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Anti-wetting behavior of negatively charged superhydrophobic PVDF membranes in direct contact membrane distillation of emulsified wastewaters

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Abstract:

Membrane wetting is a key issue in causing deleterious performance in membrane distillation. In this work, superhydrophobic membranes were challenged in a direct contact membrane distillation (DCMD) process using cationic/anionic surfactant emulsified oil-in-water emulsions in order to assess the antiwetting properties of superhydrophobic surfaces in a highly demanding environment. Contact angle, Zeta potential and DCMD performance of the membrane were determined. It was found that superhydrophobic PVDF membranes exhibited strongly negative charges on the surface, as well as stable MD performance in concentrating the anionic surfactant emulsified waste water, but suffered from severe wetting when cationic surfactant was used. In contrast, the virgin hydrophobic PVDF membrane experienced severe wetting for either surfactant stabilized emulsions. Extended DLVO theory was utilized to explain the membrane-foulant interaction based on the EDL, acid-based and hydrophobic-hydrophobic interaction. Cleaning of supherydrophobic membranes was performed and restore of membrane performance was achieved for membranes that were used for treatment of negatively charged emulsions. This research outlined the experimental evidence and the importance of negative charges of a superhydrophobic surface for a stable membrane distillation