290r Hydraulic and Chemical Cleaning of Cellulose Acetate Ultrafiltration Membranes

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Natural organic matter (NOM) is considered a major component of irreversible membrane fouling in water separation applications. NOM fouling has been observed to correlate with membrane properties, such as hydrophobicity, surface roughness, charge, and molecular weight cutoff (MWCO). Other studies have made opposite observations, such as no relationship between NOM fouling and surface roughness. Because the chemistry of NOM is complex, variable and largely unknown, considerable research has focused upon more specific investigations of polysaccharides and proteins within NOM that may cause fouling. Recent evidence suggests that organic colloids (e.g., cell fragments and residues) are important foulants; in some cases, these foulants have been misinterpreted as inorganic colloids. Another form of NOM is effluent organic matter (EfOM) associated with wastewater treated to a secondary (biological) level. EfOM consists of organic matter contributed by the drinking water source plus soluble microbial products (SMPs) produced during biological treatment, and has relevance from the perspective of effluent-impacted drinking water sources or wastewater reuse. Operational definitions of NOM fractions by various separation techniques has led to rankings of foulant potential. The various fractions were introduced as feed to hydrophobic membranes and the decreasing order of fouling was consistently hydrophilic neutral > hydrophobic > transphilic > hydrophilic charged compounds. The negative charge of most membrane surfaces repels like-charged organic substances, which explains these results. However, divalent calcium ions (especially calcium) greatly enhance NOM fouling by complexation and subsequent formation of intermolecular bridges among organic foulant molecules. The size of the NOM compounds can also influence fouling. Larger molecular weight compounds have a stronger impact on fouling than smaller molecular weight compounds. In summary, fouling of membranes is determined by the composition of the feed water and the physical/chemical properties of membranes and foulants. In addition, the interaction among the feed water components, including bacteria, and interaction between components and properties of membranes also contribute to the variation of performance and fouling of membranes. The current understanding of all of these chemical and physical interactions is still insufficient to gain a comprehensive picture of membrane fouling.