Membrane Technology

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Chapter 3
Nanofiltration

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Chapter Description

- Aims
  - Understand what is nanofiltration and its separation mechanism
- Expected Outcomes
  - Understand nanofiltration membrane in general.
- Other related Information

Subtopics

3.1 Nanofiltration Membrane

3.2 Membrane Characterization

3.1 Nanofiltration

- Characteristics between RO and UF membranes, also known as loose RO, low-pressure RO. However, the common term used is nanofiltration (NF).

- It has NaCl rejections in the range 20-80% and molecular weight cutoffs (MWCO) in between 200 Da up to 1000 Da.

3.1 Nanofiltration

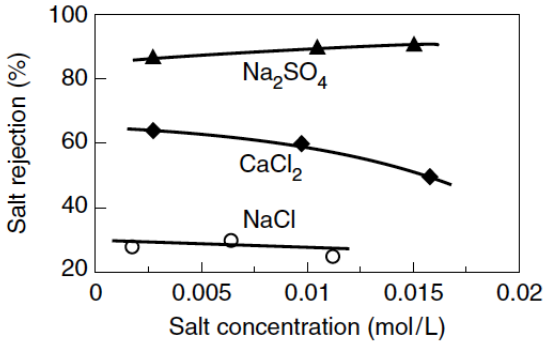
- Most of NF membrane are produced by interfacial polymerization approach to produce thin film composite membrane. Through this method, acid groups are attached to the polymeric backbone substrate (i.e. Polyethersulfone, Polysulfone).

- The separation of lactose, sucrose and raffinose which are classified as neutral solutes solely affected by the solute size where the rejection is proportional to solute size. In this case, the presence of charged groups does not affect the solute separation.

3.1 Nanofiltration

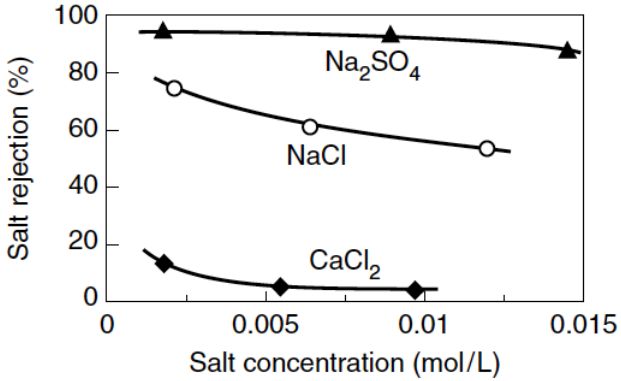
- It’s separation mechanism is more complicated. This is due to the effect of molecular/solute size (sieving effect) and Donnan exclusion effects (charge effect).
- It has very high rejections and permeances for very low concentrations salt, however the selectivity loss when concentrations of the feed are above 1000 - 2000 ppm salt. Therefore NF normally used to remove low levels of salt from already relatively clean water.
- The operated pressure is in the range of 50–200 psig and relatively low compare to RO.

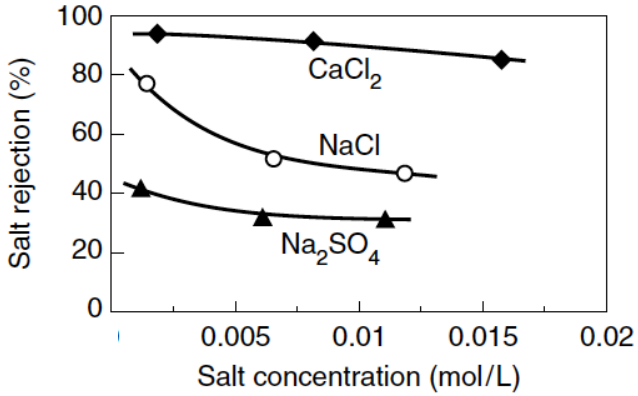
3.2 Separation Mechanism



Neutral membrane

- Simple size discrimination
- Rejection is $Na_2SO_4 > CaCl_2 > NaCl$





Anionic membrane
(fixed positive charges)

- Rejects Ca^{2+}
- Preferentially permeates SO_4^{2-}
- Rejection is $CaCl_2 > NaCl > Na_2SO_4$

Cationic membrane
(fixed negative charges)

- Rejects SO_4^{2-}
- Preferentially permeates Ca^{2+}
- Rejection is $Na_2SO_4 > NaCl > CaCl_2$

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References

- Mulder, M. (2000) Basic Principles of Membrane Technology, second ed., Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Baker, R.W. (2000) *Membrane Technology and Applications.* New York, Mc Graw-Hill.

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