SP13. SYNTHESIS OF HIGH-PERFORMANCE BIOLOGICALLY-INSPIRED NANOFILTRATION MEMBRANES FOR WATER TREATMENT

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Aquaporins are membrane protein water channels present in cells, and they restrict the passage of contaminants without preventing the passage of water. Small molecules such as urea and boric acid, the removal of which is inefficient by conventional membranes are also rejected. Biomimetic membranes, an innovation in water filtration technology attempts to replicate this natural process of highly selective and efficient transport of different molecules across a semi-permeable membrane occurring at the cell level. Therefore, aquaporins have received worldwide attention because of their potential to form biomimetic membranes with high flux and selectivity for water reuse and desalination. However, challenges involved in the incorporation of aquaporin proteins in membranes limit their applicability. One of them is to attach aquaporins to the membranes without chemically altering or damaging the aquaporins during the binding to the membrane. The second challenge is to design and prepare an assembly that allows biomimetic membranes with aquaporins to sustain hydraulic water pressure gradients without losing their integrity and performance. The overarching objective of this project is to form a biomimetic membrane made of unaltered aquaporins dispersed in a polymeric membrane selective layer and capable of operation under high hydraulic pressure. Polybenzimidazole (PBI) membranes were surface modified with treated aquaporins in order to achieve higher water flux and selectivity. Membranes modified with aquaporins displayed lower flux declines and higher flux recovery values after backwash as compared to unmodified PBI membranes. Also, modified membranes showed improved rejection values for both protein and salt solutions of different concentrations. However, there was leakage of ions between the channels. Therefore, in order to improve the rejection of protons, ions and other impurities, aquaporin channels were aligned with the direction of water flow. Functional groups were installed on AqpZ for covalent attachment to the polymer matrix so that the proteins could be immobilized to the membranes and aligned in the direction of the flow.