EFFECTS OF HYPOCHLORITE DAMAGE ON FLUX THROUGH POLYETHERSULPHONE ULTRAFILTRATION MEMBRANES

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ABSTRACT

Polyethersulphone (PES) ultrafiltration membranes are widely used for the ultrafiltration of cheese and casein whey, and other dairy products. Solutions of sodium hypochlorite are used as sanitising agents during the cleaning of these membranes, but long-term exposure causes degradation of the membranes.

PES membranes with a nominal molecular weight cut-off of 10 kDa were degraded in solutions of sodium hypochlorite over a range of pH values at 50 °C to achieve exposure measured in ppm-days of chlorine exposure. Scanning electron microscopy evidence of surface pitting in this work has already been reported.

The degraded membranes were tested, using an AKTA crossflow system, for clean water flux, demineralised whey flux and protein rejection. The water fluxes for three membranes (new, 10,000 ppm-day pH 12, and 10,000 ppm-day pH 9) were found to be about 100, 200 and 400 L $m^{-2}h^{-1}$ respectively with cross flow at 1 bar transmembrane pressure. However whey fluxes were about 23, 5, and 6 L $m^{-2}h^{-1}$ for the same three membranes. Any membrane that had been exposed to hypochlorite had a significantly lower whey flux than a new membrane. Size exclusion chromatography of the permeates showed significant leakage of α-lactalbumin and β-lactoglobulin through membranes degraded at pH 9 for 20,000 ppm-days, while almost no leakage was found for degradation at pH12.

These results show that hypochlorite degradation affected fluxes with at least two mechanisms. It was likely that membrane pitting increased the pore size, or exposed some large pores, causing increased water flux and protein leakage. However hypochlorite also seemed to alter the membrane surface properties, causing the protein to form a less permeable layer that reduced the flux of whey.