

Membrane technologies

Outline

1. Introduction

Overview on principles, concepts, state-of-the-art and industrial relevance

2. Membranes

- 2.1 Membrane materials, preparation and manufacturing of membranes
- 2.2 Characterization of membranes
- 2.3 Transport in membranes
- 2.4 Polarisation phenomena
- 2.5 Membrane fouling

3. Module and process design principles

- 3.1 Modules
- 3.2 Membrane systems and operation

4. Membrane processes

- 4.1 Pressure-driven membrane processes
 - 4.1.1 Microfiltration¹
 - 4.1.2 Ultrafiltration
 - 4.1.3 Reverse osmosis
 - 4.1.4 Nanofiltration
- 4.2 Concentration difference as driving force
 - 4.2.1 Gas separation and vapour permeation
 - 4.2.2 Pervaporation
 - 4.2.3 Dialysis
 - 4.2.4 Carrier-mediated transport
- 4.3 Electrically driven membrane processes
 - 4.3.1 Electrodialysis
 - 4.3.2 Membrane electrolysis

¹ underlined are membrane processes with particular relevance for water treatment and purification

- 4.4 Thermally driven membrane processes
 - 4.4.1 Membrane distillation
- 4.5 Membrane contactors
 - 4.5.1 Gas-liquid contactors
 - 4.5.2 Liquid-liquid contactors
- 4.6 Membrane reactors
 - 4.6.1 Membrane reactor concepts for (bio)chemical synthesis
 - 4.6.2 Fuel cell systems

5. Exemplary membrane technologies for water treatment and purification

- 5.1 Production of ultrapure water
- 5.2 Desalination of seawater
- 5.3 Production of drinking water
- 5.4 Waste water treatment (MBR)

Main reference books:

Marcel Mulder, *Basic Principles of Membrane Technology*, 2nd Ed., Kluwer, 1996.
Richard Baker, *Membrane Technology and Applications*, Wiley, 2004.