Preparation and characterization of porous PVDF hollow fiber membranes for CO(2) absorption: Effect of different non-solvent additives in the polymer dope

Abstract

Different types of non-solvent additives were introduced into the polyvinylidene fluoride (PVDF) dope to investigate improvement of the hollow fiber membrane structure for CO2 absorption. Phase-inversion behavior of the PVDF dopes was studied using cloud points measurements. Glycerol, phosphoric acid, ethanol and polyethylene glycol (PEG-400) were used as non-solvent additives in the polymer dope. With addition of the additives, precipitation of the polymer dopes increased following the trend of phosphoric acid > glycerol > ethanol > PEG-400. From morphology examination, PEG-400, glycerol and phosphoric acid resulted in the membranes with almost sponge-like structure due to high viscosity of the spinning dopes. The low wetting resistance and high permeability of the plain PVDF and PVDF/ethanol membranes were attributed to the large finger-likes structure. Among the additives, glycerol provided the membranes with larger mean pore size (9.62 nm). CO2 absorption by distilled water was conducted through the gas–liquid membrane contactors. The PVDF/glycerol membrane demonstrated higher CO2 absorption flux than the other membranes. At the absorbent flow rate of 280 ml/min, CO2 flux of 7.8 × 10-4 mol/m2 s was achieved, which was approximately 30% higher than CO2 flux of the plain PVDF membrane. In conclusion, a developed membrane structure prepared by controlled phase-inversion process can be a promising alternative for CO2 capture in gas–liquid membrane contactors.