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Published in:
Procedia Engineering

Link to article, DOI:
10.1016/j.proeng.2012.09.031

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 44 (2012) 2026

Procedia Engineering

www.elsevier.com/locate/procedia

Euromembrane Conference 2012

[P3.149]

Strategies for controlling the rejection of charged oligosaccharides during ultrafiltration: Modification of molecular shape, operational pressure and membrane cutoff

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An increase of pH causes carboxymethylcellulose (CMC) molecules to pass from an entangled spherical-like shape to a more linear one, due to an increasing repulsion among the negative charges on the carboxyl groups of the molecule. Spherical-like molecules (pH 2) were able to build a much more compact external layer on the surface of the membrane –as compared to the linear ones-, which induced a dramatic decrease of permeate flux and a rejection enhancement. A decrease of pressure from 4 to 2 bars also resulted in increasing values of rejection during the first minutes of CMC concentration, to later attain the same values regardless the operational pressure. Such results were ascribed to the formation of a cake layer on the surface of the membrane, which was found to have a concentration 50% higher than the concentration of the feeding solution (40 g/L). An increase of the membrane cutoff from 100 to 300 kDa did not result in a significant difference in the flux through the membrane. However, rejection was found to be much higher for the 300 kDa membrane. Such rejection increase was presumably due to the occurrence of internal fouling, which was favored by the enhanced pore size –becoming easier for the molecules to penetrate the pores-. The results of this study show three different strategies –pH, pressure, and membrane cutoff- to control the rejection of a particular charged solute during concentration, which can be applied independently or in combination and probably be extrapolated to other solutes with similar molecular features.

Keywords: Charged oligosaccharides, Molecular shape, Rejection control, Carboxymethylcellulose (CMC)

doi:10.1016/j.proeng.2012.09.031