Study of PVDF asymmetric membranes in a high-throughput membrane bioreactor (HT-MBR): Influence of phase inversion parameters and filtration performance

Porous polyvinylidene fluoride (PVDF) membranes with different morphology were prepared via phase inversion followed by comprehensive screening for use in activated sludge filtration applying new type of lab-scale high-throughput membrane reactor (HT-MBR). First, the validation of the HT-MBR was performed involving multiple filtration tests of PVDF membrane samples, either in the same or in different positions in the reactor to verify reproducibility of the measurements in the HT-MBR and to check the homogeneity of the feed liquor hydrodynamics in the reactor. The validated set-up was then used for an accelerated screening of a systematic set of membranes with varying structure. Sixteen PVDF-membranes with mean pore size ranging from 0.05 to 0.37 µm and surface porosity from 2.8 to 13.9% were prepared via non-solvent induced phase separation by varying some phase-inversion parameters. The results showed that lowering the polymer concentration in the
membrane casting solution, increasing the exposure time to the air of the cast membrane before solidification, and the use of additives (polyvinylpyrrolidone, PVP) to the casting solution resulted in more porous membranes, larger average pore sizes and higher surface porosities, thus offering higher clean water permeability. Activated sludge filtrations were evaluated implementing two different tests: a flux-stepping and a long-term filtration test. The more porous membranes were superior over the less porous ones, as higher critical fluxes and (slightly) higher permeance was maintained during the 37-day long-term test, although a sharp permeance decrease was observed in the first 7 days. However, for long-term application, these porous membranes should still be improved in order to have more sustained high permeability.

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