

Fouling and cleaning of ultrafiltration membranes

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Ultrafiltration (UF) is a form of membrane filtration that is used in a wide variety of applications, one of which is drinking water treatment. The main advantages of UF for drinking water treatment are low pressures (compared to other types of membranes) and excellent removal of colloidal substances, Giardia and viruses.

Fouling is a major problem in the operation of UF. Therefore, adequate membrane cleaning is essential. Membranes are cleaned hydraulically (using water and sometimes air) or chemically. However, a fundamental foundation for currently used cleaning procedures for ultrafiltration membranes does not exist.

The objective of this MSc. project was to get more insight into the basic processes fouling and cleaning of UF membranes so that cleaning procedures could be optimized effectively. This was done by

1. Carrying out a survey to gather practical experiences of eight UF installations in the Netherlands
2. Performing experiments at Kiwa Water Research, Nieuwegein, the Netherlands.

The survey showed that cleaning procedures used at the installations were not uniform. Also, optimizations of chemical cleaning



Figure 1 - Experimental set up.



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Figure 2 - Photos of the concentrate side of a membrane, left photo: new membrane; middle photo: membrane after back flushing; right photo: membrane after chemical cleaning. Clearly the blocked capillaries are visible.

procedures were experienced to be more effective than optimizations of hydraulic cleaning procedures. The experiments had a surprising outcome. Next to the already known fouling mechanisms of UF membranes (pore blocking, cake layer formation), some membranes capillaries (straws) were found to be completely blocked. Therefore water could not be transported out of the capillaries during cleaning. This resulted in capillaries that were completely filled with solids. This fouling mechanism was never described before in literature.

The blockings appeared especially in the end part of the capillaries. The potting (where capillaries are glued together) hindered chemicals to soak into the blockings.

Further research must clarify more about the reasons for the appearance of blockings and if capillary blocking also appears at full-scale plants. Following the discovered fouling mechanism, promising hydraulic cleaning methods are intermittent flushing, a more powerful forward flush and flushing from the opposite direction.

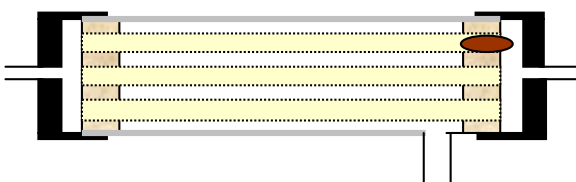
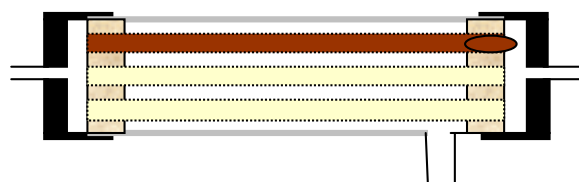


Figure 3 - A capillary can become blocked....



...and totally filled with solids during cleaning.