Humidity Effects on Facilitated Gas Separations Using Immobilized Ionic Liquid Membranes

Paul Scovazzo,[1] Dan DuBois,[2] Carl Koval[3] and Richard Noble[1]

[1]Department of Chemical Engineering
University of Colorado
Boulder, CO 80309
USA

[2]National Renewable Energy Laboratory
1617 Cole Blvd
Golden, CO 80401

[3]Department of Chemistry
University of Colorado
Boulder, CO 80309

Immobilized Liquid Membranes (ILMs) use porous supports whose pores are impregnated with a solvent. In ILMs, solute molecules dissolve into the membrane at the feed/membrane interface. The dissolved species diffuse through the membrane and desorb at the opposite membrane surface. The addition of a third mobile chemical or complexing agent to the solvent that can reversibly bind to the dissolved species enhances the selectivity and flux of the membrane (facilitated transport). The disadvantages of ILMs are the loss of solvent via volatilization and the loading limits (solubility) on complexing agents in the solvent. Unlike the solvents currently used in ILMs, Room Temperature Ionic Liquid (RTIL) properties may be adjusted via chemical alteration of the ions to produce designer solvents for a specific membrane application. The potential exists for complexing agents to be one of the ions giving a mole fraction loading of a complexing agent in the solvent of one, much greater than the loadings in standard systems. Immobilized Ionic Liquid Membranes also have an advantage over ILMs due to the RTILs negligible loss through vaporization. Our initial research focus is on the carbon dioxide separation from N2 using RTILs doped with various facilitated transport agents. We have found and characterized a significant positive humidity effect on facilitated transport in these membranes. Carbon dioxide flux rates increase with an increase in feed gas relative humidity. The effect appears to depend on water acting as a catalyst in the ionic environment of the immobilized ionic liquid membranes.