Dr. Isabel Escobar, Professor in Chemical and Environmental Engineering at the University of Toledo recently completed her Ohio Water Resources Center funded project via OWDA subaward. Her project titled “High-performance Biologically Inspired Membranes for Water Treatment” relied on the idea of combining the ultra-efficient functioning of biological molecules with the productivity of synthetic membranes. These biomimetic membranes with structure and function similar to the membranes of living organisms may offer the ultimate breakthrough for low-energy desalination.

The objective of the project was to make a new class of biomimetic nanofiltration membranes by modifying their surface and making them chemically and mechanically stable (Figure 1). In short, aquaporins were treated with polysaccharides to protect them, and then were embedded in amphiphilic polyvinyl alcohol with alkyl side chains (PVA-alkyl) matrix. This PVA alkyl with embedded aquaporins will be used as the nanofiltration membrane active layer on the surface of a polybenzimidizole (PBI) membrane (Figure 1 shows a PBI membrane being cast). While initial flux values of aquaporins modified membranes were lower than unmodified membranes, final flux values after 140 hours of experiment were consistently higher for the modified membranes. Furthermore, aquaporins-modified membranes showed higher flux recoveries possible due to the fact that aquaporins are bidirectional; hence, backwash was more efficient. In addition, membranes modified with aquaporins showed higher selectivities, as measured by salt rejections (Figure 2) and protein rejections, as compared to unmodified synthetic membranes and may offer ultimate breakthrough for low energy desalination.

Figure 1 Membrane preparation

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Figure 2 Calcium (left) and sodium (right) chloride filtration rejection by aquaporins modified (red diamonds) and unmodified (blue diamonds) membranes

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