AquaSPICE

Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

Circular Water Use in the Chemical Industry

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DOW's SUSTAINABILITY COMMITMENT

By 2025

Dow's freshwater intake intensity at key water-stressed sites will be reduced by 20%, compared to the 2015 baseline.

By 2030

Dow's top 20 water-dependent sites will have water stewardship plans, and 10 of those sites will be water-resilient.

By 2035

All Dow sites will have water stewardship plans.

By 2050

Dow's top 20 water-dependent sites will be water-resilient.

TWO of DOW's EUROPEAN WATER-STRESSED SITES

Dow Terneuzen, The Netherlands

- Coastal region
- Dow's 2nd largest manufacturing location in the world
- 3 Ethylene crackers
- Water consumption ~ 20 million m^3/year
- Water sources:
  - Recycled condensate, industrial and municipal WWTP-effluents
  - Local and remotely sourced surface water

Dow Böhlen, Germany

- Inland
- Main products: ethylene, propylene
- 1 Ethylene cracker
- Water consumption ~ 8 million m^3/year
- Water sources:
  - Recycled condensate
  - Local sourced surface water

MOTIVATION and GOALS

Both sites are classified as key water-stressed sites Dow internally

AquaSPICE shall deliver an implementation plan for technologies to save water and improve quality

Dow Terneuzen, The Netherlands

GOALS

Reduce water by reuse:
Fresh water intake reduction by 20 %

Digital smart control:
Design and implementation

Dow Böhlen, Germany

GOALS

Reduce water by improved treatment and reuse: Fresh water intake reduction by 1.1 million m^3/a

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MOTIVATION and GOALS

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Digital smart control:
Design and implementation

AREAS of FOCUS

- Cooling tower blowdown reuse
- Site condensate reuse
- WaterCPS* design & implementation

- Raw water treatment improvement
- Cooling tower blowdown reuse
- Site condensate reuse
- WaterCPS* design & implementation

*CPS: Cyber-Physical-System

MAJOR ACHIEVEMENTS at DOW TERNEUZEN

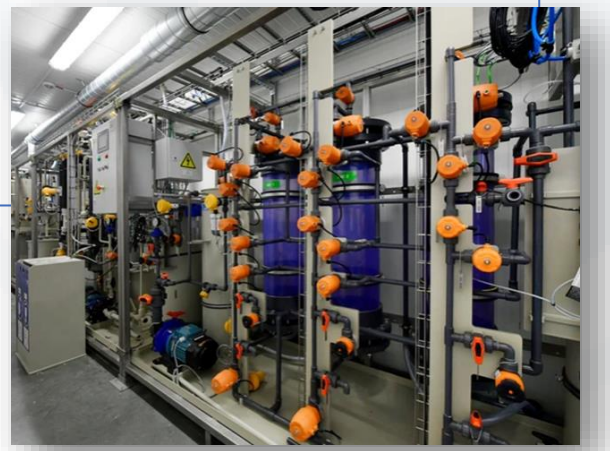
Trials with IMPROVED containers

Cooling Tower Blowdown (CTBD)

- 3 different technology trains tested
- GAC-UF-RO most promising technology train for re-use application in cooling tower
- Product water can be used as additional feedwater source
- CTBD treatment can lead to 15-20% reduction in freshwater consumption for the site

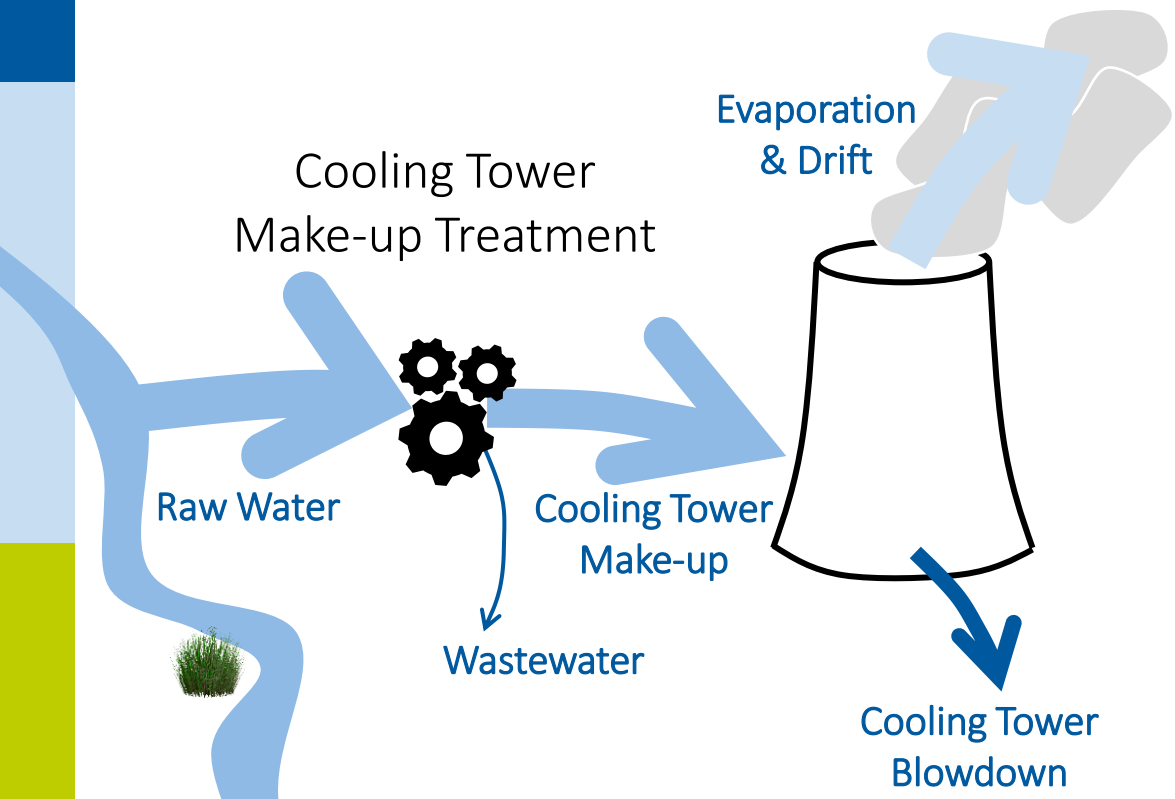
Dilution Steam Blowdown

- 9 different technology trains tested
- Product water not re-usable as boiler feedwater due to high residual TOC
- Mini-boiler experiments at Ghent University showed residual TOC will form harmful organic acids in steam systems

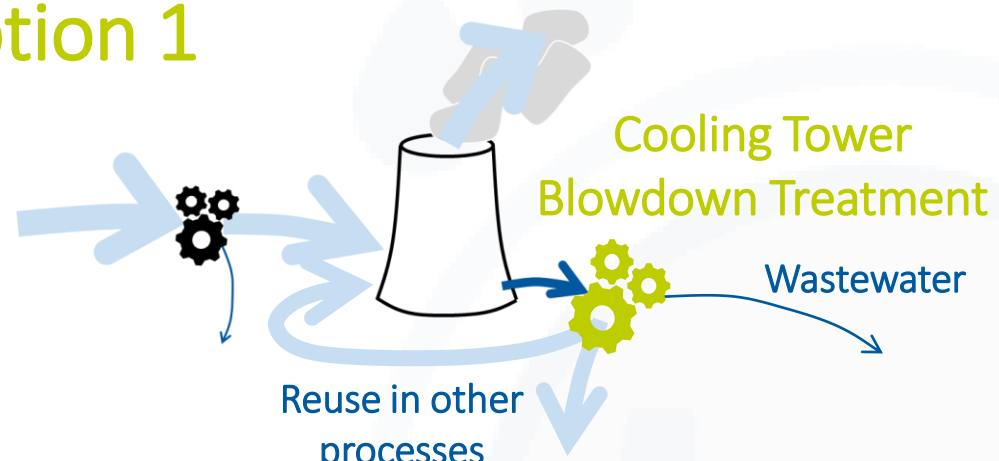


MAJOR ACHIEVEMENTS at DOW BÖHLEN

Trials with IMPROVED containers



Option 1



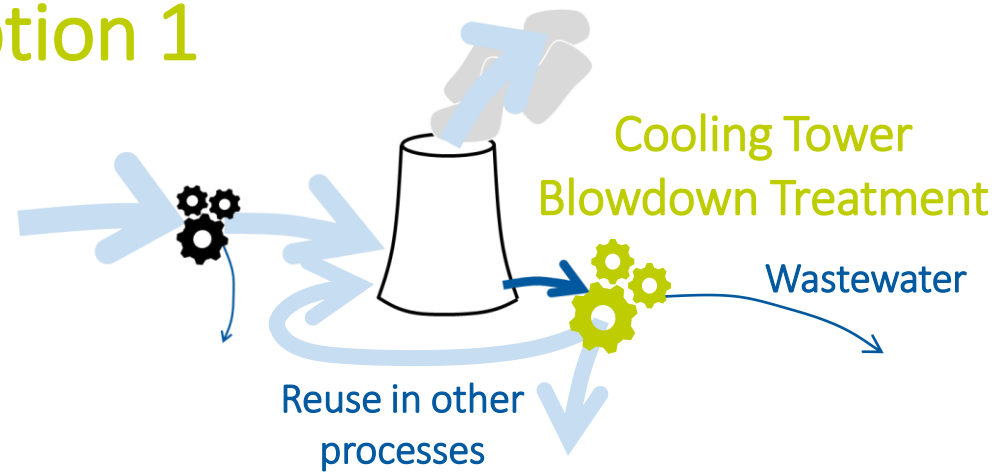
Option 2

Intensified Cooling Tower
Make-up Treatment

MAJOR ACHIEVEMENTS at DOW BÖHLEN

Trials with IMPROVED containers

Option 1



Targets:

Water Quality

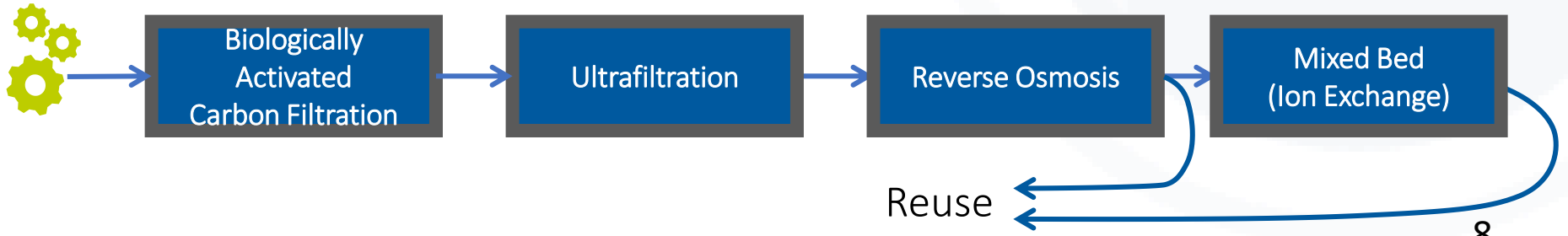
Water Efficiency

Boiler Feed Water (BFW):

Total Organic Carbon (TOC)	< 0.2 mg/L
Conductivity (EL)	< 0.1 µS/cm

Average CTBD Quality:

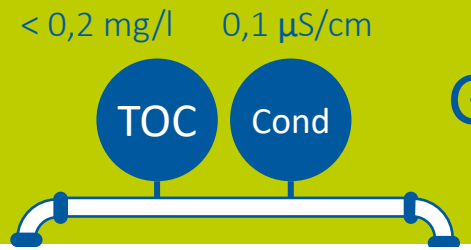
pH	7
Turbidity	7 NTU
EC	1950 µS/cm
TOC	22 mg/L



CONCLUSIONS for DOW BÖHLEN

GOAL: Water Savings – approx. 1.1 Mio. m³/a

- Full scale implementation of the recommended technologies will deliver 65% goal achievement for water savings
- Recommendation for further opportunities done (100% goal achievement possible)



GOAL: Improvement of Demin Water Quality

- Full scale implementation of the recommended technologies will deliver full achievement of the goal for quality

TRIALS at MERADES (ENGIE-LABORELEC)

Tests in cooling tower pilot comparing different water types and water treatment technologies on scaling/corrosion:

- Product water from cooling tower blowdown treatment with IMPROVED containers at Dow, Terneuzen
- High quality make-up water from Dow, Böhlen

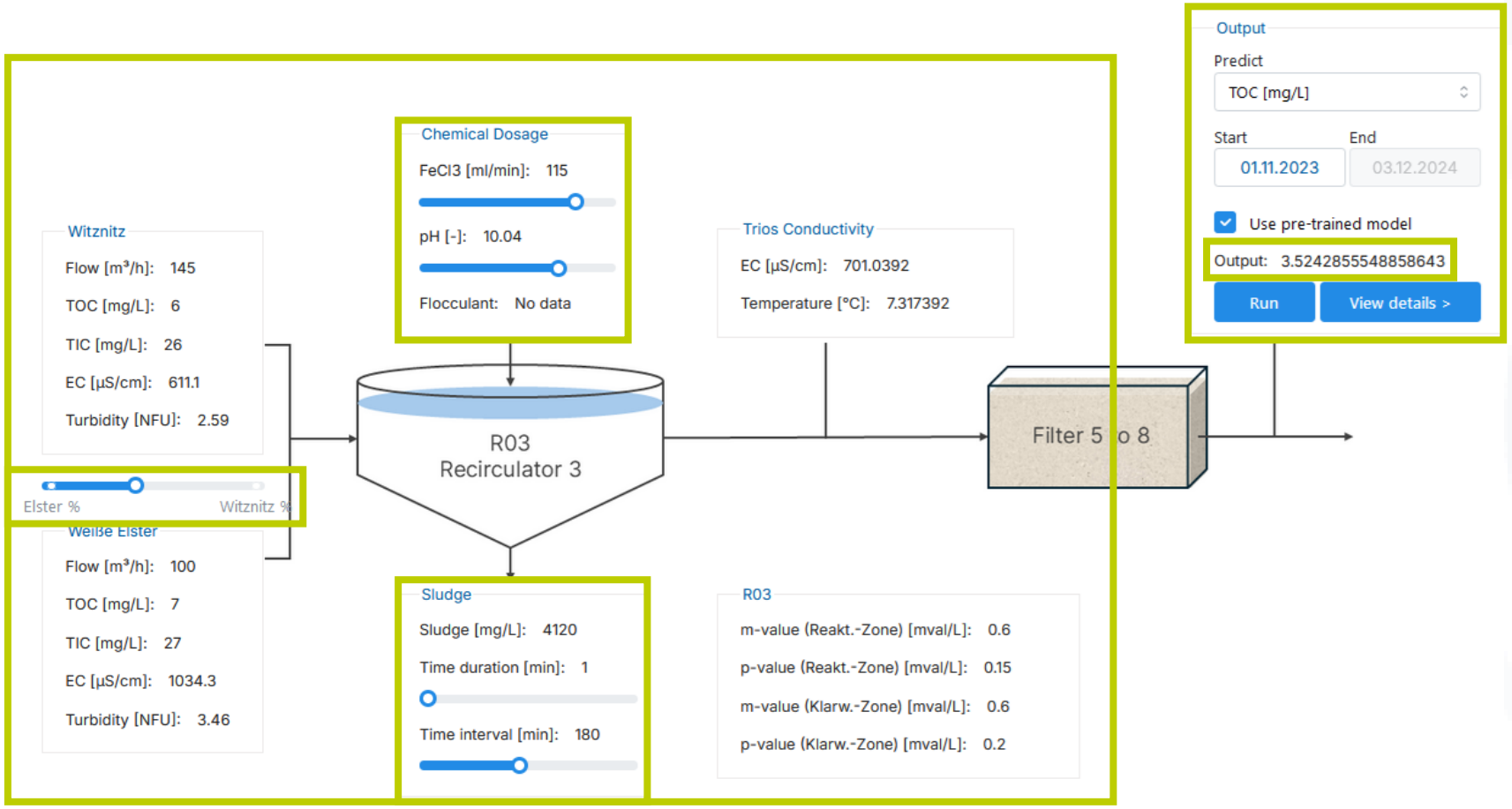
Main outcome:

- New, more sustainable cooling water treatment products possible to be used
- Running with a higher CoC will reduce water consumption

DIGITAL TWIN in WATER TREATMENT

Graphical User Interface: Simulation

Simulation

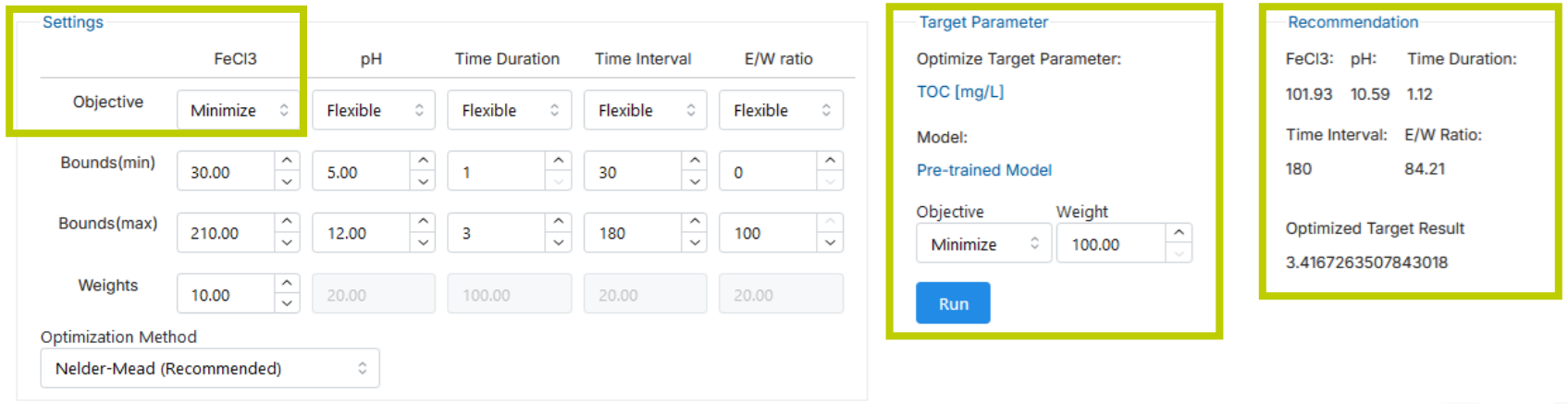


- Input parameters
- TOC simulation (Neural Network)
- Adjustable parameters

DIGITAL TWIN in WATER TREATMENT

Graphical User Interface: Optimization

Optimization



- Minimize TOC
- Minimize $FeCl_3$
- Optimized adjustable parameters

SUMMARY

Significant potential at industry sites to reduce freshwater intake

- Treatment and reuse of cooling tower blowdown are very promising
- Further water savings potential: Optimization of existing processes, e.g., production of demin water
- More sustainable cooling water treatment products and high-quality make-up water will allow operation at a higher CoC in the cooling towers and will reduce water consumption

Implementation plan in progress → Challenge: Create a business case

OUTLOOK

AquaSPICE 2.0

IMPROVED containers back on Böhlen site for trials with:

- effluent from our industrial wastewater treatment plant, and
- further tests with cooling tower blowdown

WOLLs - Water Oriented Living Labs

Beyond AquaSPICE, strengthening local initiatives for more sustainable water management in the region

AquaSPICE

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Thank you!

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