Abstract

India is one of the world's major cane sugar producers, manufacturing plantation white sugar by the double sulfitation process. The juice clarification step involves liming and sulfitation, resulting in a yellowish-brown juice that still contains suspended solids as well as dissolved non-sugar components. The clarified juice characteristics can be improved significantly by ultrafiltration (UF) using polymeric membranes. This, in turn, leads to enhanced yield of superior quality sugar and overall increase in factory capacity. However, the application is seriously limited by membrane fouling.

This work focused on identification of the fouling components in sugarcane juice UF, particularly in the feed polysaccharide fraction, followed by fouling control through surface modification of polysulfone (PS) / polyethersulfone (PES) membranes. Commercial PS and PES membranes, having nominal molecular weight cutoff (MWCO) rating between 10 and 150 kD, were tested with sugarcane juice and the juice polysaccharide fraction, which was used as a model foulant. A detailed characterization of the foulant was performed, and the effect of fouling on flux and membrane MWCO was studied. Different chemical cleaning procedures, with emphasis on short cleaning duration (< 30 minutes), were examined. Select membranes were modified via photograft copolymerization using poly(ethyleneglycol) monomethacrylate (PEGMA) monomer and their UF performance with sugarcane juice was investigated.

Membrane fouling in sugarcane juice UF was predominantly due to the dissolved non-sugar components and surface fouling was an important phenomenon. A 130 kD high molecular weight component in the juice polysaccharide fraction, containing arabinogalactan protein, along with some phenolics and lipids, was a significant membrane foulant. Short chemical cleaning cycles (up to 20 minutes) using alkali and hypochlorite was effective; however NaOCl treatment resulted in significant change in membrane properties, including flux enhancement and pore damage. Membranes with a NMWCO rating between 30-50 kD appeared to be most appropriate for this application. Furthermore, surface modification reduced the membrane propensity to foul and also improved the ease of cleaning.