Development of a Composite Membrane with a Liquid-barrier Chemical-resistant Polymer Matrix to Recover Water from Urine-containing Wastewater

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Abstract:

Current osmotic processes offer the potential to increase water recovery from wastewater; however there are two problems with currently available reverse osmosis (RO) membranes. First, the polyamide-based RO membranes rapidly degrade when exposed to acid pretreated urine and urine brines. Additionally, present RO membranes have relatively low rejections (~60%) of neutral solutes such as urea[1] while they have very high rejections (>99%) of ionic solutes.

Our research focuses on the development of mixed matrix membranes that solve both problems. We developed an innovative mixed matrix membrane design that integrates water-selective zeolite nanoparticles into a liquid-barrier chemically resistant polymer film.[2] The main distinguishing characteristics of our new membrane design compared with current mixed matrix membranes include: (1) the use of an impermeable polymer matrix enabling us to use a broader range of chemical resistant polymers; (2) the use of zeolite particles with specific pore size ensureing us the high rejection of the neutral molecules since water is transported through the zeolite rather than the polymer; (3) the use of latex dispersions as the polymer matrix source. Latexes are environmentally friendly water based-solutions, sharing the qualities of low volatile organic compound (VOC), low cost, and non- toxicity. In our design, the zeolite particles are anchored to a porous substrate. Then, a liquid-barrier chemically resistant polymer matrix fills the space between the zeolite nanoparticles and binds the zeolite into a versatile nanocomposite thin film.

In this talk, we will discuss our progress on development and synthesis of this novel membrane. We have successfully anchored zeolite nanoparticles to porous substrates. We have studied the effect of the polarity of solvents, leaving group of silane agents, the temperature and time of the silanization reaction on anchoring zeolite nanoparticles to porous substrates. Furthermore, we have developed a novel fundamental understanding of the latex film formation on porous substrates. We investigated the effect that the properties of the latex solution and the properties of the porous substrate have on the formation of defect free films of latexes on porous substrates.[3] Additionally, we will report on the flux and sodium chloride rejection of brackish water, as well as the material characterization, of our new mixed matrix membrane.

References

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