Development of a decision support tool for water fit-for-use

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Introduction

- The decline of water resources makes research about **resource recovery** very important.
- This also applies to the delivery of **process water** in industry.
- Conventional wastewater treatment with activated sludge is not sufficient, **physico-chemical water treatment processes** are necessary.
- Challenges:
  - → changing feed water properties
  - → requirements vary by sector
- Solution: simulation with **models** to anticipate on these challenges

Problem Statement

- Main shortcomings in existing models:

  → **Lack of flexibility**

  Models are provided by different technology manufacturers which makes the coupling of models often not possible.

  → **No dynamics involved in the models**

  Current implementations are mostly considering steady state. In fact, changing input values have an influence on the process efficiency.

  → **No notion of uncertainty**

  How reliable are the results?
- A lot of experimental data is being collected but not used.

Solution: A decision support tool

Immediate:
+ Insight in processes
+ More optimal solutions

Longer term:
+ Models can be refined
+ Models can be added
+ Integration with process scheme models

Stages

1. Steady State Models → 2. Dynamic Models → 3. Couple the UP in a process train → 4. Uncertainty bands around model predictions

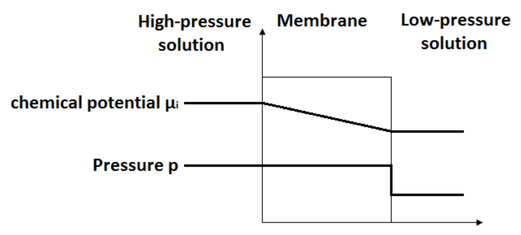
For several unit processes (UP)

Reverse Osmosis

= Pressure driven membrane process, mostly used for desalination

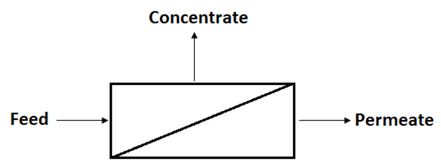
Transport through membranes described by the **solution-diffusion model:**

- Assumptions:
  - → Fluids on both sides of the membrane are in equilibrium with the membrane interface
  - → Pressure within the membrane is uniform in all directions



- For RO:

Solute flux: $J_s = B \cdot (C_{s,f} - C_{s,p})$
Water flux: $J_w = L_p \cdot (\Delta P - \Delta\pi)$



Membrane properties (L_p, B)
$C_{s,f}$
Range of ΔP
→
$C_{s,p}$
Rejection $R = 1 - \frac{C_{s,p}}{C_{s,f}} = \frac{J_w}{J_w + B}$

Relevant Project

IMPROVED industrial water use
Interreg Vlaanderen-Nederland

= 'improved water technology for chemical industry'

- 3 state-of-the-art mobile research facilities:
  - → purify the water in the most efficient way
  - → estimate the effect of corrosion or biofilm growth on the distribution system
  - → test the impact of the water quality on the downstream process goal
- Data for calibration and validation

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