World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:10, No:02, 2016

Room Temperature Ionic Liquids Filled Mixed Matrix Membranes for CO2 Separation

Authors : Asim Laeeq Khan, Mazhar Amjad Gilani, Tayub Raza

Abstract : The use of fossil fuels for energy generation leads to the emission of greenhouse gases particularly CO2 into the atmosphere. To date, several techniques have been proposed for the efficient removal of CO2 from flue gas mixtures. Membrane technology is a promising choice due to its several inherent advantages such as low capital cost, high energy efficiency, and low ecological footprint. One of the goals in the development of membranes is to achieve high permeability and selectivity. Mixed matrix membranes comprising of inorganic fillers embedded in polymer matrix are a class of membranes that have showed improved separation properties. One of the biggest challenges in the commercialization if mixed matrix membranes are the removal of non-selective voids existing at the polymer-filler interface. In this work, mixed matrix membranes were prepared using polysulfone as polymer matrix and ordered mesoporous MCM-41 as filler materials. A new approach to removing the interfacial voids was developed by introducing room temperature ionic (RTIL) at the polymer-filler interface. The results showed that the imidazolium based RTIL not only provided wettability characteristics but also helped in further improving the separation properties. The removal of interfacial voids and good contact between polymer and filler was verified by SEM measurement. The synthesized membranes were tested in a custom built gas permeation set-up for the measurement of gas permeability and ideal gas selectivity. The results showed that the mixed matrix membranes showed significantly higher CO2 permeability in comparison to the pristine membrane. In order to have further insight into the role of fillers, diffusion and solubility measurements were carried out. The results showed that the presence of highly porous fillers resulted in increasing the diffusion coefficient while the solubility showed a slight drop. The RTIL filled membranes showed higher CO2/CH4 and CO2/N2 selectivity than unfilled membranes while the permeability dropped slightly. The increase in selectivity was due to the highly selective RTIL used in this work. The study revealed that RTIL filled mixed matrix membranes are an interesting candidate for gas separation membranes.

Keywords : ionic liquids, CO2 separation, membranes, mixed matrix membranes
Conference Title : ICSPT 2016 : International Conference on Separation and Purification Technology
Conference Location : Barcelona, Spain
Conference Dates : February 15-16, 2016