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Separation of wastewater from carwash stations by ultrafiltration

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INTRODUCTION

The amount of water required for washing each car depends on the type of vehicle and its equipment and is estimated in the range from 150 to 600 L. Water consumption can be reduced by using the water recycling systems. Carwash wastewaters contain significant amounts of contaminants such as oil and grease, surfactants, solids, nitrogen, and phosphorus. Various treatment technologies have been used for the treatment of these wastewaters. In the present study, the ultrafiltration process was applied for separation of effluents from carwash stations.

EXPERIMENTAL

In this work, the UF polyethersulfone membranes, MWCO of 10 (UE10) and 110 kDa (UE110), were applied. The transmembrane pressure (TMP) was maintained at 2.0 bar, and the feed flow velocity over the membrane was equal to 1.7 m/s. During the UF tests, the retentate was recycled to the feed tank. The feed was prepared using commercial carwash chemicals: “white surfactant”, “blue surfactant” and “Turbo Active Green” – the agents that facilitate the formation of foam, and hydrowax used to form a protective layer on the cars. After completion of UF process, the membranes were cleaned with deionised water or with base (pH=11) solutions of agents (produced for car washing) followed by rinsing with deionised water.

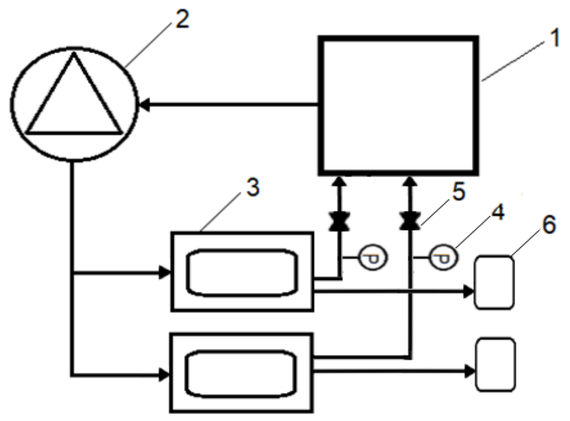

Fig. 1. Experimental set-up. 1- feed tank, 2 – feed pump, 3 – membrane module, 4 – pressure gauge, 5 – throttle valve, 6 – permeate tank

RESULTS

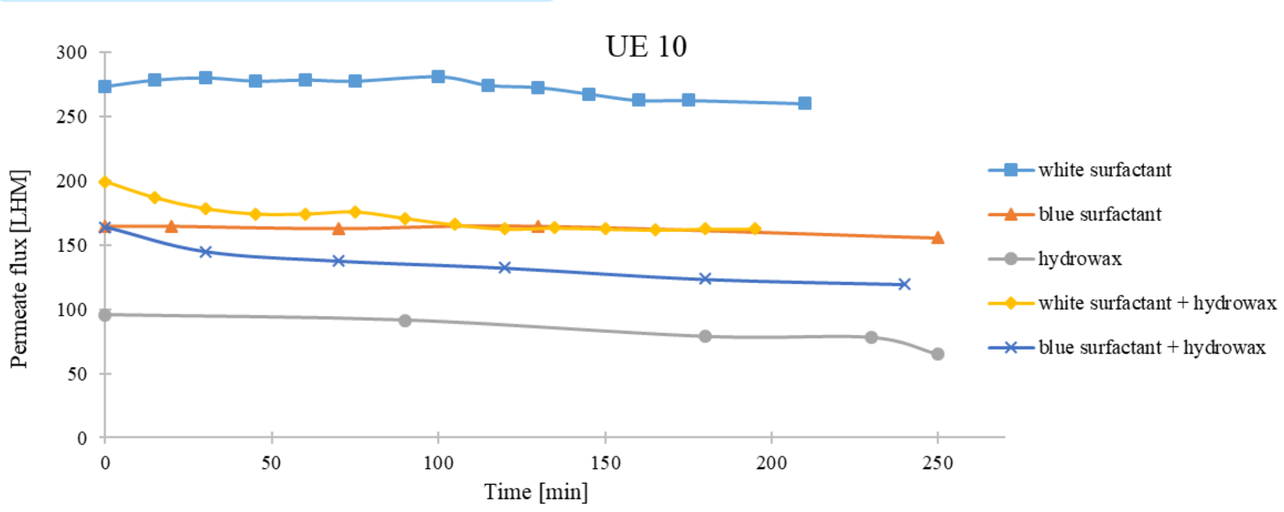

Fig. 2. Permeate flux changes during ultrafiltration of car washing agents

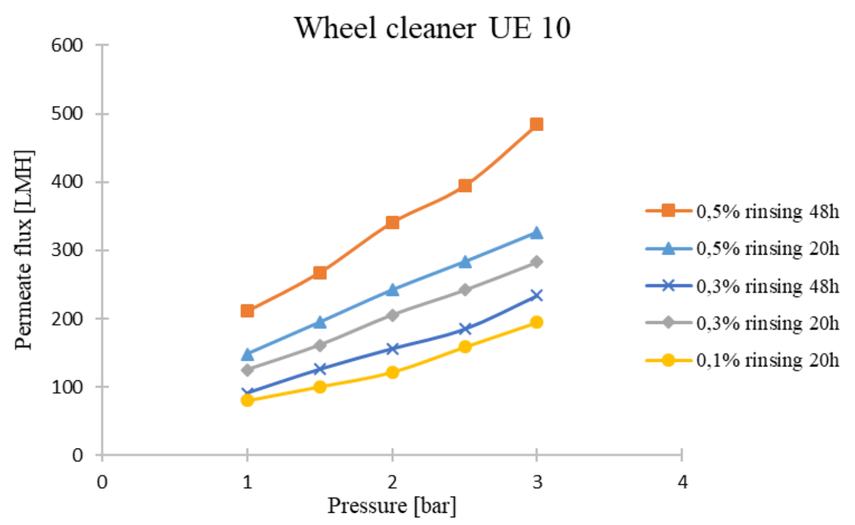

Fig. 3. Effect of washing solution concentration and contact time on the permeate flux

It was reported that, the flux was initially relatively high (200-300 LHM) for UE10 membrane, and it decreased significantly during the process run (Fig. 2) due to fouling phenomenon. The similar results were obtained for UE110 membrane. This observation indicated that the UF process of liquids used to wash cars has a large fouling potential. It is related to the fact that applied membranes tend to be affected by components present in a feed stream which leads to a significant reduction in the permeate flux. The results obtained in the present study clearly demonstrate that the permeate flux depends on the feed composition.

A method of static membrane washing can be used during night shutdowns of the installation. However, this method requires several hours of action of the cleaning agent (Fig. 3). The contact time can be significantly reduced by using a dynamic system in which the washing solution flows along the membrane surface (1.7 m/s) (Fig. 4). The effective cleaning of UE10 membranes required 90 minutes of rinsing, which indicates that the agents used in the car wash strongly contaminated the surface of the membranes tested.

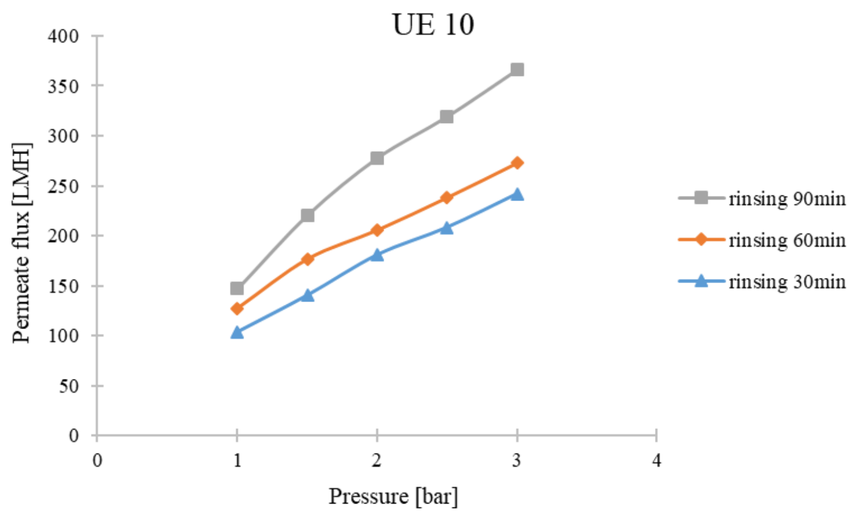

Fig. 4. Changes in the permeate flux depending on the rinsing time of the modules

CONCLUSIONS

The conducted research confirmed that the UF process can be successfully applied for the separation of wastewaters generated at carwash stations. The composition of such wastewaters is complex and the significant membrane fouling should be expected. For this reason, the industrial implementation of the process requires to develop the effective cleaning methods. The results obtained in the present study have shown that alkaline car washing agents can be effectively used for these purposes.

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