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Treatment of ammonia nitrogen wastewater by membrane distillation using PVDF membranes

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ABSTRACT

Three operation technologies based on PVDF membranes including membrane contactor (MC), direct contact membrane distillation with pure water as permeate solution (DCMD), reaction direct contact membrane distillation with sulfuric acid solution as permeate solution (RDCMD) were tested for ammonia removal from water. The effects of feed run parameters (temperature, pH, initial concentration and velocity) and permeate temperature on the ammonia removal rate, mass transfer coefficient and selectivity in RDCMD process were investigated in detail. Results showed that, comparing with MC and DCMD, RDCMD performed the highest ammonia removal efficiency and mass transfer coefficient. In RDCMD, feed pH value was proved to be the most dominant factor, when the pH value increased from 9 to 11, mass transfer coefficient increased noticeably from 0.54×10^{-5} m s^{-1} to 2.2×10^{-5} m s^{-1} and selectivity increased from 1.73 to 6.95, respectively, but with the further increase of pH from 11 to 13, mass transfer coefficient and selectivity increased slightly. Increasing feed temperature could lead to higher ammonia mass transfer coefficient but lower selectivity. Permeate temperature was in favour of the selectivity, but had no remarkable effect on mass transfer coefficient. Feed velocity and initial concentration had a negligible influence on mass transfer coefficient and selectivity. A laboratory scale application of RDMCD was carried for 0.50 mol L^{-1} ammonia wastewater, after 4 h operation at optimal process conditions, 98.5% ammonia was removed, however, the membrane only was polluted a little and can be easily washed by deionized water. In addition, the PVDF membrane can maintain stable properties to resist 0.5 mol L^{-1} sulfuric acid solution, and is potential in the ammonia removal by RDCMD.

Keywords: Ammonia; Direct contact membrane distillation; PVDF membranes; Mass transfer coefficient; Selectivity

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