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Studies of membrane scaling during water desalination by membrane distillation

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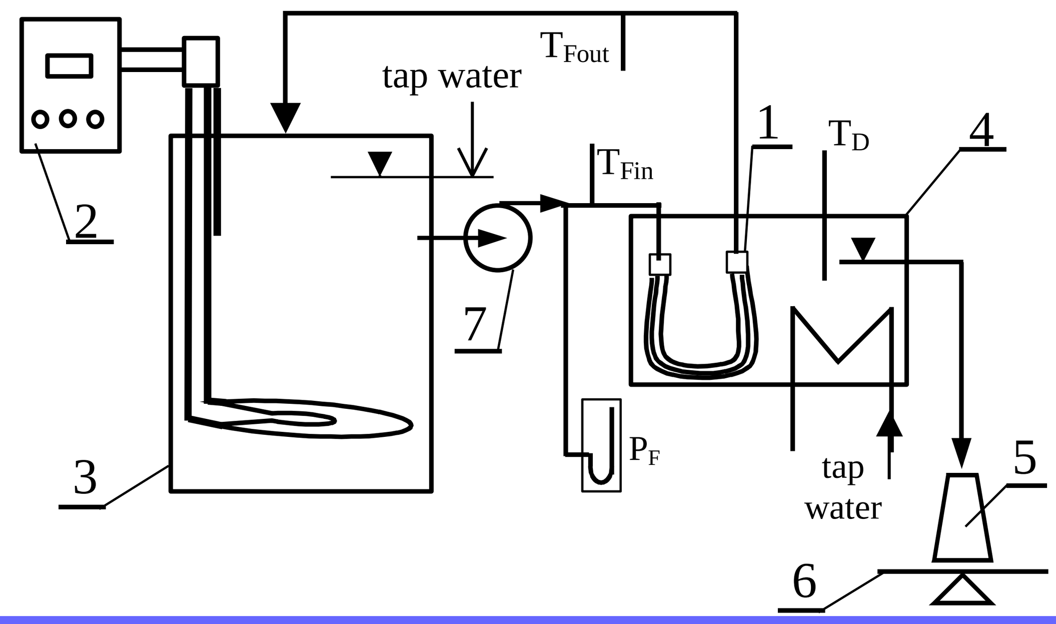
INTRODUCTION

In the case of MD carried out with natural water, the salts present in such water are retained and produced distillate is demineralized water. A major problem that hinders an industrial implementation of MD is a phenomenon of membrane wetting, which is often induced by membrane scaling

EXPERIMENTAL

The applied polypropylene membranes (Accurel PP S6/2, Membrana GmbH) have pore sizes with a nominal and maximum diameter of 0.2 μm and 0.6 μm, respectively, and porosity of 73%.

Fig. 1. DCMD experimental set-up. 1 – MD module, 2 – Nűga temperature regulator, 3 – feed tank, 4 – cooled distillate tank, 5 – distillate collector, 6 – balance, 7 – pump, P_F – manometer, T_{Fin}, T_{Fout}, T_D – thermometer (notation: F – feed, D – distillate, in – input, out – output



RESULTS

The membrane modules were supplied with the feed preheated to a temperature 313 K and 333 K. The yield obtained for these temperatures was 2.8 and 9.7 L/m²h, respectively (Figs 2 and 3). Low values of electrical conductivity of obtained distillates indicated, that the membranes were non-wetted during MD proces.

The changes of ions concentration in the feed were presented in Fig.4. Water demineralization by MD was carried out for 1400 h without module cleaning. However, the membrane scaling was confirmed by SEM examination of membrane samples (Figs 5 and 6).

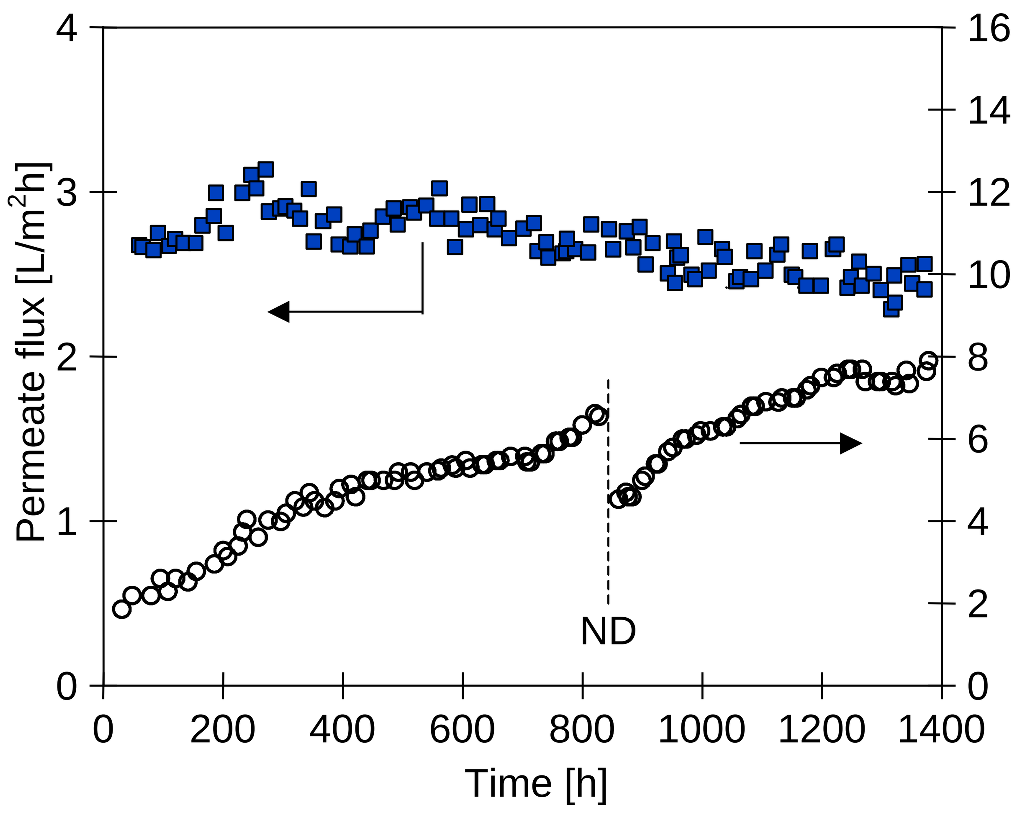


Fig. 2. Changes of the permeate flux and distillate electrical conductivity as a function of process time. ND –distillate tank refilled with distilled water. Feed: tap water (313 K).

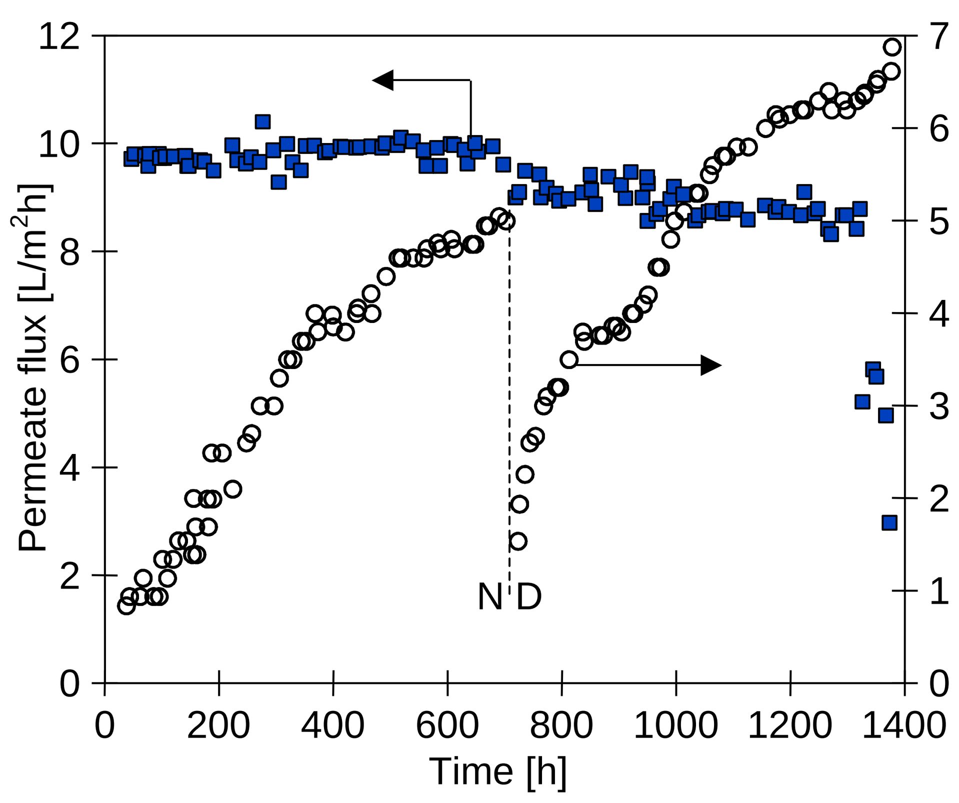


Fig. 3. Changes of the permeate flux and distillate electrical conductivity as a function of process time. ND –distillate tank refilled with distilled water. Feed: tap water (333 K).

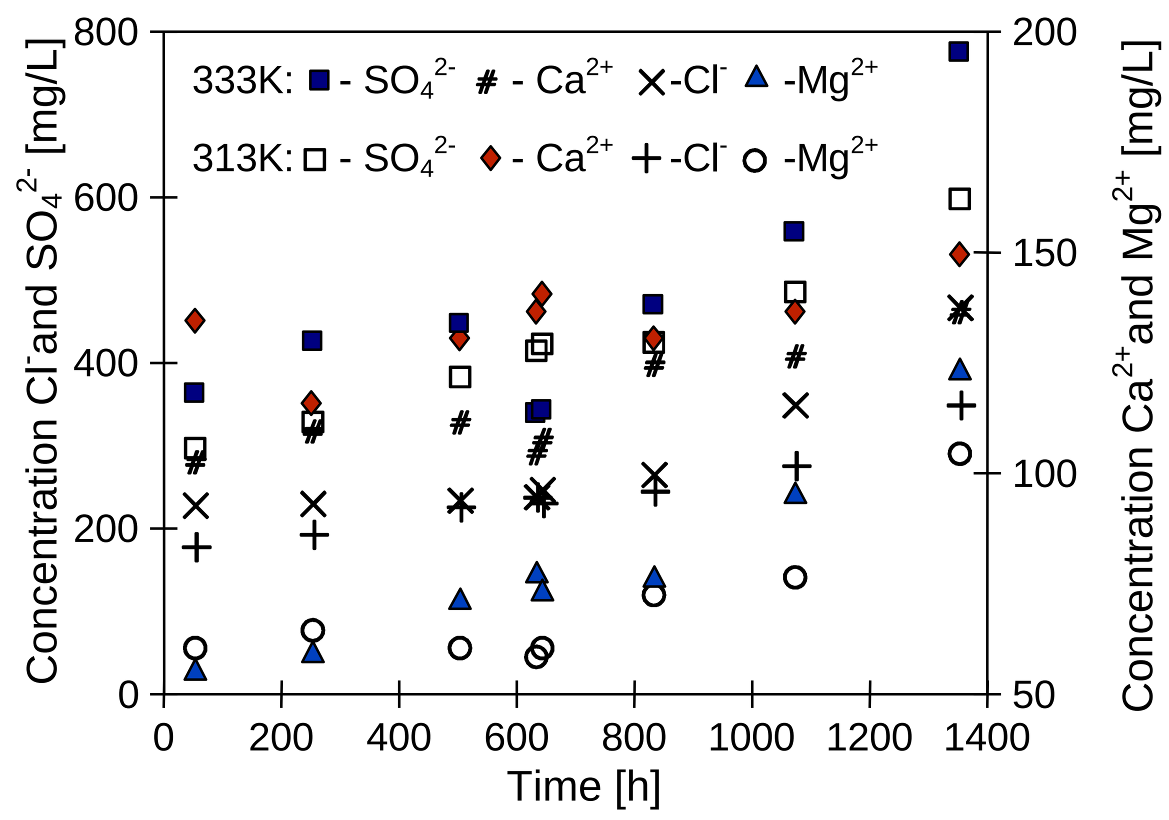


Fig. 4. Changes of ions concentration in the feed during MD process.

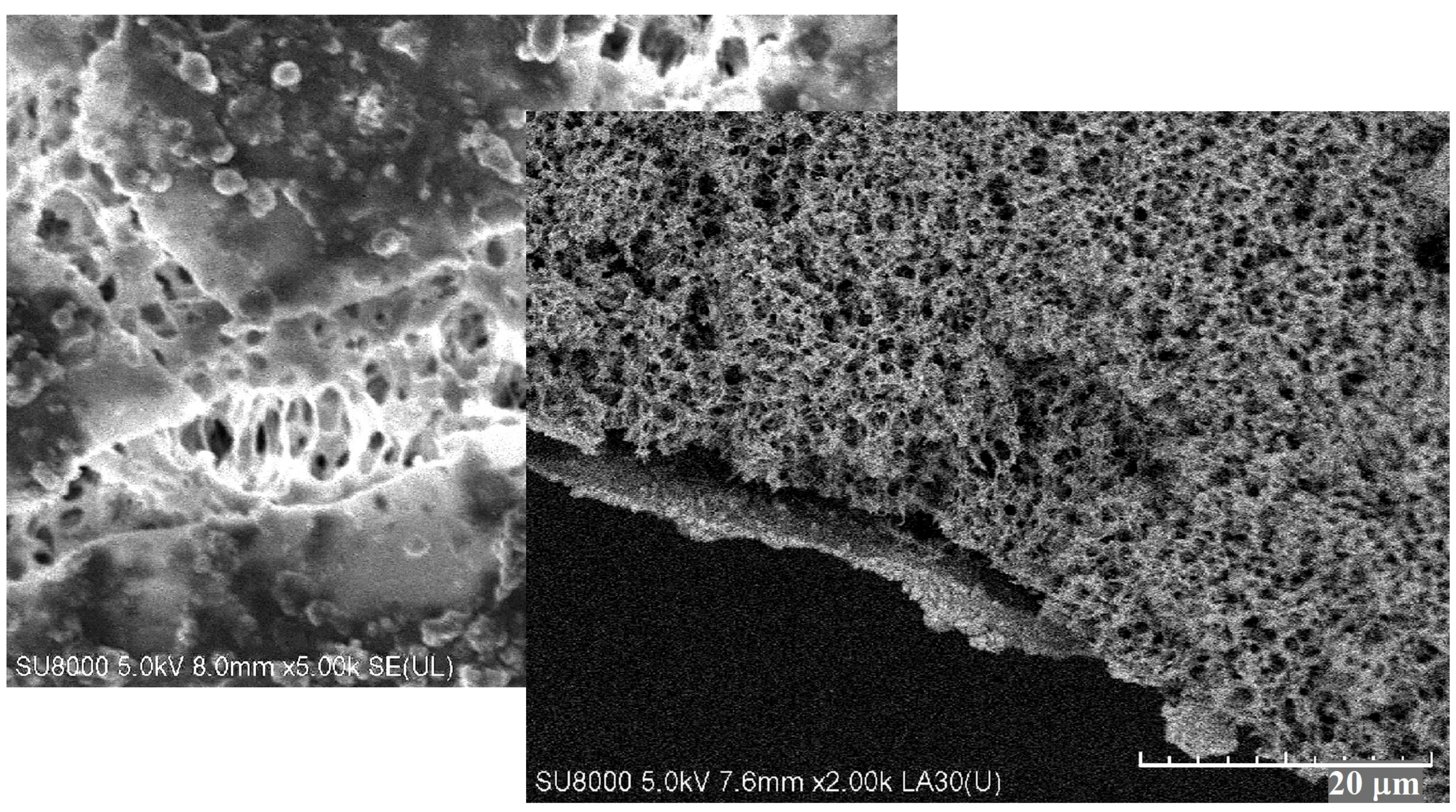


Fig. 5. SEM image of the membrane surface and cross-section (313 K)

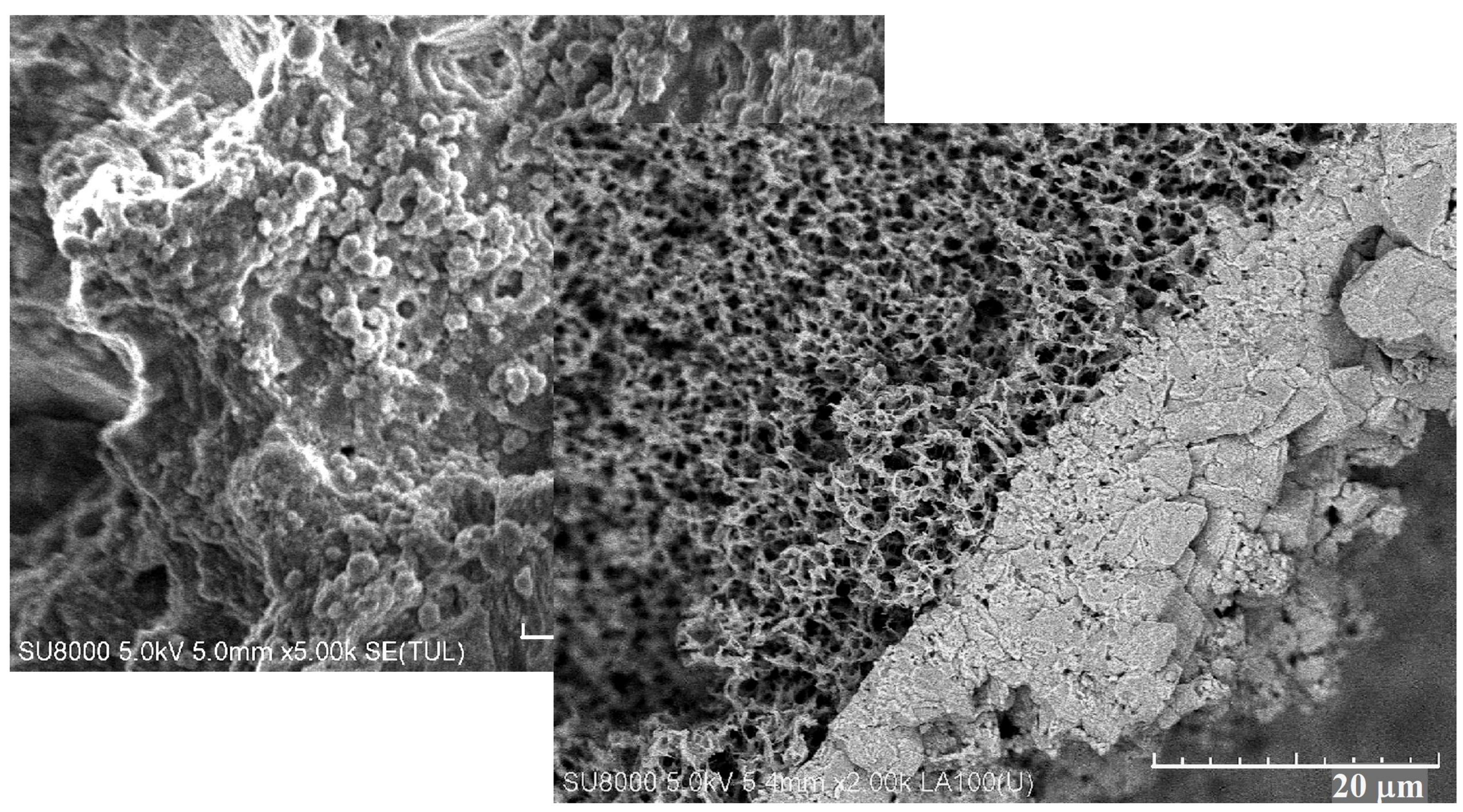


Fig. 6. SEM image of the membrane surface and cross-section (333 K)

CONCLUSIONS

The used PP membranes exhibited a good resistance to wettability during a long-term study of water demineralization by MD process.

A lowering of the feed temperature to 313 K allowed to significantly limit the scaling intensity and as a result, the MD process can be operated for several months without necessity to clean the modules.

The National Science Centre, Poland is acknowledged for the support of this work (DEC-2014/15/B/ST8/00045)