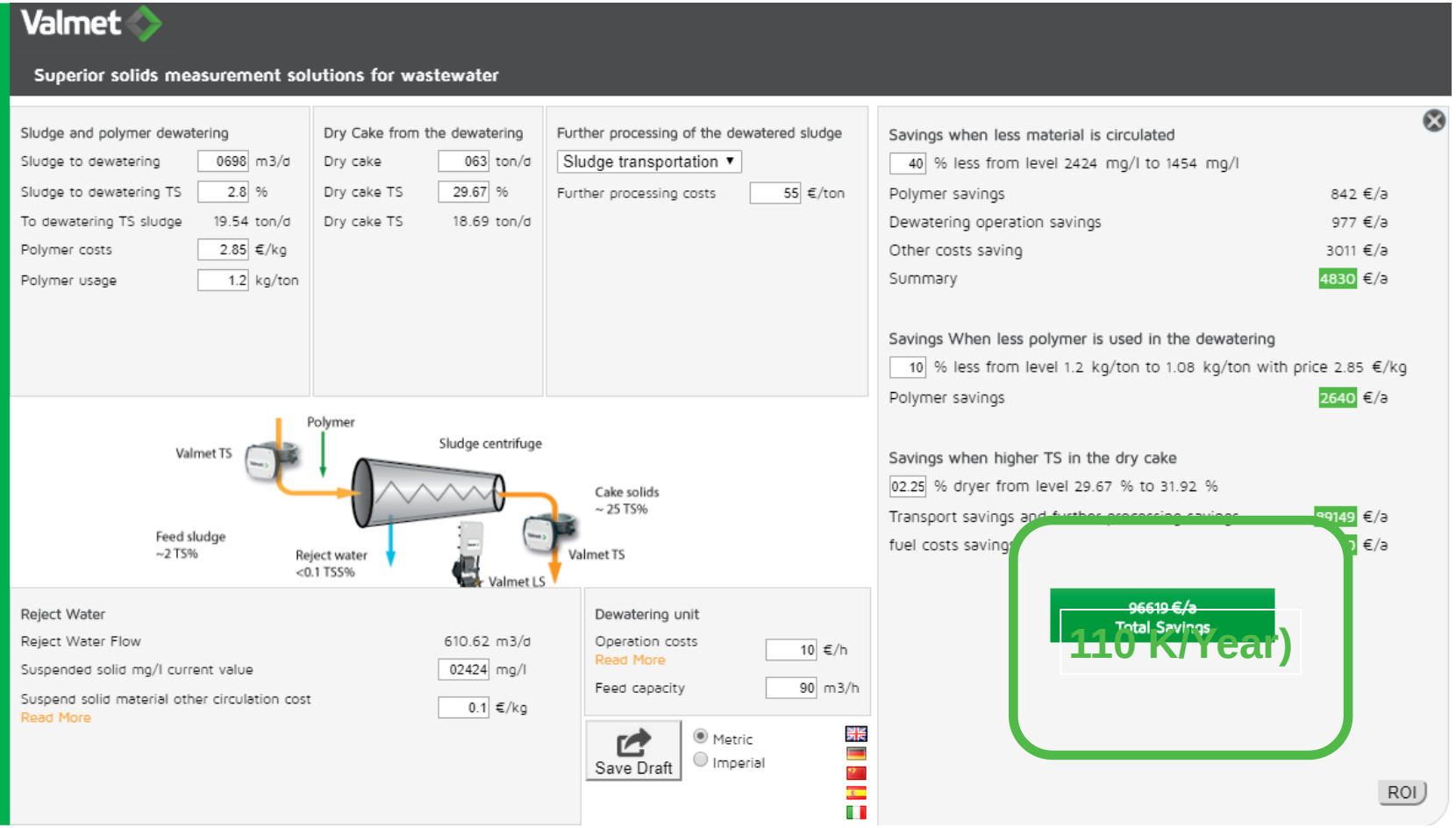
# Story of Tampere Water, Finland, with Valmet SDO

Savings estimation in the pre-project phase – conservative estimate

ROI calculator is online for customer input, google Valmet Wastewater

## Valmet SDO pre work

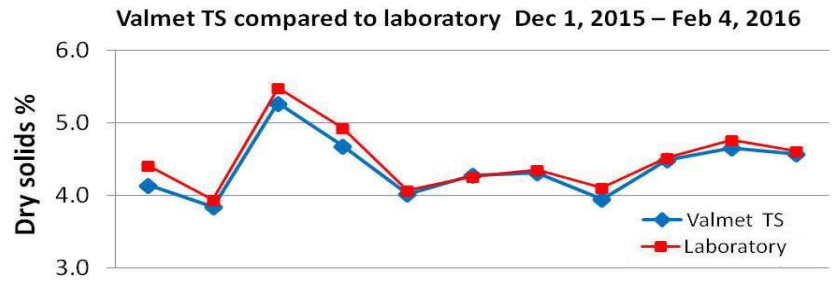
- Savings estimation based on real customer data
- Project feasibility agreed
- Project risk minimized

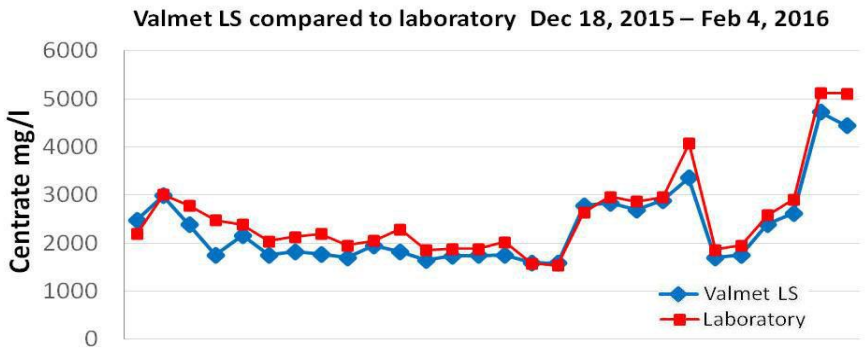


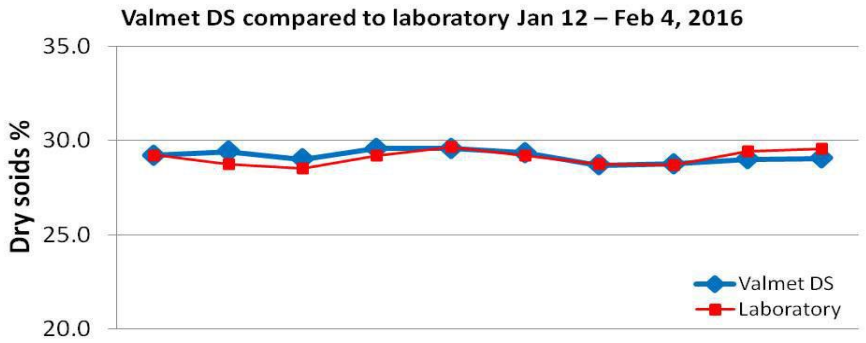
# Story of Tampere Water, Finland, with Valmet SDO

## Measurements verification

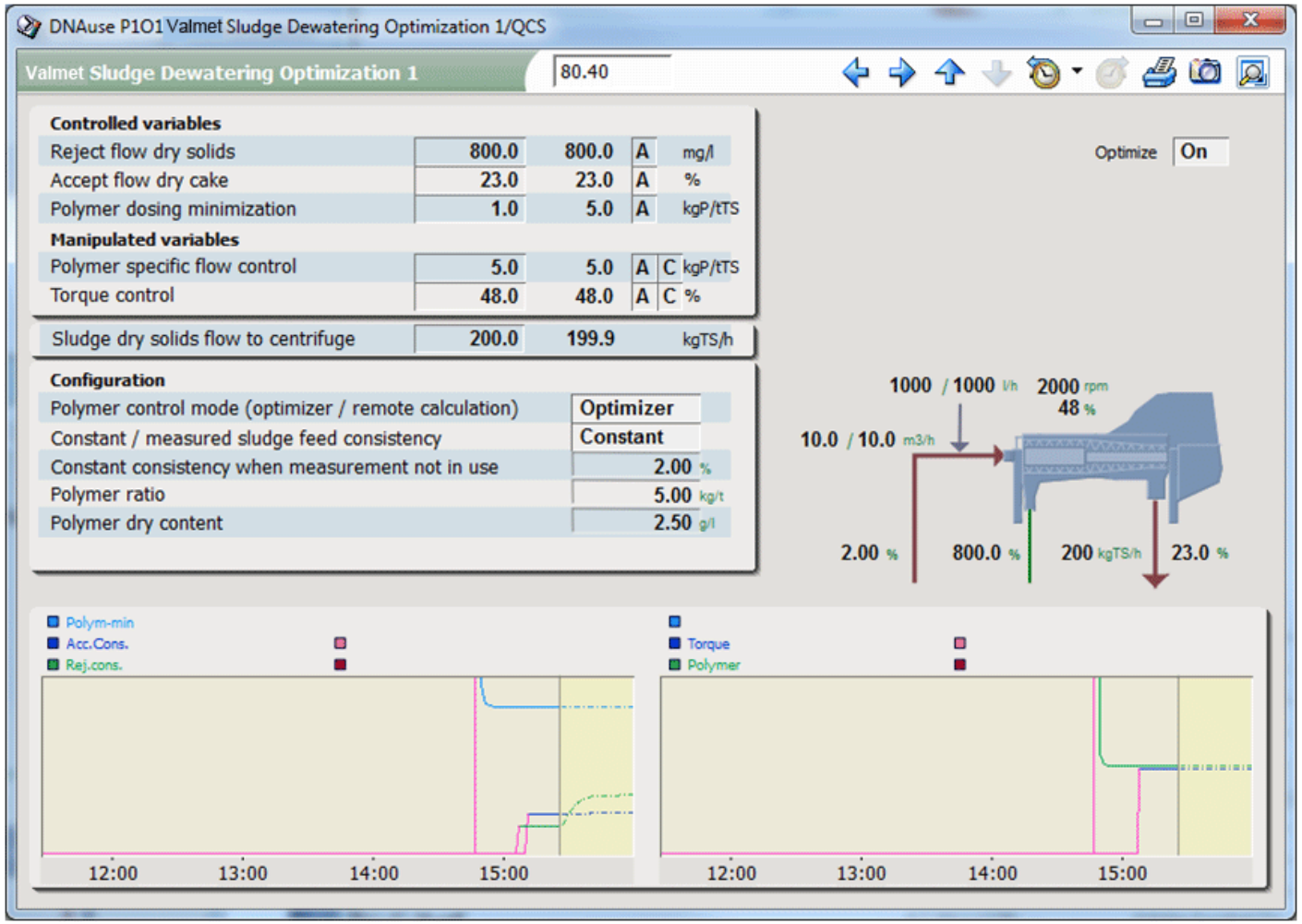


# Example of  the operator display



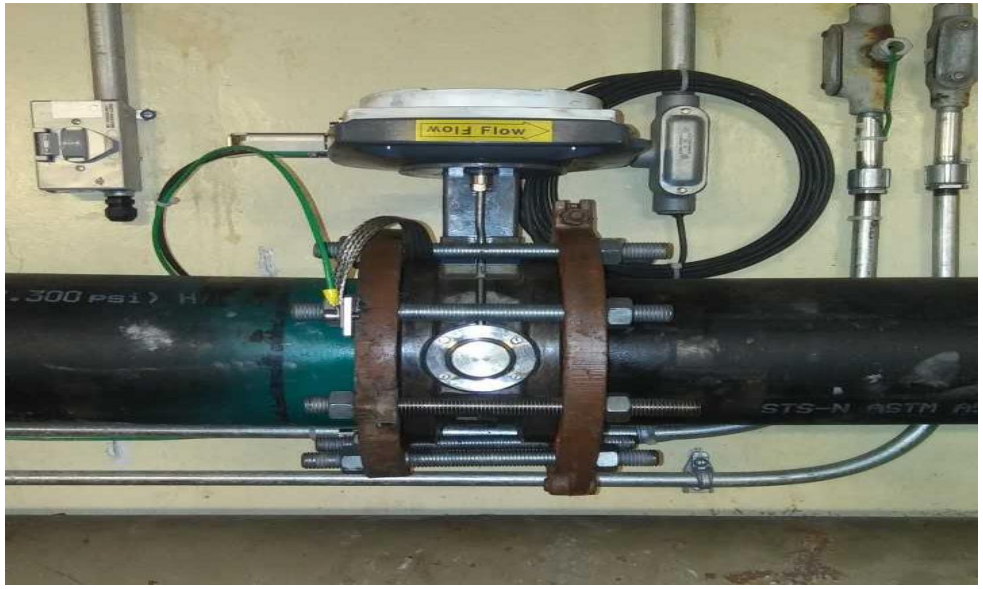

 

# Install and maintenance

- SDO software should be tied in to Valmet factory through a 4G network. This needs to be agreed with user. Enables remote diagnostics and performance checks as needed.
- Some possible challenges when feeding centrifuge with thickened primary sludge (TPS) which could contain bad levels FOG and other debris, really plugging  up piping and sensors. Glass lining and purging the sensor has proven to help.
- Instruments need power and utilities, such as 24V (TS), 240V (LS/DS), plant air and hot water to activate actuators and solenoids.
- Calibration of TS is simple single point although final tuning needs at least 5 samples, while LS and DS need a few days of grab samples to build best correlation curve and enable measurement cell backflush cleaning cycle timing.
- TS and LS have minimum flow rate requirements and flow profile (LS). DS installed on throw side of chute.
- Check of measurements should be done likely weekly to lab.
- Valmet USA-based technicians/engineers provide full site support, training and commissioning.

# Recent installations (clockwise LS-DS-TS)





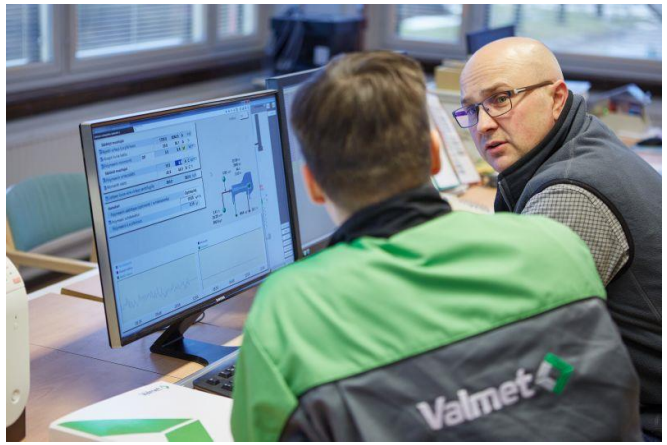
# Story of Tampere Water, Finland, with Valmet SDO **($157K USD) savings per year**

18.5 MGD capacity plant

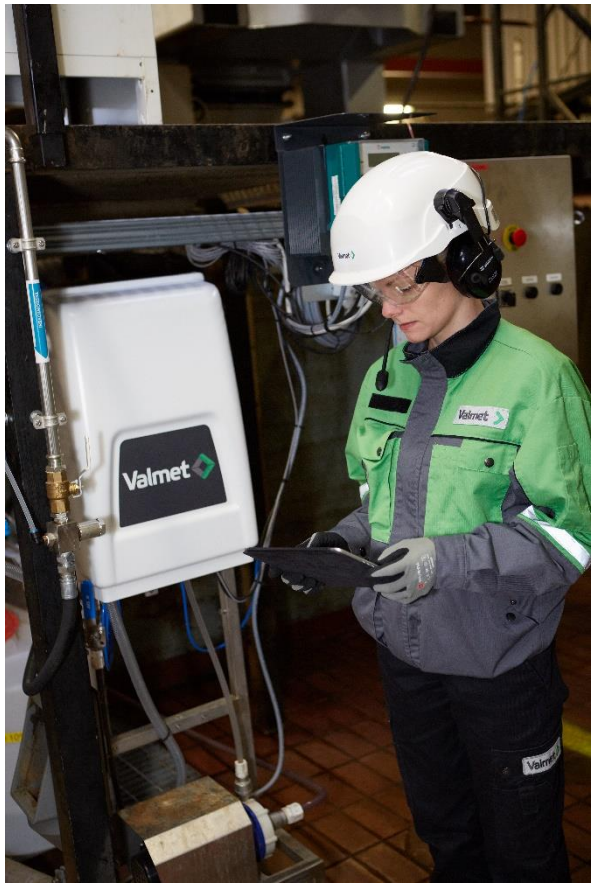
Centrate water average solids % reduced by 50% and stabilized. Savings in circulated material were $11K USD /year

Polymer consumption reduced by almost 40% from 13 lbs/ton. Savings in polymer usage were $55K USD/year

Dry cake solids content has increased by ≈1.3% from 29.7% to over 31%. Transportation savings were
$91K USD/year



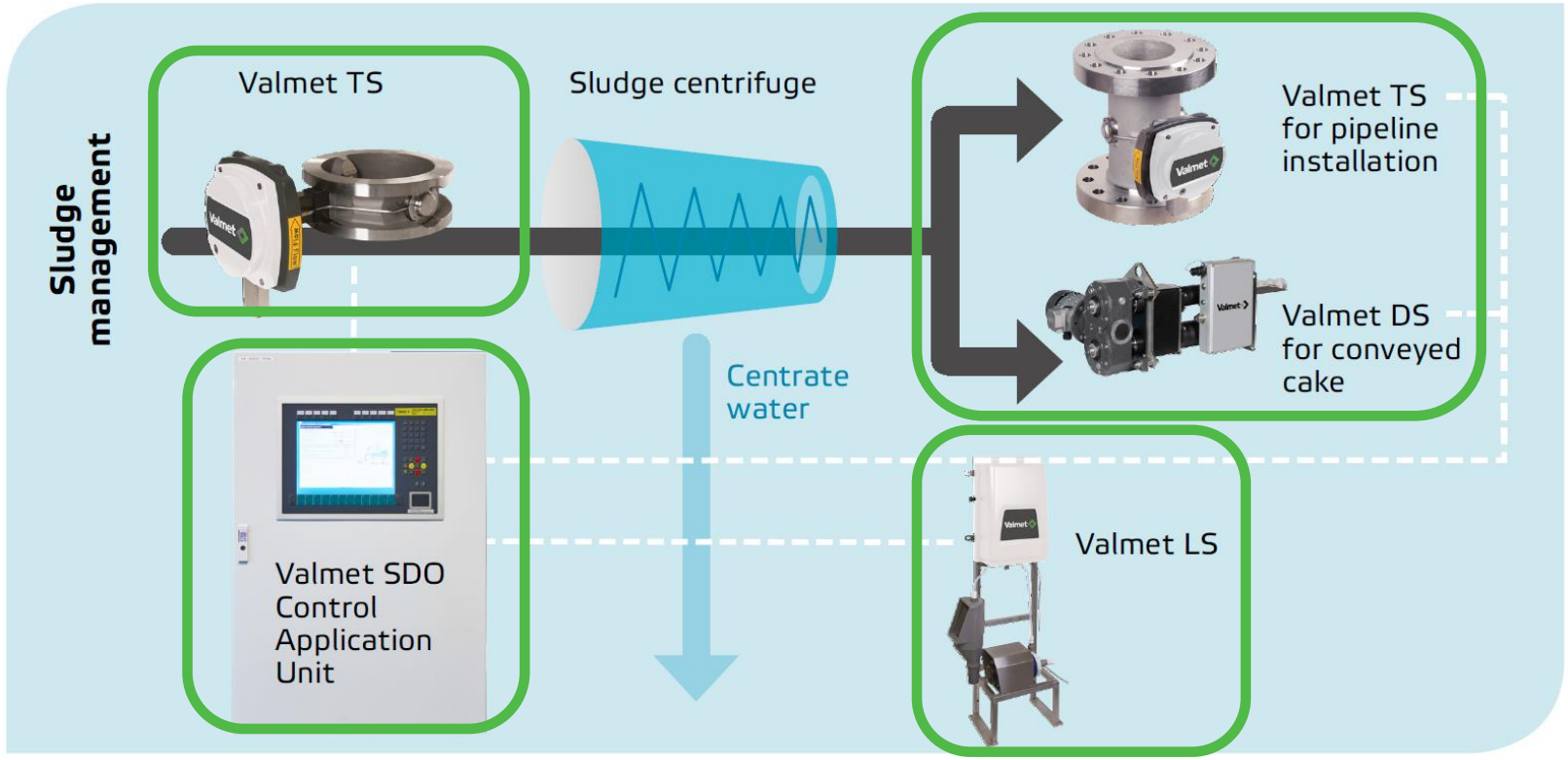




# Typical Valmet SDO scope

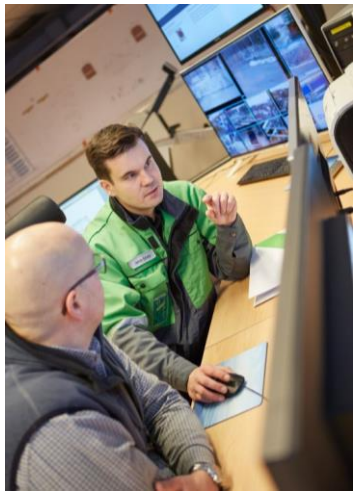
## Investment/ROI

- Estimated Investment $180,000 USD
- Estimated ROI 1 – 1.5 years
- Additional centrifuges need less investment as control application can handle to 4 units. Only measurements required to duplicate.



# Valmet wastewater portfolio

- Proven and unique technology
  - Multivariable Controls
  - Unique measurement portfolio
- Verified references
  - 5 x Valmet SDO references since launch is 2017
    - Finland, South Africa
    - 2 new orders in USA and 1 in Canada 2019
  - 1000+ Valmet TS installations
  - 10’s Valmet LS and Valmet DS installations
    - San Francisco, Denver, Ottawa, etc.
- Established aftersales support network
- Contact Valmet for ROI/site visit
- Cooperation with TAG members
  - Recent Tag London, UK

Valmet
FORWARD

http://www.valmet.com/wastewater

# Supporting Slides Follow

# Progress built on 220 years of industrial history

1797 Tampereen Verkatehdas
1841 Götaverken
1856 Tampella
1858 Beloit
1860 KMW
1868 Sunds Defibrator

**1942**
Rauma-Raahe

**1951**
Valmet

**1968–1996**
Several M&As:
1986 KMW

1987 Wärtsilä paper finishing machinery

1992 Tampella Papertech

**1999**
Metso created through merger of Valmet and Rauma

**Acquisitions**
2000 Beloit Technology

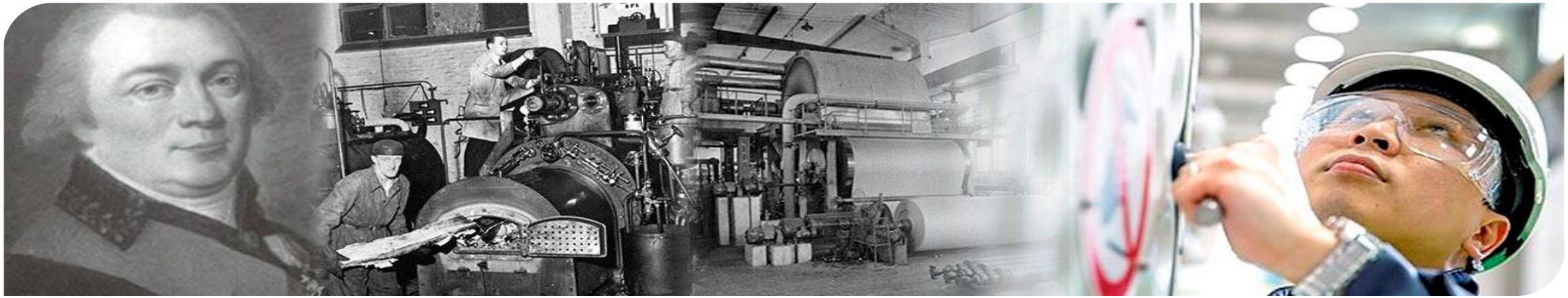
2006
Kvaerner Pulping
Kvaerner Power

2009 Tamfelt

**End of 2013**
Demerger to Valmet and Metso

**2015**
Metso Process Automation Systems to Valmet

**2019**
Valmet acquires GL&V



# Key figures in 2018

**Orders received**
EUR 3,722 million

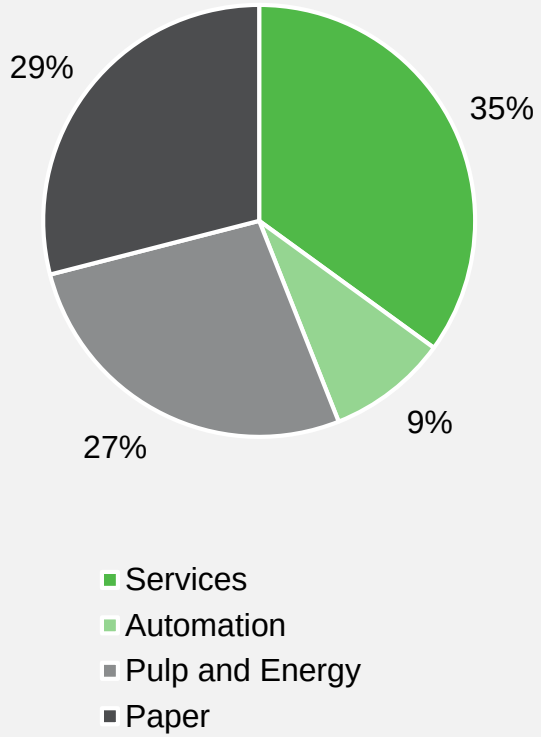
**Net sales**
EUR 3,325 million

**Comparable EBITA**
EUR 257 million

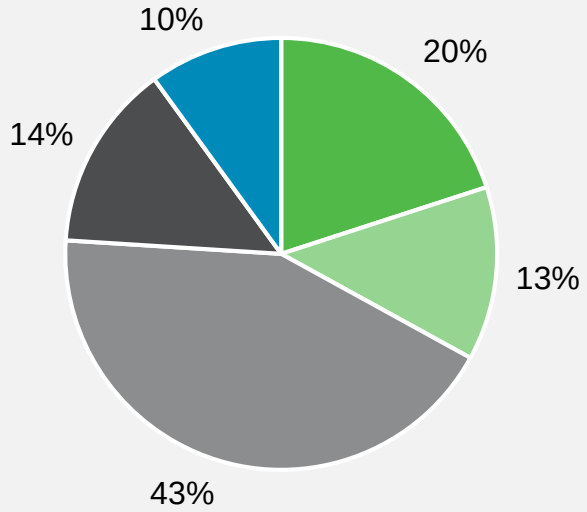
**Comparable EBITA margin**
7.7%

**Employees** (on Dec 31, 2018)
12,528

## Orders received by business line




## Orders received by area

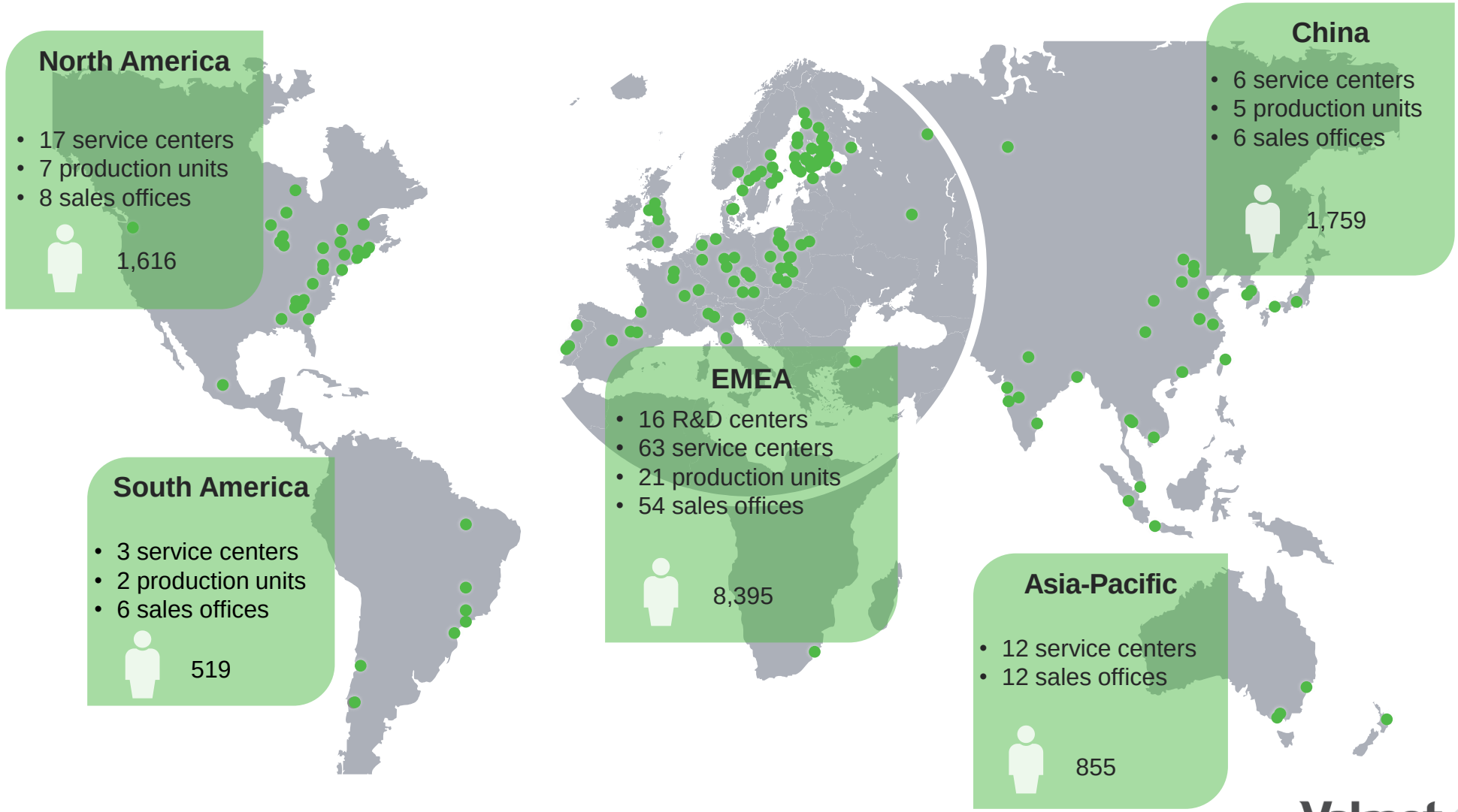


# Strong, global presence is a good platform for growth

## Over 100 service centers, 85 sales offices, 35 production units, 16 R&D centers

**Wastewater Partners**

Finland
Sweden
Norway
Denmark
Spain
Portugal
Italy
Switzerland
The Netherlands
Romania
Bulgaria
Greece
Hungary
Serbia
Israel
Egypt



# Analyzer and Measurement Solutions Portfolio

## MEASUREMENTS

**Valmet MCA**
Microwave-based total consistency measurement for demanding applications

**Valmet Rotary**
Shear force based, r… consistency transmit…, especially for chemic… pulp mills and bleach… applications at RCF … mechanical pulping

**Valmet SP**
Blade type transmitt… for wide range of consistency applicati…

**Valmet OC**
Optical consistency transmitter for many fiber consistency applications with operating range of 0… to 7 %

**Valmet LC**
Optical consistency transmitter for low consistency applicati…

**Valmet Conductivity Measurement**
Conductivity, concentration, cooki… liquor and causticizi… measurements for demanding applicati…

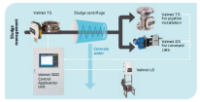


**Valmet TS**
Reliable total solids measurement for municipal wastewater treatment plants

**Valmet LS**
Optical total suspended solids measurement for municipal wastewater treatment plants

**Valmet Nove and Nove H**
Reliable sampling for all pulp grades. Now with cutting edge pistons

**Valmet Dry Solids Measurement**
Microwave-based dry cake total solids measurement for municipal wastewater treatment plants



**Valmet SDO Sludge** Dewatering optimizer

## ANALYZERS

**Valmet Kappa QC**
On-line kappa, brightness and fiber/shives analyzer for chemical pulping control

**Valmet Piston & Valmet Screen Extractor**
Filtrate sampler for continuous fiber-free sampling

**Valmet AT**
Automatic online titrator for $ClO_2$ process management

**Valmet Alkali R**
Valmet Recovery Liquor Analyzer is modular analyzer concept for chemical recovery process. Green liquor, lime milk, white liquor alkali analyses and recovery boiler reduction degree analysis based on standard laboratory titrations

**Valmet Cormec5 X**
Inline brightness sensor for chemical-, DIP- and mechanical pulping applications. Also industrial mineral model available.

**Valmet Polarox5**
Inline chemical residual sensor

**Valmet Chip 'n' Bark Moisture Analyzer**
A continuous chip moisture measurement to improve digester operation and cooking liquor dosage control

**Valmet Polarox5 F/FP**
Online total/active peroxide and $CLO_2$ chemical residual sensor

**Valmet MAP**
Fast and reliable online pulp analyzer for freeness, fiber property and shive content measurement for control applications

**Valmet RM3**
Total and true ash consistency measurement, ideal for wet end monitoring and control

**Valmet WEM**
Modular, multiline analyzer for wet end management includes charge, consistency, chemistry and turbidity measurements

**Valmet Corrored**
Valmet Corrosion Reduction Analyzer measures from bio power boiler flue gas total chlorine- and sulphur concentration and calculates S/Cl molar ratio for superheater corrosion risk evaluation

**Valmet Alkali C**
Valmet cooking liquor analyzer is modular analyzer concept for cooking process. White- and black liquor alkali analyses based on standard laboratory titrations.

**Valmet DCD**
Automatic dirt count analyzer of dry pulp sheets

**Valmet Pulp Expert**
Fully automatic online analyzer for complete pulp quality specification

**Valmet FS5**
Analyzer for the advanced measurements of fiber properties.

**Valmet Paper Lab**
Automated paper and board testing analyzer with wide selection of industry standard tests

**Valmet Fractionator**
Automated laboratory fractionator, e.g. to replace Bauer-McNett.

**Valmet MR**
Moisture analysis for pulp and paper, biofuel and minerals

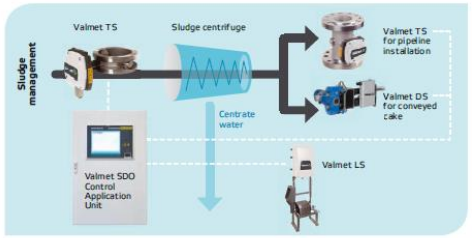
Valmet

Valmet

# Valmet offering for wastewater management

## Advanced measurement technology and controls for municipal & industrial wastewater dry solids management

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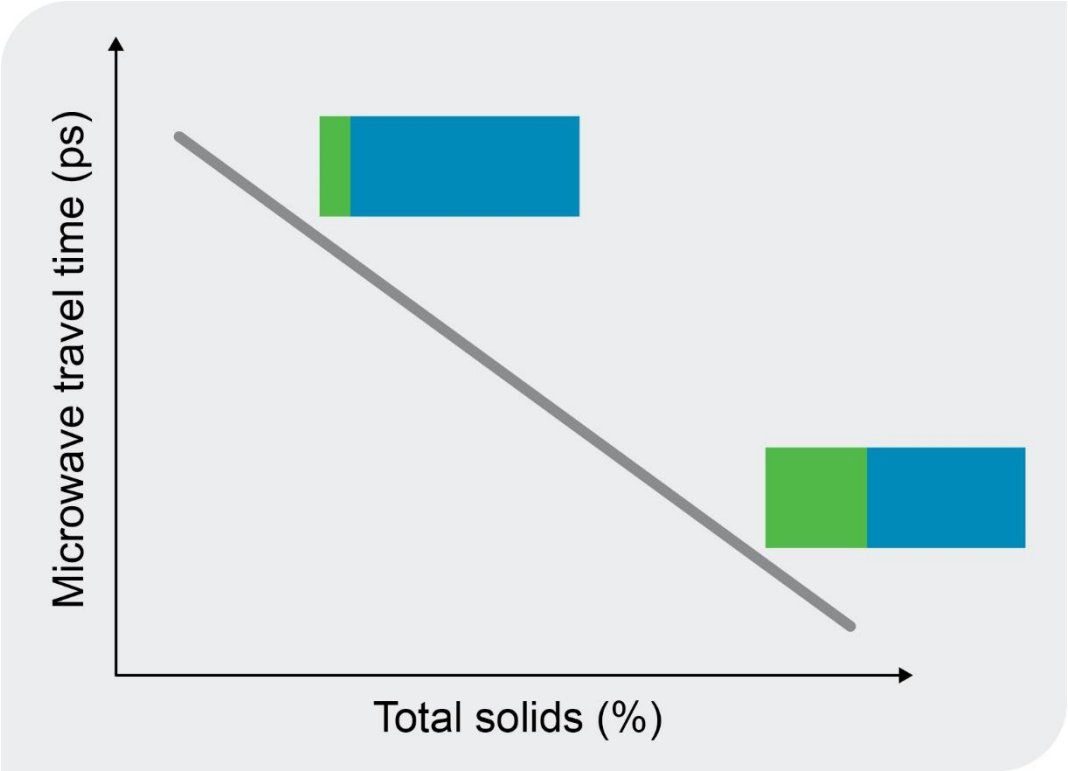
# Valmet TS

## Measurement principle

- Valmet TS measures the time of flight of a microwave signal in the sludge
- Microwave's delay time in water vs. total solids has a linear relationship

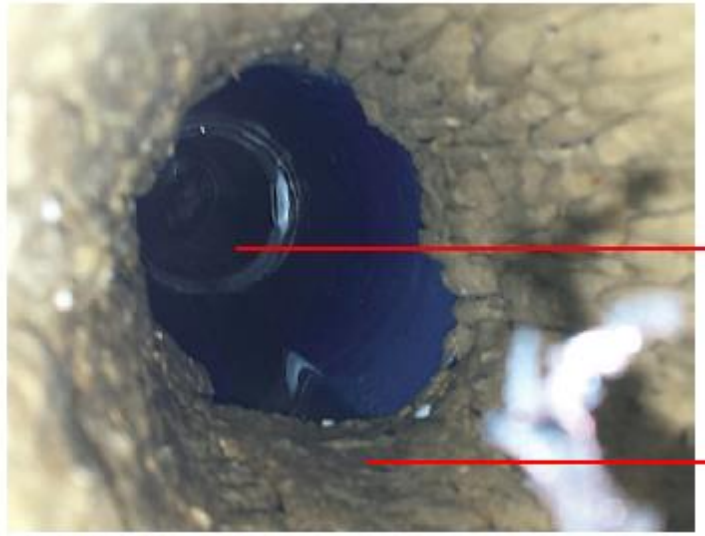



# A glass lined Valmet TS to resist grease build-up

*Teflon lined Flow Meter*

*Glass lined Valmet TS*

*Above Teflon lined flow meter and a glass lined Valmet TS.*



*Clean White Glass Lined Internals of Valmet TS*

*Grease build-up on Teflon lined Flow Meter internals*

*The Valmet TS – spotless!*


# Process know-how and performance increase

| | Valmet TS before the centrifuge | Valmet LS at centrate | Valmet TS / DS after the centrifuge | Control application |
|---|---|---|---|---|
| Function | • Polymer dosage based on mass flow | • Feedback of the polymer dosing level as well as torque level . Monitoring of the centrifuge performance | • Feedback of the torque level as well as polymer dosing level. Monitoring of the centrifuge performance | • Optimizing the centrifuge performance |
| Benefits | • Fast saving in polymer costs<br>• Immediate more stable process<br>• More information of the process dynamics | • Select Correct polymer type<br>• Optimize the Centrate TSS value<br>• Minimize recycling material inside the plant | • Maximized total solids, higher thermal capacity for the incinerator, less transport costs | • 24/7 optimization with automatic control application<br>• Maximized benefits by modular structure<br>• Step by step expansion of the control application |
| Savings annually | • 20% polymer | • No wasted money to wrong polymer type<br>• Minimize chemical 30% and pumping costs inside the plant 50% | • 1% increase in dry cake means about 3-5 % volume decrease<br>• Customer example in 800 000 p.e plant 1% increase means €150 000 savings in further sludge handling<br>• Customer (400 000 ton sludge/d) calculated that 0.3 % increasing mean 60 kL/year of oil saving (about €36 000 in incineration) | • Even 50% of polymer saving and 50 % recycling material decrease |

The complete package is more than each component separately

# Principle of the Multivariable Process

With a multivariable process it is difficult to use a one--to--one relationship to control each
process output (CV) by changing only one manipulated variable (MV).When one of the manipulated variables is changed in order to drive one of the controlled variables, other controlled variables are also affected at the same time (see Figure 7). The correct way to control the multivariable process is to use a multivariable feedback controller for regulating all manipulated variables (MV) simultaneously in order to drive the coupled process outputs to follow the multiple targets (setpoints).

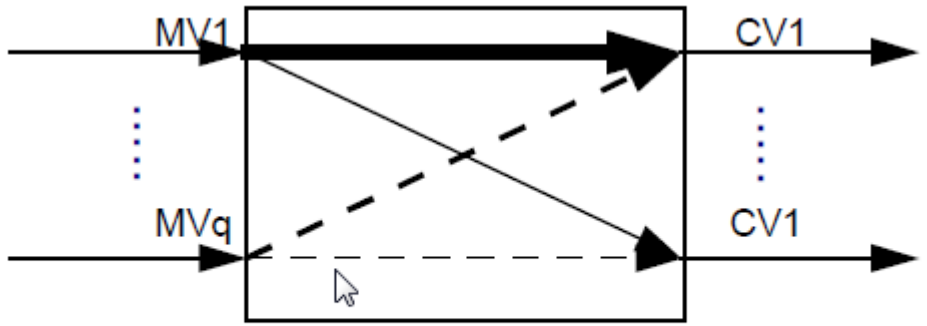



*Figure 7* *Principle of the Multivarible process*



Valmet

# MPC Control principle

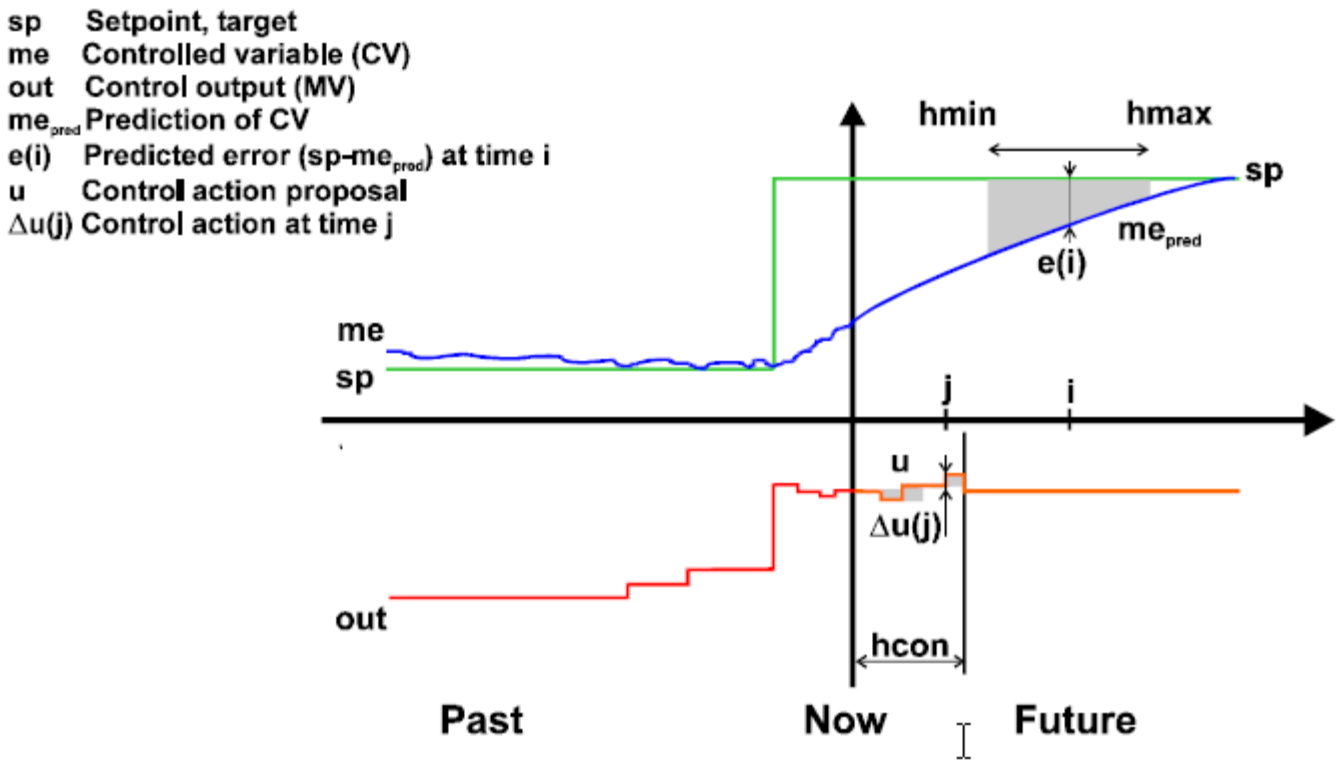



*Figure 9* *Control principle of the MPC for one controlled variable*

# The MPC control principle is based on the following strategy

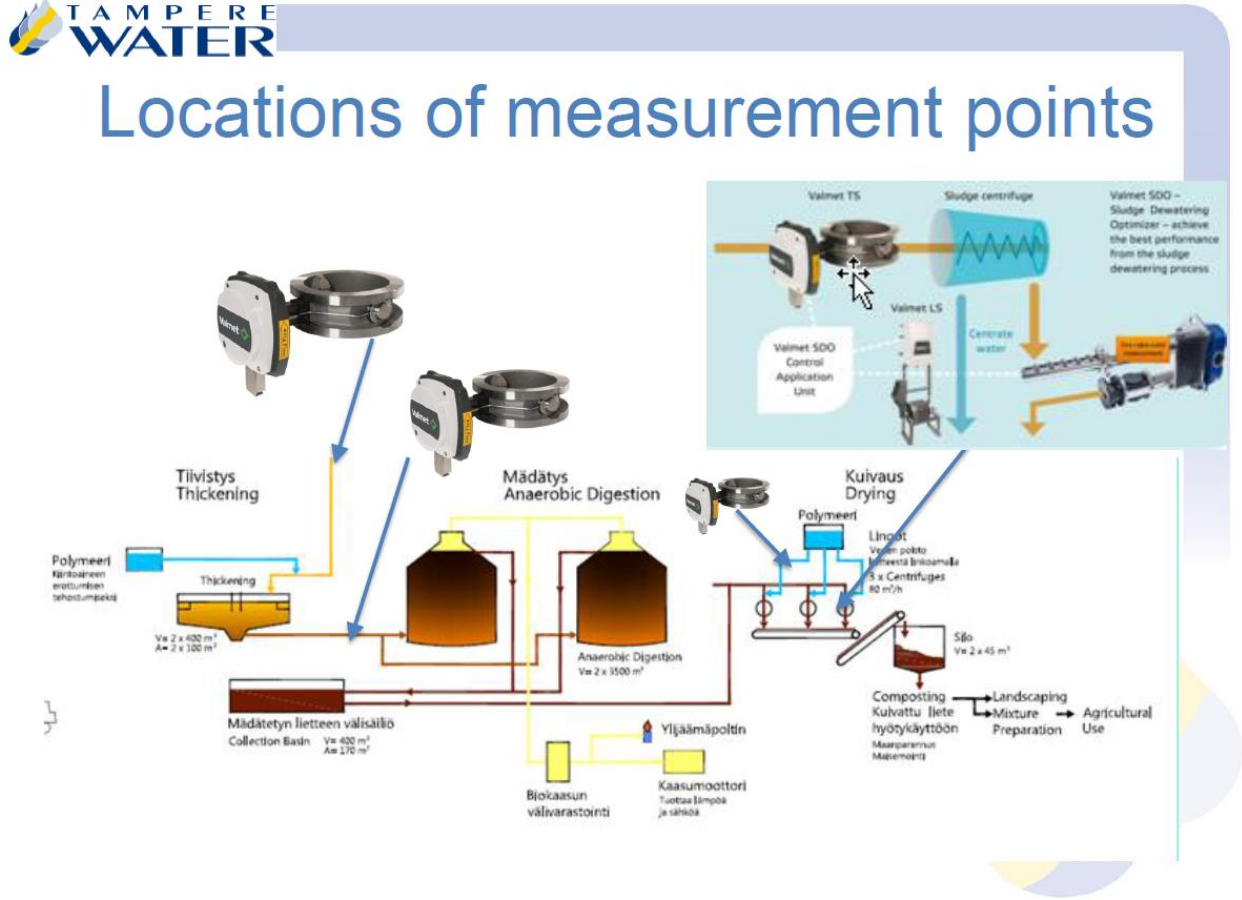
1 At each control execution moment, the controller performs a forecast of the process output, i.e., it predicts the future behaviour of the controlled variables. Predictions are made over a certain time horizon *hmax and are based on process models and* known control actions (history).

2 The controller calculates the optimal subsequent *hcon control actions, which keeps* the number of errors occurring between setpoints and predicted process outputs as small as possible during the time period *hmin--hmax. The calculation is based on an* optimization of the cost function, which presents how the smallest possible error occurrence is achieved with minimal control actions.

3 First, one of the proposed control actions is applied to the process. All other actionsare ignored and the whole procedure is repeated, leading to updated control actions with corrections based on the latest measurements.

# Customer example

## Tampere Water, Finland



# Customer example

## Tampere Water, Finland

TAMPERE WATER

### Advantages 1/2

- Sludge pumping from clarifier tanks is based on time and thickness. Pumping is more efficient and saves energy
  - energy savings are abt. 37 %, 5000 €
- Thickness has increased 1,5 %→ 3,5 % by using TS-measurement.
  - 32 % less sludge to treatment
- Solid content of centrate water is now 50 % lower from 2500 mg/l before starting the project

# Customer example

## Tampere Water, Finland

### Advantages 2/2

- Dried cake content has increased about 1-2 % from 29,7 %
  - → Savings in transportation costs due to smaller density of the dry cake
- Polymer consumption has decreased almost 40 % from level 8 kg/ton
- Savings:
  - when less material is circulated, 10 000 €/a
  - when less polymer is used in the dewatering, 49 000 €/a
  - when higher TS in the dry cake (transportation costs), 80 000 €/a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FORWARD