REDUCING CHEMICAL USE FOR ION EXCHANGE PROCESSES WITH ARTIFICIAL NEURAL NETWORKS

Introduction

For the optimal operation of water production, *digital twins* or the real-time use of models would represent a powerful tool to monitor water quality and improve efficiency. Their potential to optimise chemicals and energy consumption is nevertheless still unexploited in the industry.

Ion exchange (IX) is an electrochemically driven process often used in water demineralisation. However, since the resins used for ion exchange gradually saturate and performance is reduced, regeneration becomes an essential part of the IX process. A major part of the operation costs is due to the chemicals used to regenerate the resins and the disposal of the waste streams generated. A powerful model capable of predicting water quality and resin saturation would allow to reduce the energetic and material impact of the process, maximising the environmental and economic sustainability of water production.

Methodology

Mechanistic models (based on differential equations) provide a mathematical representation of the system but often have limited predictive power due to unaccounted, complex phenomena such as resin fouling. A hybrid approach, where mechanistic models are combined with data-driven models such as *artificial neural networks* (ANNs), can mitigate these shortcomings. This allows to create very powerful models that can be used for smart operation and control of the process.

The work will focus on the development and validation of a hybrid model that predicts the breakthrough of specific ions during the different steps of an IX train operation, but also the regeneration process of the resins. An existing implementation of a mechanistic model will be used as a starting point. The final developed model will be used to establish a regeneration procedure minimising economic and environmental impact. Production of boiler feed water at a major chemical company will be used as a case study.

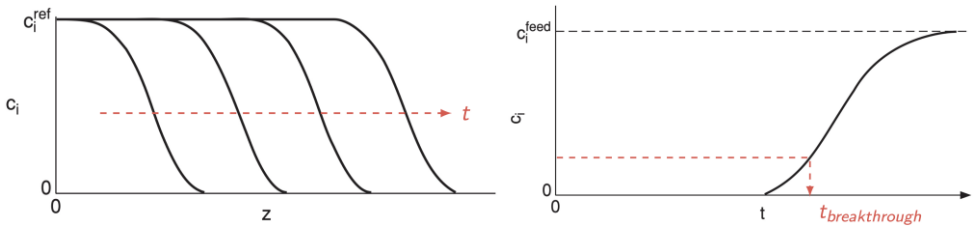


Figure 1 – Concentration profiles (left) and breakthrough curve (right) of an IX column.

Objectives of the thesis

The goal is to validate an algorithm to optimise the ion exchange operation and regeneration. Background knowledge of process modelling, simulation and basic programming skills are recommended, but not required.

SUPERVISOR

Prof. dr. ir. Ingmar Nopens

CO-SUPERVISOR

Prof. dr. ir. Elena Torfs (ULaval)

TUTOR

Ir. Daniel Illana González

BACKGROUND

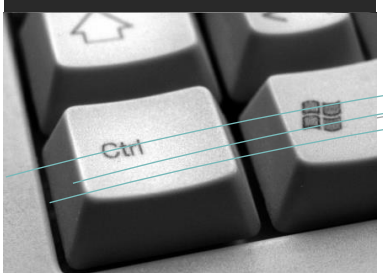
Chemistry & bioprocess tech., Environmental technology

LANGUAGE

English

MORE INFO

Daniel.IllanaGonzalez@UGent.be



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