

Cleaning polyethersulfone membranes fouled by carwash wastewaters

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INTRODUCTION

The polyethersulfone (PES) membranes were applied for separation of effluents generated during car washing. This wastewater contained several compounds (oil and grease, surfactants, solids, nitrogen, and phosphorus) caused the membrane fouling, which reduced water transport across the membrane wall. In the present work, the possibility of applying alkaline washing agents for chemical cleaning fouled PES membranes were studied.

EXPERIMENTAL

The ultrafiltration (UF) plate PES membranes, MWCO of 10 (UE10) and 100 kDa (UE50), were applied. The transmembrane pressure (TMP) was maintained at 2.0 bar, and the feed flow velocity over the membrane was equal to 1 m/s. During the UF tests, the retentate was recycled to the feed tank. The UF studies were performed for synthetic wastewaters prepared from a mixture of commercial car wash agents: "Turbo foam" (Test A) or "Turbo Active Green" (Test B) mixed with Hydrowax (20-25 NTU). After completion of UF process, the membranes were rinsed with deionised water and cleaned with alkaline (pH=11) solutions of agents produced for car washing (Insect or Wheel cleaner) followed by rinsing with deionised water.

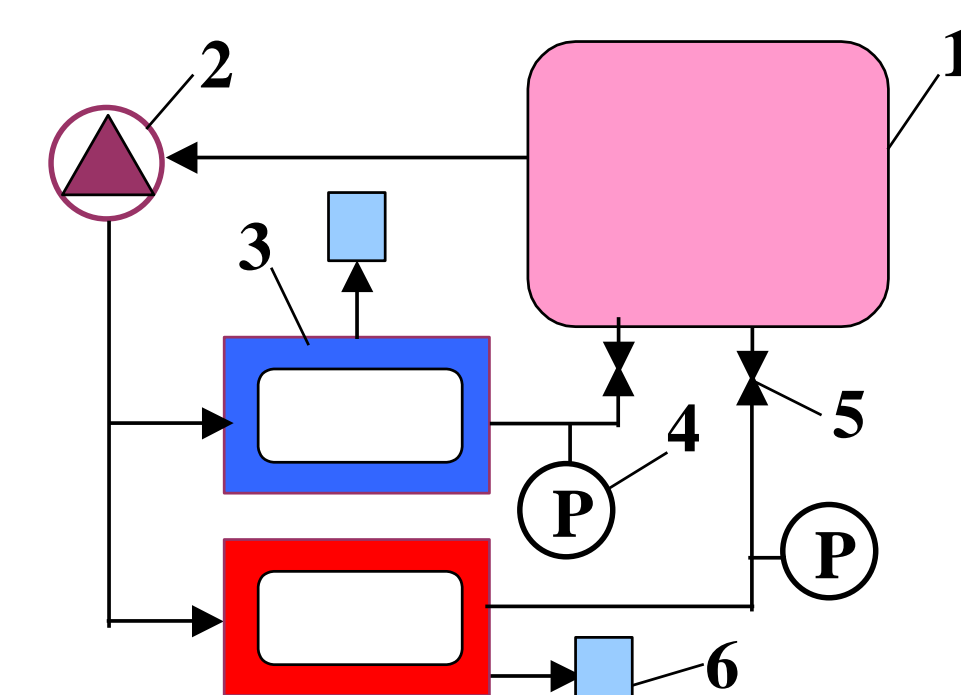


Fig. 1. Experimental set-up. 1 – feed tank, 2 – feed pump, 3 – membrane module, 4 – pressure gauge, 5 – valve, 6 – permeate tank

RESULTS

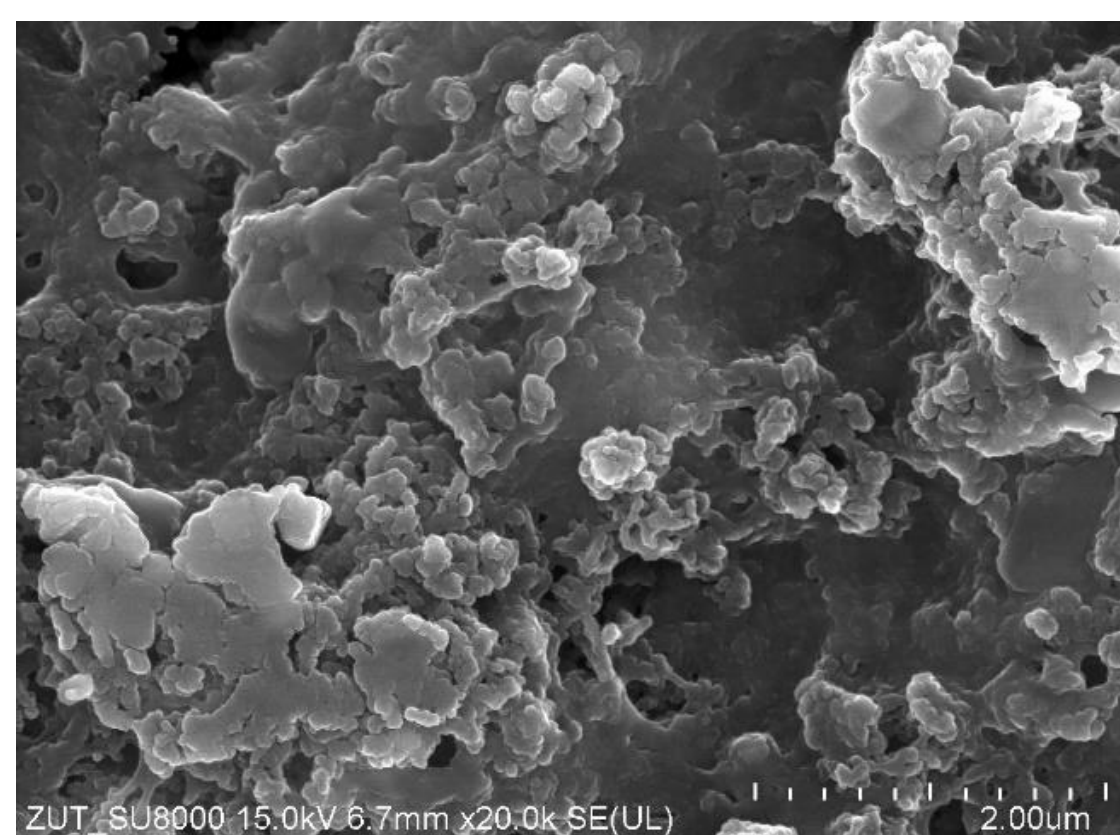


Fig. 2. SEM image of the fouled membrane

The maximal permeate flux (J_0) of the tested membranes obtained for DI water was 400 L/m²h (UE10) and 780 L/m²h (UE50). The membrane fouling (Fig. 2) caused the decrease in the permeate flux, which stabilized at the level of 0.4 (UE10) and 0.3 (UE50) of the maximum value obtained for DI water (Fig.3). After cleaning the membranes in 0.5% Wheel Cleaner (R3) and soaking the membranes in DI water (R4), the relative flux increased to 0.91 J_0 (UE10) and 0.75 J_0 (UE50). The application of Insect as a cleaning agent allowed to maintain the permeate flux at the level of 0.8 J_0 (Fig. 4).

The repetitive cycles of chemical cleaning could result in degradation of the membrane and, over time, the decrease of its performance. However, the results shown in Fig. 5 indicate that as a result of the washing operations (Fig. 4), the degree of Chemical Oxygen Demand (COD) retention was not significantly deteriorated. In each of the tested cases, the retention of COD significantly exceeded 50%.

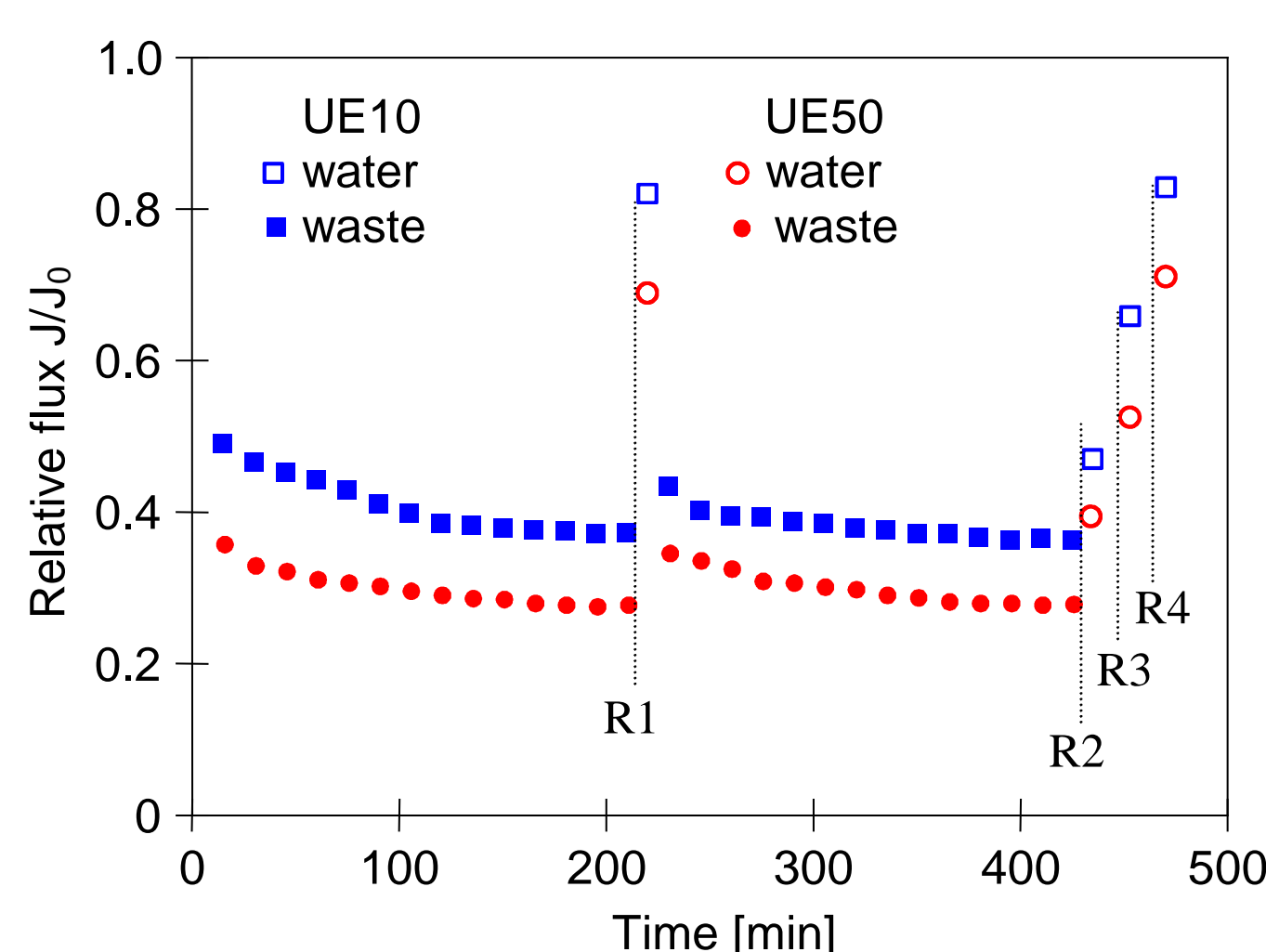


Fig. 3. Test A. Rinsing: R1, R2, R4 – water, R3 – Wheel cleaner

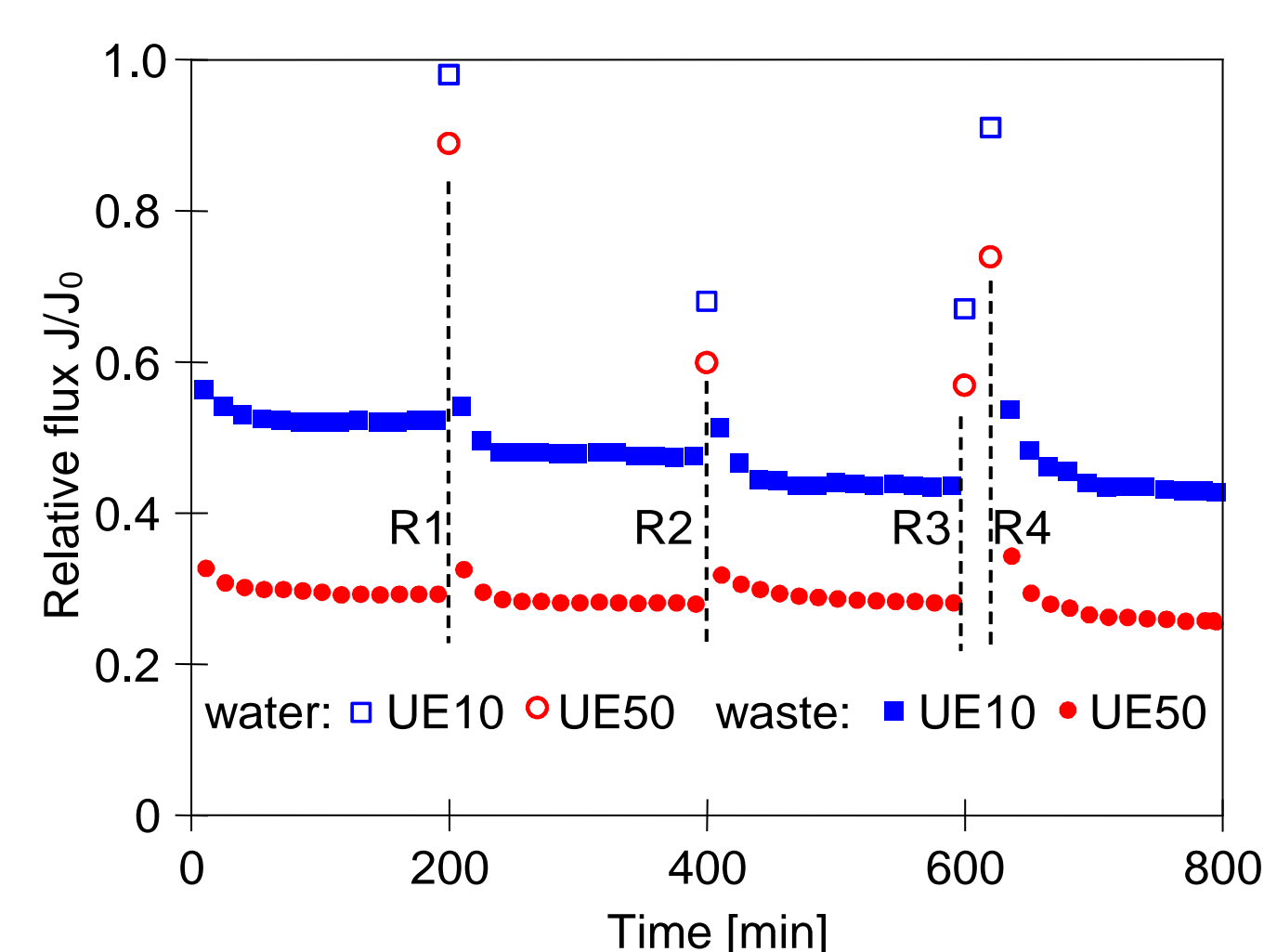


Fig. 4. Test B. R1 - R4 membrane cleaned with 0.5% Insect solution

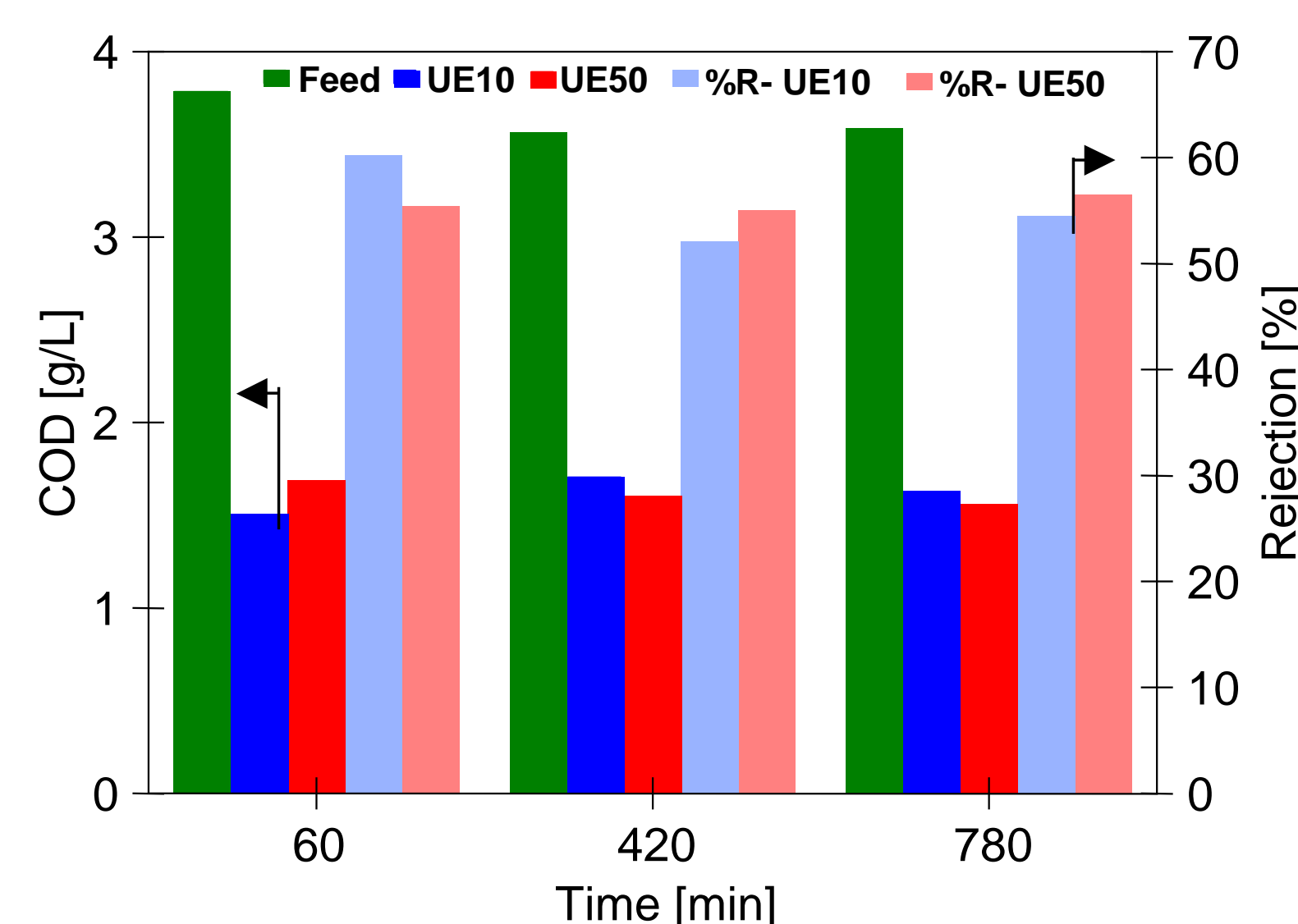


Fig. 5. Comparison of the degree of COD retention for the tested membranes

CONCLUSIONS

The conducted research confirmed that the UF process can be successfully applied for the separation of wastewaters generated at carwash stations. The obtained results revealed that the carwash wastewaters cause the significant membranes fouling. The use of alkaline cleaning solutions (pH>11) allowed to remove deposits from the membranes surface and the initial modules performance was restored in the 80%. It has been determined that the chemical cleaning did not changed the COD retention. This finding indicated that cleaning agents used in the present work did not damage the PES membranes tested.