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NITROGEN CONTENT AND HEAVY METALS REMOVAL BY POLYETHERSULPHONE ULTRAFILTRATION MEMBRANE

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Introduction

Heavy metals removal from aqueous systems can be achieved by conventional treatment processes such as ion exchange, electrochemical removal and chemical precipitation. Membrane processes, such as reverse osmosis (RO), nanofiltration (NF), microfiltration (MF) and ultrafiltration (UF), represent a valid alternative to treatment and to improve the quality of aqueous systems. This study will investigate the applicability of the ultrafiltration process for removal of nitrogen content and heavy metals Cr, Ca^{2+}, Na^{+} and K^{+} from aqueous collagen solutions. The study was conducted using two polyethersulphone membranes with different molecular weight cut-off (5 kDa and 10 kDa) that were characterized the point of view of ultrapure water fluxes, permeability and rejection.

Materials and methods

The feed solutions used in the experiments consisted of stock solutions of bovine collagen hydrolysate with a molecular weight of 2000 Da, 5600 Da, 7000 Da, 10000 Da. Aqueous collagen solutions were prepared in ultrapure water, obtained using a Milli-Q instrument, France. The collagen solutions were homogenized by magnetic agitation at 600 rpm for 60 min at 25ºC. The solutions had 1% collagen concentrations. All ultrafiltration experiments were performed using a 5 kDa (M1) and 10 kDa (M2) polyethersulphone flat-sheet membrane (Sartorius Stedim Biotech GmbH, Germany), with 76 mm diameter. The filtration experiments were performed with ultrafiltration membrane system, LABCELL CF-1 Koch Membrane Systems, United Kingdom. The Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES) with an Optima 5300 DV Perkin Elmer spectrometer was used for determination of the heavy metals content. A Shimadzu analyzer TOC-L CPH/CPN was used to determine the nitrogen content.

Results and conclusions

The ultrapure water fluxes for the two membranes tested in the study were performed at five different pressures, from 2 to 6 bar, with 1 bar increment. The permeability graph as a function of transmembrane pressure for M1 and M2 membranes is shown in Figure 1. It can be seen that the permeability's increases with increasing transmembrane pressure.

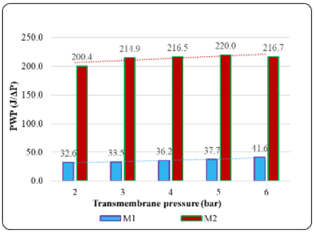

Figure 1. Permeability of M1 and M2 membranes depending on transmembrane pressure

The degree of rejection of polyethersulfone membranes was determined by analyzing the total nitrogen in the initial solutions, permeates and concentrates. In Figure 2. the degrees of rejection of polyethersulfone membranes are shown.

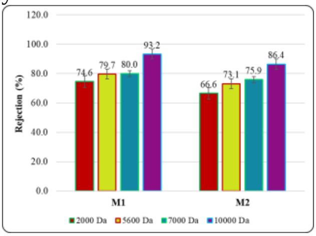

Figure 2. Rejection of nitrogen content with M1 and M2 membranes

From figure 2 it can be seen that M1 membrane performs better rejection in terms of nitrogen content for all four tested solutions compared to the M2 membrane. Nitrogen rejection for the four solutions used increases with increasing molecular weight of the collagen hydrolysate.

In Figures 3 and 4 were presented the rejection of heavy metals with M1 and M2 membranes.

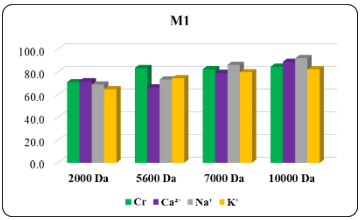

Figure 3. Rejection of heavy metals with M1 membrane

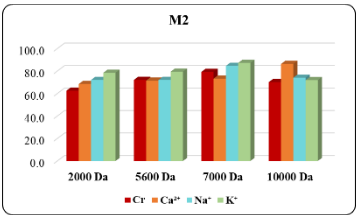

Figure 4. Rejection of heavy metals with M2 membrane

Heavy metal rejection varies between 64.8 and 88.9% for the M1 membrane, and between 62.6 and 87.2% for the M2 membrane.