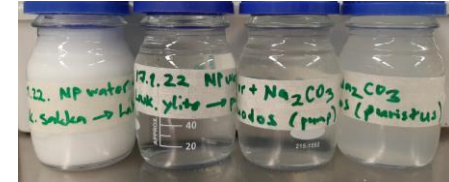


Lab scale testing

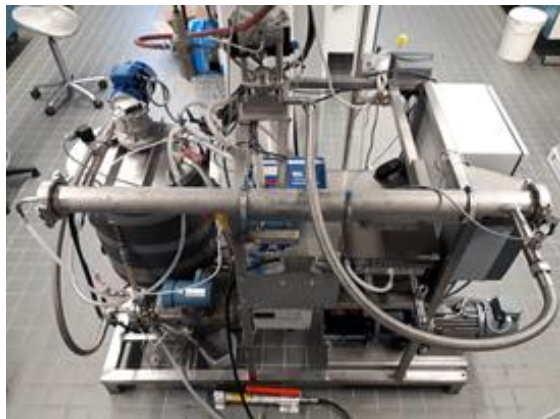
- Pretreatments
 - Precipitation of scalants before NF/RO
 - Transforming NH_4 to NH_3 gas form before MC
 - Multivalent ions removal before BMED
- Solids separation
 - Clarification, pressure filtration
- Clear liquid to membranes
 - DuPont: FilmTec NF270
 - MgSO_4 rej. 97.0 %, max. 41 bar
 - DuPont: FilmTec NF90
 - MgSO_4 rej. 98.7 %, max. 41 bar
 - LG Chem: LG SW
 - NaCl rej. 99.8 %, max. 83 bar



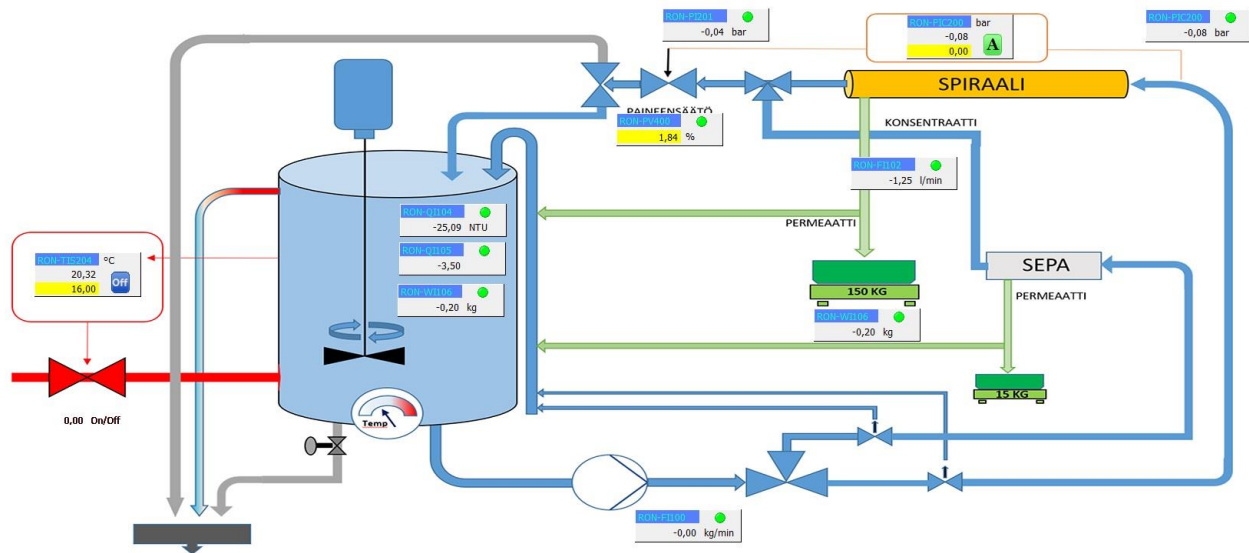
HP4750X Hastelloy Stirred Cell (Sterlitech, USA)

- MF, UF, NF and RO separations
- High-pressure, chemically resistant stirred cell
- Maximum pressure 172 bar
- Active membrane area 14.6 cm^2
- Maximum processing volume of 300 mL

Spiral NF/RO membranes



- FilmTec NF270-2540
- FilmTec NF90-2540



Membrane contactor

- Membrane contactor set-up
 - 3M Liqui-Cel MM-1x5.5 series X50
 - NaOH for feed pH adjustment, pH~10
 - Feed temperature ~25°C
 - Absorbent 0.5 M H₂SO₄
- Product ammonium sulphate
 - $2\text{NH}_3 + \text{H}_2\text{SO}_4 \longrightarrow (\text{NH}_4)_2\text{SO}_4$
- Ammonium sulphate concentration
 - AMS Technologies: NanoPro™ A-3011
 - Acid stable membrane, cut-off 100 Da

