Sulphate removal bench pilot experiments

E-workshop of the Virtual Upscaling project
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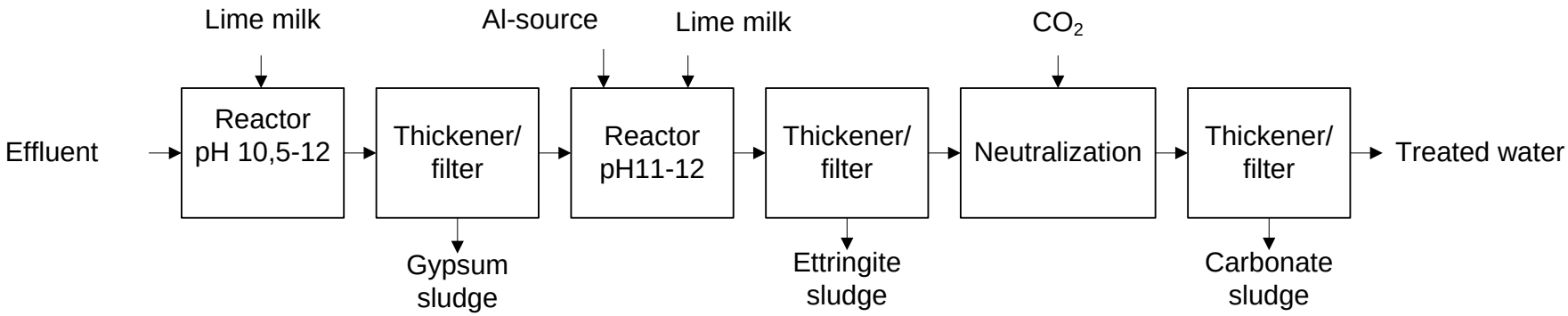
Background

- Sulphate removal from effluents of metal mines and other industrial sites is becoming unavoidable
  - Tightening environmental regulation often requires 1) lower contaminant levels in effluents and 2) increased recycling of process waters
  - Sulphate accumulation in water hinders water recirculation
- Treatment of sulphate bearing effluents with lime to precipitate gypsum is the traditional method, with which sulphate levels of around 2 000 mg/l can be reached
- Today, even lower sulphate levels are sometimes required
- Ettringite precipitation is an option to reach low sulphate levels even <200 mg/l

Ettringite process

- Ettringite is a mineral with very low water solubility in alkaline conditions.
- $3CaO + 3Ca^{2+} + 3SO_4^{2-} + 2Al(OH)_3(s) + 28H_2O \rightarrow [3CaO{\cdot}3CaSO_4{\cdot}Al_2O_3(s){\cdot}31H_2O]$
- Commercial processes are available (SAVMIN, CESR, Outotec Ettringite Process, Veolia LoSO4)



Aims and contents of the present study

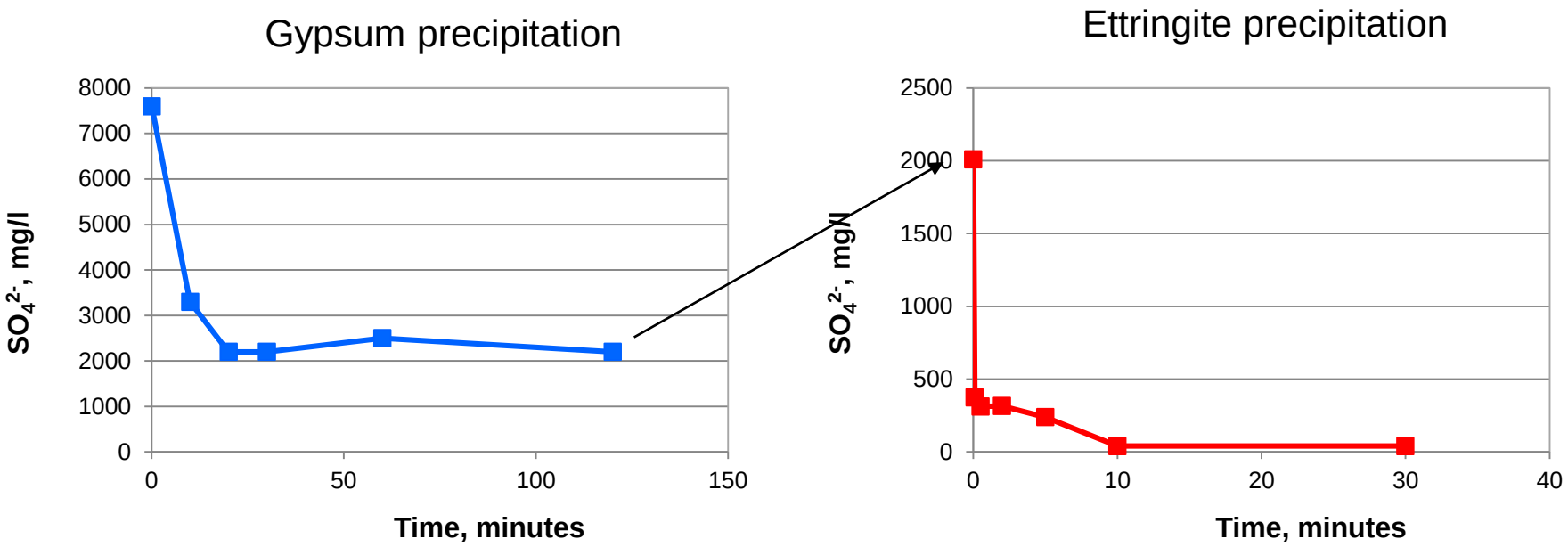
AIMS

- To produce experimental data for developing systemic-level models and tools (e.g. CFD and LCD)
- To take sulphate removal with the ettringite process into bench-pilot scale at VTT

CONTENTS

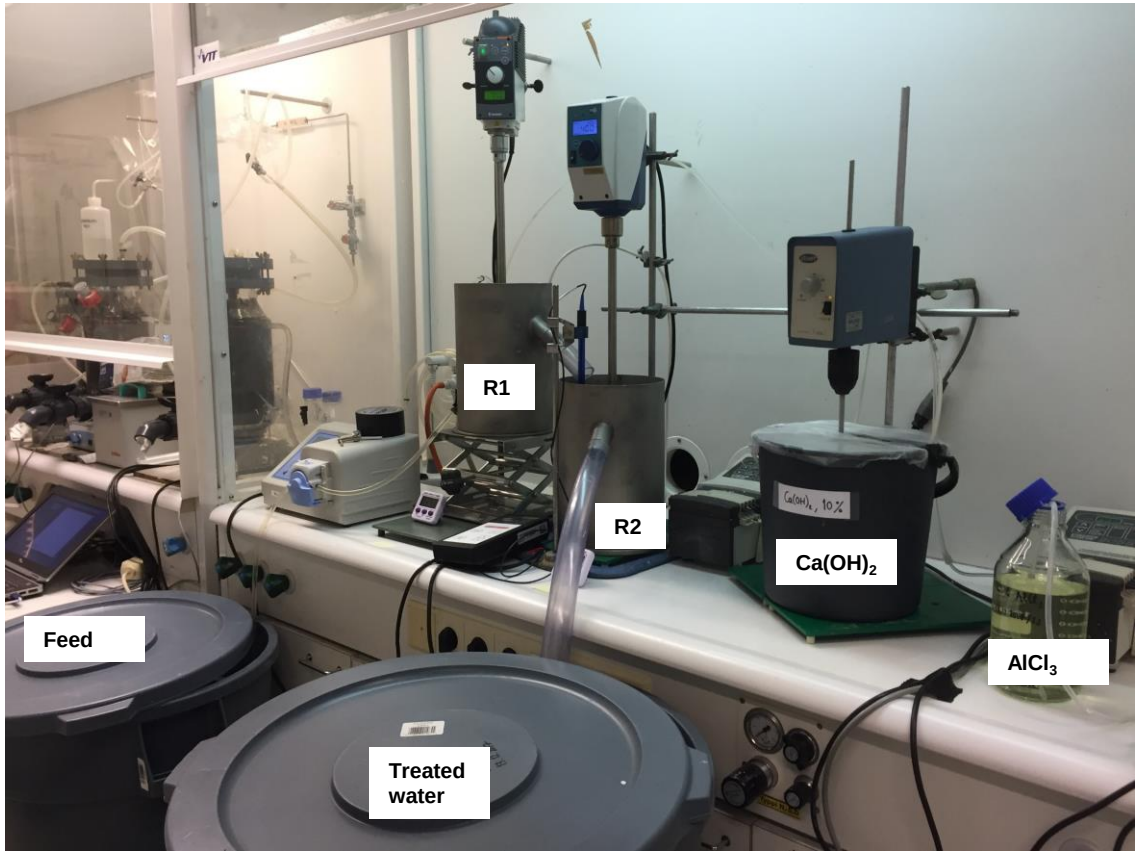
- Batch test for designing the continuous pilot runs
- Continuous ettringite precipitation experiments for sulphate removal

Results: Batch tests for pilot design

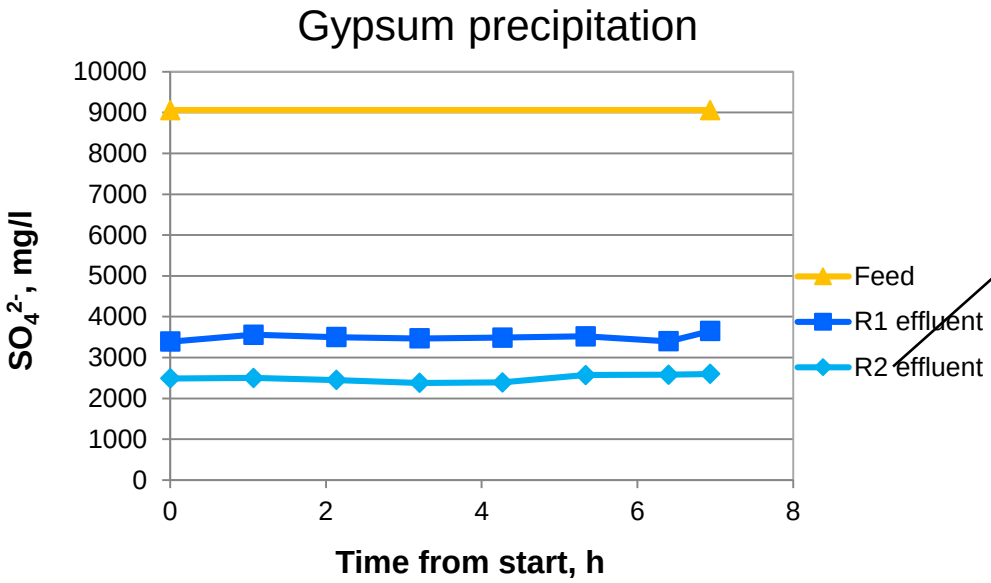


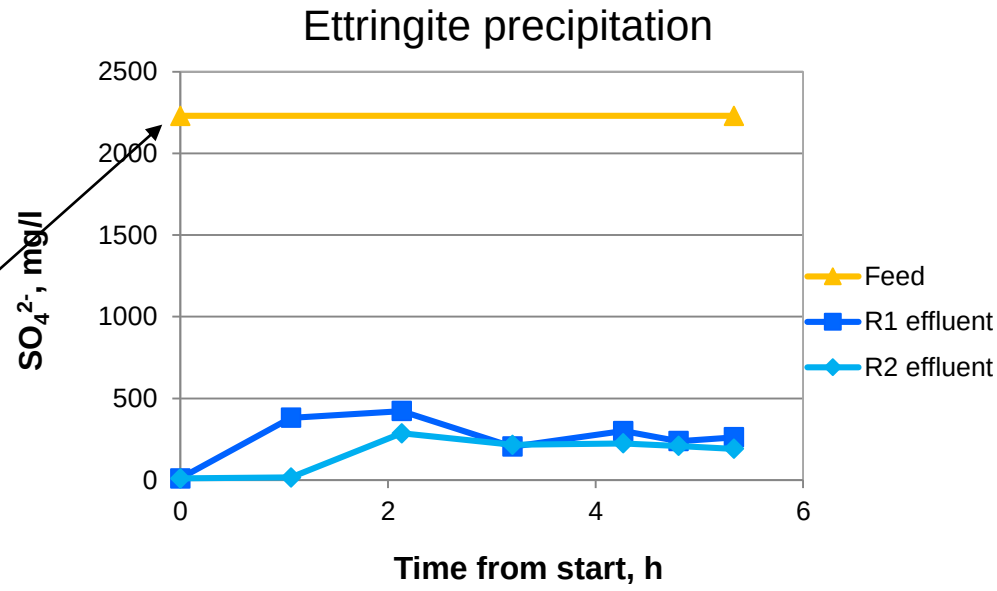
Design of continuous experiments

- 60 minutes retention time (R1 30 min + R2 30 min)
- $Ca(OH)_2$ and $AlCl_3$ dosing (to R1) based on batch tests
- Sampling and sulphate analysis from 1) Feed 2) effluent from R1 3) effluent from R2
- Operated for 6 to 8 hours both for gypsum precipitation (Day 1) and ettringite precipitation (Day 2)



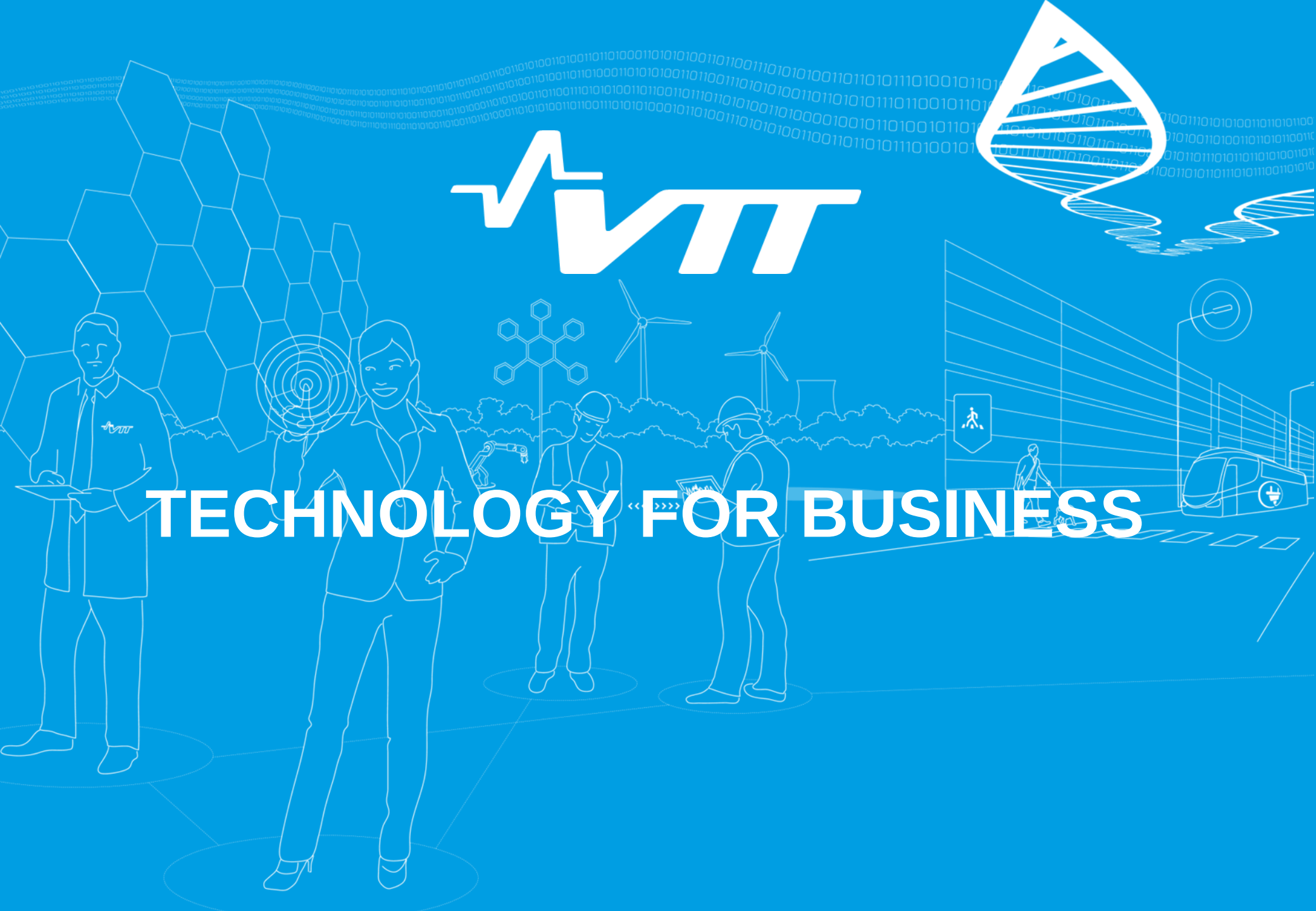
Results: continuous experiments





Outcomes

- Ettringite process for sulphate removal was taken to continuous stage at VTT
- Stable operating conditions were reached in the continuous sulphate removal experiments
- Results enable interaction with modelling to further develop the process and models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