Study of MOF incorporated dual layer membrane with enhanced removal of ammonia and per-/poly-fluoroalkyl substances (PFAS) in landfill leachate treatment

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Abstract:

Landfill leachate is a highly polluted and complex wastewater as it contains large amounts of organic matters, ammonia-nitrogen, heavy metals, and per-/poly-fluoroalkyl substances (PFAS), which makes its treatment very challenging. In this paper, hydrophilic/hydrophobic dual layer membranes combining advantages of pervaporation and membrane distillation was employed to treat leachate in a direct contact membrane distillation (DCMD) configuration. An aluminium fumarate (AlFu) metal organic framework (MOF) incorporated poly(vinyl alcohol) (PVA) hydrophilic layer was coated on hydrophobic PTFE membrane to overcome the low separation efficiency of PFAS and ammonia and wetting issues encountered by the conventional hydrophobic PTFE membrane used for DCMD. The rejections of dual layer membranes with different MOF loading to PFAS, ammonia, TOC and TDS were assessed based on the amount of AlFu MOF incorporated into the PVA layer. Based on the conducted adsorption tests, it was found that AlFu MOF increases the rejection of PVA layer to PFAS and ammonia. The coating of the hydrophilic layer could enhance the wetting resistance with/without MOF addition. In comparison with the pristine PTFE membrane using synthetic feed containing 3 wt% NaCl, 1 wt% addition of AlFu MOF into the PVA layer showed slightly increased flux. All the tested membranes showed more than 99% rejection to TOC. The rejection to ammonia was increased as more MOF was incorporated into the PVA layer. The maximum rejection of ammonia was 99.8% when the PVA layer containing 10% MOF. All the membranes showed more than 99% rejection to PFOS and PFHxS. However, PTFE membrane did not show any rejection to PFOA. As more MOF was added into the hydrophilic layer, the rejection to PFOA increased, but plateaued at 65.6% with 5% MOF incorporation into the hydrophilic layer.

Keywords: dual layer membrane, MOF; PFAS; ammonia; leachate