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Development Cellulose Acetate /Polysulfone Membrane for Desalination Application

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ABSTRACT

The work consists of preparing organic polymer membranes based on polysulfone (PSf) and cellulose acetate (AC) PSf / AC using the phase inversion technique induced by coagulation in a NIPS water bath followed by a heat treatment in an oven for 15 min at 90 ° C. Polyethylene glycol PEG was used as an additive and DMF as a solvent. It has been shown that the membrane manufacturing parameters such as the thermal annealing treatment, the level of PEG, the PSf / PEG ratio in the casting solution, have considerably influenced their structure and consequently their efficiency and performance. The retention of monovalents salts was studied, the obtained results were satisfied for Mg and Ca salts which is in accordance with WHO standards.The NaCl salt retention reaches the maximum peak of 50% for the membrane in pure cellulose acetate.

Keywords : Membrane, Cellulose acetate, Performance.

1 Introduction

One of the most promising approaches to alleviate the water shortage is desalination can increase the water supply beyond what is available from the hydrological cycle. Seawater desalination indeed provides an infinite, steady supply of high-quality water that does not harm natural freshwater ecosystems. The leading process for desalination in terms of installed capacity and yearly growth is the membrane technology. This technology has proved the efficient membrane should combine high permeability with high rejection. Ideally, to achieve the optimum filtration performance, a membrane should be as thin as possible to maximize water permeability, as selective as possible and as mechanically robust as possible to inhibit membrane disintegration [1-2]. This work concerns the morphological modification of membranes based on cellulose acetate-polysulfone PSf-CA in the presence of polyethylene glycol additive PEG 400, using a heat treatment on the surface of the membrane and their applications in the retention of divalent and monovalent salts[3-4].The water permeation and retention properties of the polymeric membranes were tested using a lab-made cross-flow filtration apparatus at room temperature.

2 Results and Discussion

The obtained results for rejection of divalent ions such as magnesium Mg^{2+}, calcium Ca^{2+} and sodium chloride NaCl was evaluated for the different membranes. It was noticed that for Magnesium Mg^{2+}, a strong elimination was observed for all the membranes, it increases from 70 to 98%. The hydrated radius of Mg^{2+} is greater than that of Ca^{2+} , the membrane therefore exhibits a greater rejection of Mg^{2+}. For calcium, the rejection rate is estimated between 63% to 35%. We find that the discharge of divalent ions shown in Figure.1 meets WHO freshwater standards. The low retention of the MAc membrane is probably due to the compaction effect which caused an increase in flux and decreased retention because this membrane consists only of cellulose acetate which is very sensitive to compaction [5-6]. The NaCl salt retention reaches the maximum peak of 50% for the MAc membrane and the minimum for the MC membrane. It is the lowest compared to that of the divalent salts MgSO4 and CaCO3. This decrease is justified by the increase in the level of PEG in the mixture; it involves sieving the sizes of the pores of the

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membranes formed; That is, the larger the pore size, the lower the ion rejection. On the other hand, the smaller the pore size, the greater the ions rejection. It was found that the highest retention rate is obtained for the membrane characterized by a low filtration flux. These two parameters vary inversely. This confirms the previous results.

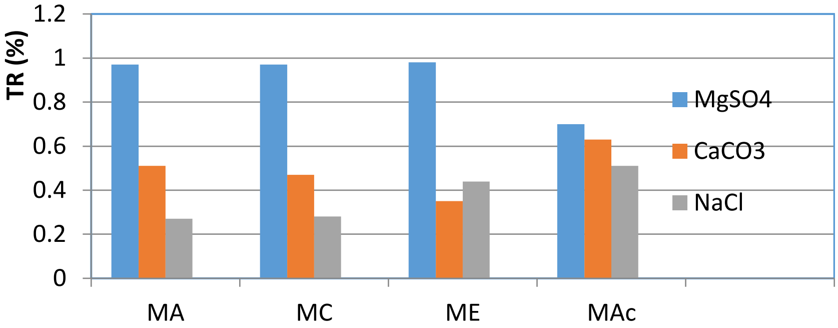

Figure1: Salt retention rate for the different membranes.

3 Conclusions

In summary, the salt elimination study for MA, MC, ME, MAc membranes, allowed us to say that in terms of selectivity; the MC and MA membranes showed more or less similar results with a maximum efficiency of retention of Mg^{2+} and Ca^{2+} salts. Regarding the NaCl salt, the best retention rate is obtained for the MAc membrane but it remains insufficient to meet the salinity standards required by WHO. In conclusion, the rejection salts rate for the membranes studied follows the following sequence: MgSO4> CaCO3>NaCl. MA (10/15/75) and MC (12/25/63) membranes can be considered the most reliable and efficient for elimination of divalent salts from a flux point of view. They present the optimal parameters; but it is the MC membrane that is more appropriate for a flux of 87.2 L/ h.m2 at 20 bars, retention rates of Mg2+ and Ca2+ salts 98% and 35% which meets WHO standards. The qualitative results concerning salts rejection studied for the MA, MC, ME membranes, revealed that the best NaCl salt retention rate is obtained for the MAc membrane and remains insufficient to meet the salinity standards, concerning the rejection of salts divalent Mg^{2+} and Ca^{2+}. The MC membrane (PSF/ PEG/ AC):(12/25/63), can be considered to be the most reliable and efficient. It presents the optimal parameters; a flux of 87.2 L/ h.m2 at 20 bars, retention rates of Mg2+ and Ca2+ salts 98% and 35% which is in accordance with WHO standards.

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