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Development of novel green membrane without the use of organic solvent

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Nowadays, the most widespread industrial processes to manufacture polymeric membranes by phase inversion (NIPS, VIPS or TIPS) use large solvent quantity, hence leading to environmental and health problems. With polymer concentration usually in the range of 15-20% and since frequent renewal of coagulation and washing baths, large amounts of aqueous solutions must be treated. This work aims at developing novel free organic solvent membranes, in agreement with green chemistry principles. To the best of our knowledge, such solvent free membranes had never been prepared before for water filtration applications. Two water soluble polymers were focused: the hydroxypropylcellulose (HPC) and the polyvinyl alcohol (PVA), characterized by moderate lower critical solution temperature (LCST) of around 40 °C. The phase separation was induced by an unconventional method-the LCST-TIPS process. The polymer solution was heated above the critical solution temperature to induce the phase inversion. Porous membranes from HPC/water and PVA systems were therefore prepared under various operating conditions. Since water soluble polymers were used, consolidation of the film structure was carried out by chemical cross-linking. Lastly, porogen molecules were added in the initial formulation, in order to improve the membrane's filtration performances. First, the phase diagrams of both systems were studied using UV visible spectrophotometer and DLS measurements. Spinodal curves were also determined for both systems in the usual polymer concentration ranges for membrane preparation. The cross-linking performances and rate were then investigated using rheological measurements (Anton Paar Rheometer) at different crosslinker/polymer ratios. For PVA based membranes, a modelling approach was also used to optimize the operating conditions with regards to crosslinking efficiency. Finally, the mechanical resistance and filtration performances were studied for both systems. Such unconventional membrane exhibited surprising and very promising performances during filtration of water solutions.

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