Preparation and characterization of nanofiltration membranes based on Polisulfonamide

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Membrane separation processes have been becoming an increasingly important alternative purification of products and water treatment in general. One such process is nanofiltration (NF): an intermediate process between reverse osmosis and ultrafiltration membranes. The NF membranes have the property of separate molecules of low molecular weight and multipurpose ion [1]. NF membranes are obtained mainly by interfacial polymerization between a diamine and an acid chloride. The performance of NF membranes is dependent on several factors such as type and ratio of monomers used: the preparation and the condition of post-treatment [2]. The piperazine (PIP) is a monomer widely used for interfacial polymerization, which reacts with trimesoíla chloride (TMC), leading to the formation of NF membranes poly (piperazinamida) [2].

Most of the commercial membranes are of type polyamide and few scientific works have been performed for the development of membrane type sulfonamides. A comparison of the chemical properties of the amides and sulfonamides suggests that the later have some advantages such as: they are chemically and thermally more stable in acids, basic, and oxidative. Their resistance to biocides, and their polisulfonamida formation reaction is much slower than for polyamide, resulting in a reaction zone which is more diffuse, leading to the formation of a less dense film [3]. This work aims to synthesize, characterize and evaluate NF membranes with selective layer polisulfonamida, obtained through the reaction between diamines: PIP/4,4diaminodiphenylsulfone (DDS) and the acid chloride: TMC. The commercial membrane UF of poly (ether sulfone) (PES) was used as support. The support remained in water for 24 hours and then was impregnated with solution 1% (w /w) PIP:DDS: a concentration gradient (PIP: DDS = 100:0, 90:10, 80:20, 70:30 , 60:40 and 50:50). Then withdrew the excess diamine solution and added to the organic solution (hexane: toluene 8:2) 0.2% TMC so that the polymerization reaction occurs forming the interfacial film on the surface of polisulfonamida support. The reaction time was 60 seconds.

Membranes were characterized as transport properties and content of DDS incorporated in the selective layer for the following analyzes: Infrared (IR) and X-ray diffraction. Experiments to determine the transport properties: permeate flux and rejection of sulphate ions were performed using a permeation system with displacement tangential flow with operating pressure of 15 bar. It was used as the feed solution Na_2SO_4 2600 mgL^{-1}. The concentration of sulfate in the solutions permeated and feeding were determined in ICS-1000 ion chromatograph and the rejection of the membranes calculated, according to the equation:

$$R(\%)=(1-Cp/Ca)x100$$

The table 1 shows the results obtained in the performance of the membranes with respect to permeate flux and rejection of sulphate ions, and the content of S incorporated in the selective layer by X-ray diffraction.

Table 1 - Results on the performance of the membranes

Code membrane	Diamine Composition	Transport Properties		S content incorporated
	PIP/DDS	Permeate flux (L/m2h)	rejection SO_4^{2-} (%)	(% C/S)
L -81	100/0	15	91	-
L-100	90/10	16	81	57
L-102	80/20	27	73	50
L-105	70/30	51	28	38
L-123	60/40	18	14	45
L-115	50/50	64	5	48

Regarding the results shown in the Table 1, it can be concluded that the rejection of sulphate ions decreased with increasing content of DDS, probably due to the larger size pores of the selective layer with increasing content of DDS. Through X-ray diffraction was confirmed the incorporation of the DDS in every synthesized membranes.

References

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