INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Production of clean water and energy from renewable sources via an innovative technology is very important to minimize the freshwater usage and greenhouse effect. Considering the recent innovations in membrane development activities, membrane technologies such as forward osmosis (FO) and pressure-retarded osmosis (PRO) are becoming exceptional and emerging technologies. The work in this thesis focuses on the performance evaluation of the existing FO/PRO process and development of a mathematical model that replicates the actual process. The former reduces the effect of experimental uncertainty on the FO/PRO processes, and the latter helps to get an optimal result from these processes through simulation and optimization studies. Initially, the research focused on analyzing the errors in membrane characterization experiments due to the experimental uncertainties such as water evaporation, variation in solution volume and concentration, for low and high flux FO membranes. The incorporation of water evaporation model in the design model showed 3.7 and 5.7 % variations in the mass and concentration, respectively. In the next stage of the research, a mathematical model was developed for the axial flow HF (hollow fiber) FO module and validated with unsteady-state FO experimental data. A multi-objective optimization (MOO) was formulated to get optimal Pareto between FO water flux and power consumption. The optimization result revealed the exponential behaviour of power consumption with respect to the permeate flow rate. Finally, the Indian blue energy potential was estimated by mixing Indian river water and seawater before discharging into the sea through the optimized PRO process.