INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Ashim Kumar Basumatary
Roll Number	:	126107031
Programme of Study	:	Ph.D.

Thesis Title: Fabrication, Characterization of Zeolite-Ceramic Composite Membranes and Their Application in Separation of Metal Ions from Aqueous Solution.

Name of Thesis Supervisor(s)	:	Prof. G. Pugazhenthi
Thesis Submitted to the Department/ Center	:	Chemical Engineering

Date of completion of Thesis Viva-Voce Exam	:	02-12-2015
Key words for description of Thesis Work	:	MCM-41, MCM-48, FAU, Analcime, Zeolite-ceramic composite membrane, Pore size, Porosity, Cr (VI), Trivalent ions, Rejection.

SHORT ABSTRACT

This work reports the fabrication and characterization of MCM-41, MCM-48, FAU and Analcime-C zeolite-ceramic composite membrane on a porous circular shaped ceramic support by hydrothermal synthesis method. A facile uni-axial compaction method was employed for the preparation of ceramic support and sintered at 950 °C. The properties of zeolite powders and zeolite-ceramic composite membranes were evaluated by X-ray diffraction (XRD), thermogravimetric analysis (TGA), nitrogen adsorption-desorption isotherm (BET), Fourier transform infrared spectroscopy (FTIR), zeta potential measurement, field emission scanning electron microscopy (FESEM), porosity, pure water and solvent permeability tests. The porosity of the ceramic support reduces from 47 to 23, 22, 33, 24%, with the deposition of MCM-41, MCM-48, FAU, Analcime-C zeolite, respectively and the average pore size of the support also decreases from 1.0 to 0.173, 0.142, 0.153, 0.155 µm. Solvent permeation studies through these membranes disclose that non polar solvents are more permeable than the polar solvents and the chemical nature of liquids is the main controlling factor for the transport of solvents. The fabricated zeolite-ceramic composite membranes were subjected to investigate their potential for the separation of metal ions from aqueous solution using dead-end and cross flow ultrafiltration (UF). The influence of various parameters such as applied pressure, feed concentration and pH of the solutions on the rejection and flux of Cr (VI) and trivalent metal ions (Fe^{3+} and Al^{3+}) was examined. The rejection and permeate flux behavior of Cr (VI) and trivalent metal ions are found to be mainly dependent on the electrostatic interaction between charged molecules and the zeolite-ceramic composite membrane. In the dead-end filtration studies, the highest Cr (VI) rejection of 80, 81, 83, and 80% is observed for MCM-41, MCM-48, FAU and Analcime-C zeolite membrane, respectively, whereas in the cross flow mode operation, the maximum rejection is found to be 82, 77 and 75% with FAU, MCM-48 and MCM-41 zeolite composite membrane, respectively. No flux decline is noticed in the entire duration of cross flow operation for the removal of Cr (VI). MCM-41, MCM-48 and FAU zeolite membranes display the maximum rejection of 82, 81 and 75% for $AlCl_3$ and 83, 86 and 81% for $FeCl_3$, respectively. In a cross flow operation, MCM-41, MCM-48 and FAU zeolite membranes demonstrate ~86, 87, and 88% rejection of $FeCl_3$ and 82, 83 and 84% rejection for $AlCl_3$, respectively. Among the studied zeolite membranes, FAU zeolite membrane is better in terms of higher removal efficiency, lower synthesize time, cost of raw materials used for synthesis and no calcination process is involved that leads to the reduction of fabrication cost.