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Cleaning and ageing of ultrafiltration membranes

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Fouling is one of the most important limiting factors in the industrial application of membrane processes. It implies the need of periodical stops in order to apply cleaning procedures to reestablish membrane properties. Despite both fouling and cleaning are known problems, almost all studies have been directed so far to increase the understanding of fouling basics to define strategies in order to minimize it, leaving the cleaning in the background. As a result, most of the cleaning procedures are carried out under excessive dosages (or not the most appropriate chemicals), temperatures and exposure times, which leads to the shortening of membrane lifetime and eventually, finally leads to an increase of the operating costs. Moreover, cleaning involves the use of energy, chemicals and water, in addition to that required by the membrane separation process.

The aim of this work is to contribute to the understanding of membrane cleaning, by collecting experimental data which enable to characterize the kinetics of chemical cleaning and membrane ageing as a function of cleaning chemical concentration and temperature. The study focused on ultrafiltration polymeric commercial membranes made of different materials. Two foulants were used: cheese whey and and hydrolyzates from lignocellulosic materials.

Membranes under study were obtained from Nadir, GE Osmonics, Koch and Millipore. They were characterized by permeability, rejection of molecular markers -polyethylene glycol (PEG) solutions (in order to compute differences in molecular weight cut-off, MWCO)- and specific solutes (during the fouling steps), FTIR-ATR, contact angle and streaming potential.

Sets of experiments have been carried out with membranes of (i) similar MWCO (both previously characterized) and made of different materials (PSf, PES, PVDF and RC) and manufacturer, and (ii) membranes of the same material, but different MWCO and manufacturer. The protocol has first established the boundaries of the variables by subjecting the membranes at extreme conditions enough to degrade them within a few hours (which are essentially a function of the membrane material). Then, lower concentration and temperatures were used to collect data with time in order to follow cleanability and membrane degradation in an accurate way, and to collect data for a cleaning model, which could serve as the basis for membrane screening, establishing cleaning protocols and estimate membrane ageing.

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