FLUX ENHANCEMENT IN CROSS FLOW MEMBRANE FILTRATION: FOULING AND IT'S MINIMIZATION BY FLOW REVERSAL

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ABSTRACT

The loss of permeate flux in crossflow membrane filtration, such as reverse osmosis (RO), ultrafiltration (UF) and microfiltration (MF) is inevitable. This is caused by concentration polarization and membrane fouling and is perhaps the single most important reason for relatively slow acceptance of crossflow membrane filtration in many areas of chemical and biological processing. To overcome the losses in permeate flux associated with concentration polarization and fouling, in cross flow membrane filtration, we investigated the concept of flow reversal as a method to enhance membrane flux in ultrafiltration [1,2]. Conceptually, flow reversal prevents the formation of stable hydrodynamic and concentration boundary layers at or near the membrane surface. Furthermore, periodic reversal of the flow direction of the feed stream at the membrane surface results in prevention and mitigation of membrane fouling. Consequently, these advantages are expected to enhance membrane flux significantly.

Laboratory scale tests on a hollow fiber ultrafiltration membrane module using bovine serum albumin (BSA) and Dextran T-70 as model solutes show that the permeate flux is significantly enhanced under flow reversal condition when compared with the conventional unidirectional flow [3,4]. The flux enhancement is dramatic (by an order of magnitude) with increased feed concentration and operating transmembrane pressure. The essential elements of the system include a crossflow hollow fiber membrane module integrated with a three-way valve to direct the feed flow directions. The three-way valve is controlled by a controller-timer for periodic reversal of flow of feed stream. Another important feature of the system is that with changing feed flow direction, the permeate flow direction is also changed to maintain countercurrent feed and permeate flows for enhanced mass transfer driving force (concentration difference). An update of our work on flow reversal will be given in this presentation.

References:

1. Hargrove, S.C., Parthasarathy, H., Ilias, S., "Flux Enhancement in Crossflow Membrane Filtration by Flow Reversal: A Case Study on Ultrafiltration of BSA," *Sep. Sci. Technol.*, (In Review, 2002).
2. Hargrove, S.C., and Ilias, S., "Flux Enhancement in Cross Flow Membrane Filtration by Flow Reversal: A Case Study on Ultrafiltration of BSA," *IIChE CHEMCON 2000*, vol. I, pp. NSP1-4 (2000), Calcutta, India, December 18-21, 2000.
3. Ilias, S., Sirena, H, and Talbert, M., "Flux-enhanced cross-flow membrane filter," US Patent #6,168,714 (2001).
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List of Published Journal Articles, Completed Presentations and Students Receiving Supports from the Grant:

Journal Articles:

Hargrove, S.C., Parthasarathy, H., Ilias, S., "Flux Enhancement in Crossflow Membrane Filtration by Flow Reversal: A Case Study on Ultrafiltration of BSA," *Sep. Sci. Technol.*, (In Review, 2002).

Conference Proceedings:

Hargrove, S.C., and Ilias, S., "Flux Enhancement in Cross Flow Membrane Filtration by Flow Reversal: A Case Study on Ultrafiltration of BSA," *IIChE CHEMCON 2000*, vol. I, pp. NSP1-4 (2000), Calcutta, India, December 18-21, 2000.

Presentations:

Hargrove, S.C., Parthasarathy, H., Ilias, S., "Flux Enhancement in Crossflow Membrane Filtration by Flow Reversal: A Case Study on Ultrafiltration of BSA," *12th Symposium on Separation Science and Technology for Energy Applications*, Gatlinburg, Tennessee, October 15-18, 2001.

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