OPEN ACCESS Freely available online

ISSN: 2155-9589
Journal of Membrane Science & Technology

Opinion Article

Membrane Fouling Characteristics and its Control in a Membrane Filtration System

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DESCRIPTION

Membrane Fouling (MF) is the transferred of a solution or particle on a surface of the membrane or in membrane pores during techniques such as Membrane Bioreactors (MB), Reverse Osmosis (RO), Forward Osmosis (FO), Membrane Distillation (MD), Ultra-Filtration (UF), Micro-Filtration (MF), or Nano-Filtration (NF). As a result, the membrane's performance decreases. It is a significant obstacle to the widespread adoption of this technology. Membrane fouling can cause a significant reduction in flux and a decrease in the quality of the water production. Severe fouling may necessarily require an extensive chemical cleaning or membrane restoration.

This enhances a treatment factory's operating costs. Foulants are classified as suspended particles (clay minerals, flocs), biological (bacteria, fungi), organic (oils, conductive polymers, humics), or scalability (mineral precipitates). Depending on the particle developmental strength to the membrane surface, membrane fouling is classified as either reversible or irreversible. A strong shear force or backwashing can be used to remove reversible fouling. During a continuous filtration process, the formation of a strong matrix of fouling layer with the solute will result in reversible fouling being transformed into an irreversible fouling surface. The strong arrangement of particles that can't be removed by physical cleaning it is referred to as irreversible fouling.

Causes of membrane fouling

Micro-Filtration (MF), Ultra-Filtration (UF), Reverse Osmosis (RO), and Nano Filtration (NF) are all membrane filtration systems that use semi-permeable membranes to acquire particles from liquids. Membrane fouling occurs when contaminants transfer on the surface of a filtration membrane, trying to obstruct liquid flow through the membrane's porous structure. Additional biological, colloidal, and organic particles in the groundwater; an inappropriate selection of membrane material; and unsuitable process conditions such as flow rate, temperature, and pressure can all contribute to fouling.

Factors that affect membrane fouling

According to recent fundamental studies, membrane fouling is influenced by a wide range of factors such as system hydrodynamics, operating conditions, membrane properties, and properties of the material (solute). Concentration polarization effects are minimal at low pressure, low feed concentration, and high feed velocity, and flux is directly proportionate to trans-membrane pressure difference. In the high pressure range, however, flux has become almost independent of pressure applied. Concentration polarization causes the variability from the linear flux-pressure association. At reduced feed flow rate or with increasing feed concentration, the limiting flux situation can be observed at the relatively low pressures.

Fouling control

Membrane fouling is an unavoidable phenomenon during membrane filtration; it can be reduced through methodologies such as cleaning, appropriate membrane selection, and operating condition selection. Cleaning membranes can be performed manually, biologically, or chemical characteristics. Physical cleaning techniques consist of a gas scour, sponges, jets of water, or back flushing with permeate or filled with air. Biological cleaning utilizes biocides to eliminate all micro-organisms, whereas solvent extraction employs acids and bases to eliminate micro pollutants and impurities. Another method for reducing membrane fouling is to employ the appropriate membrane for the operating condition. The phenomenon of the feed water must be determined, and then a membrane less prone to fouling with that solution is identified.

A hydrophilic membrane is preferred for aqueous filtration. A hydrophobic membrane is preferred for membrane distillation. Operating conditions are also important during membrane filtration because they can affect fouling conditions during

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Received: 03-Nov-2022, Manuscript No. JMST-22-19281; **Editor assigned:** 07-Nov-2022, Pre QC No. JMST-22-19281 (PQ); **Reviewed:** 21-Nov-2022, QC No. JMST-22-19281; **Revised:** 28-Nov-2022, Manuscript No. JMST-22-19281 (R); **Published:** 08-Dec-2022, DOI: 10.35248/2155-9589.22.12.310.

Citation: Rizwan J (2022) Membrane Fouling Characteristics and its Control in a Membrane Filtration System. J Membr Sci Techno. 12:310.

purification process. For example, cross flow filtration is frequently preferred over dead end filtration because require more extensive during the filtration results in a thinner deposit surface and therefore reduces fouling (For example tubular pinch effect). Air scour is used to promote turbulence at the membrane surface in some applications, such as membrane bioreactor applications.