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Microfiltration and ultrafiltration as a post-treatment of biogas plant digestates for producing concentrated fertilizers*

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The application of membrane technologies during treatment and/or concentration of farm effluents has been investigated previously. Fouling or membrane tendency to get dirty is one of the main factors affecting membrane applicability during the treatment of highly charged wastewaters. Previous research has generally overlooked the effect of membrane material on the filtrate production and on the phosphorus recovery from these wastewater streams. In this study, the fouling tendency of two polymeric membrane materials, namely surface-modified PVDF and PS, was investigated. Results were evaluated based on the observed zeta potential and the operational conditions (applied pressure and cross-flow velocity). Observed zeta potential will give an indication of the electrostatic interactions between membrane material and foulants, which will define the extent of membrane fouling and the formation of deposits on the membrane during the wastewater processing.

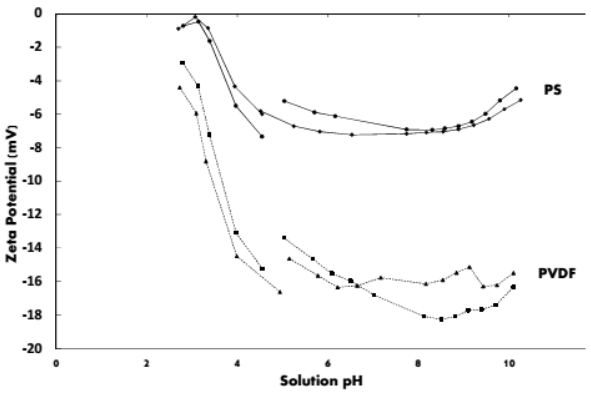

Figure 1. Observed zeta potential as a function of pH for PVDF and PS membranes

Results after membrane processing showed that the membrane material influenced both the fouling mechanism and the phosphorus recovery. When comparing the water flux results for both PVDF and PS membranes, it was found that the PS membranes can form a fouling layer faster than PVDF membranes. This situation changes when membrane fouling has already built up; then the permeate flux of the two membranes becomes similar. The PS membranes investigated here presented a higher initial fouling than the PVDF membranes, possibly due to a less-negative zeta potential (Figure 1), which tended to initially attract foulants more. Membrane pore size also influenced fouling mechanism.

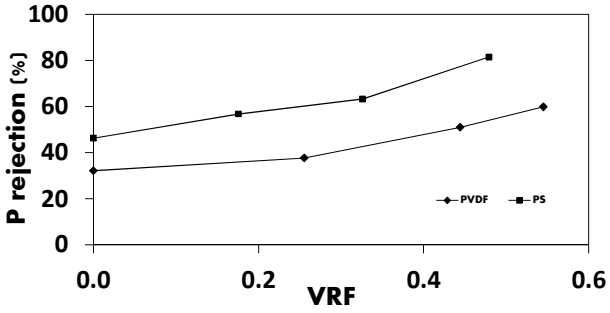

Figure 2. Phosphorus rejection in the concentrate fractions during MF and UF concentration experiments

The formation of an adsorbed layer seemed to play the main role during fouling for smaller PS membrane pore sizes. Adsorption combined with fouling seemed to control the fouling mechanism at larger PS membrane pore sizes. PVDF membranes with larger pore sizes reached higher permeate fluxes. However, the fouling mechanism for PVDF membranes was less obvious. During concentration experiments, PS membranes showed to be a good membrane material for phosphorus recovery from digestate liquid fractions (Figure 2) reaching recoveries of around 80%. However, in order to recover the permeate producing capacity of the membrane, further investigations on more suitable membrane cleaning procedures would be necessary to improve the performance of the filtration process.

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