INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

SHORT ABSTRACT OF THESIS

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Title of Ph.D thesis: **Development and Characterization of Fly ash Based Ceramic Membranes for the Separation of Oil-in-Water Emulsions**

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SHORT ABSTRACT

This work reports the fabrication and characterization of clay based membranes (SP1-SP4), fly ash based membranes (M1-M3), TiO2-Fly ash composite membrane, TiO2-clay and γ-Al2O3-clay composite membranes. Composite membranes were prepared by hydrothermal synthesis method. A facile uni-axial compaction method was employed for the preparation of clay and fly ash based membranes and sintered at 1100 °C. The properties of powders and membranes were evaluated by X-ray diffraction (XRD), thermogravimetric analysis (TGA), nitrogen adsorption-desorption isotherm (BET), Fourier transform infrared spectroscopy (FTIR, field emission scanning electron microscopy (FESEM), porosity, contact angle measurement, pure water and N_2 gas permeation tests. The porosity of the ceramic membranes increases from 21 to 34, 43, 48%, with the increment of TiO_2 content for SP1-SP4, respectively and the average pore size of the membrane also decreases from 2.97 to 1.77, 1.57 and 1.32 µm. The fabricated membranes (M1-M3) and TiO_2-Fly ash composite membrane were subjected to investigate their potential for the separation of oil-in-water emulsions using dead-end and cross flow microfiltration. The influence of various parameters such as applied pressure feed concentration and cross flow velocity on the rejection and flux of oil was examined. The rejection and permeate flux behavior of oil is found to be mainly dependent on surface nature of composite membrane. In the dead-end filtration studies, the highest oil rejection of 99.94, 99.99 and 96.12% is observed for M1, M2 and M3 membrane, respectively. For the M2 membrane, based on RSM, optimal process variable values of permeate flux (2.6×10^{-4} m^3/m^2 s) and rejection (96.94%) have been found to be 345 kPa applied pressure and 176.07 mg/L feed concentration. In cross flow mode operation, the maximum rejection of oil is found to be 98.82 and 99.15 % with M2 and TiO_2-Fly ash composite membrane, respectively at cross flow velocity of 0.0885 m/s, higher feed concentration (200 mg/L) and higher pressure (207 kPa). No flux decline is noticed in the entire duration of cross flow operation for the removal of oil for TiO_2-Fly ash composite membrane. TiO_2-clay, γ-Al_2O_3-clay and clay membranes display the maximum oil rejection of 98.96, 98.46 and 97% at 69 kPa and 200 mg/L feed concentration, respectively. In a cross flow operation, TiO_2-clay and clay membranes demonstrate 99.56 and 93.24% rejection of oil, respectively. Among the studied membranes, TiO_2-Fly ash composite membrane is better in terms of higher removal efficiency and good permeate flux values, and it also possesses superior hydrophilic surface, which helps to prevent oil adhere onto the membrane surface, hence mitigate membrane fouling.