MABMEM – a material toolbox for the modification of ultrafiltration membranes

Oliver Gronwald*, Martin Weber*, Ulrich Handge, Lara Gruenig**, Martin Heijnen***, Stefan Panglisch****, Arman Kouchaki Shalmani******

* BASF SE, 67056 Ludwigshafen, Germany
** Helmholzzentrum Geesthacht (HZG), Max-Planck-Str. 1, 21502 Geesthacht, Germany
*** inge watertechnologies, Flurstr. 27, 86926 Greifenberg, Germany
**** University of Duisburg-Essen, Lotharstr. 1, 47057 Duisburg, Germany

Keywords: ultrafiltration; membrane; additive; polyethersulfone, polyphenylenesulfone, fouling

Short Introduction

The focus of the MABMEM project funded by the German federal ministry of education and research (BMBF) is the development of novel materials and material combinations for Multibore® ultrafiltration membranes. Multibore® membranes are being employed for the treatment for surface water but also for waste water treatment. New additives were synthesized and transported as polymer dope additives during the phase inversion process into the Multibore® separation layer. Their presence in the separation layer influences membrane parameters such as pure water permeability, molecular weight cut off and fouling propensity.

Material and Methods

Synthesis of the additives conducted by condensation reaction and testing of the ultrafiltration membranes regarding pure water permeability and molecular weight cut-off is described [Weber 2016].

Results and Discussion

A large variety of MABMEM additives was synthesized and characterized by GPC and ^{1}H-NMR. Figure 1 outlines the synthetic strategy.

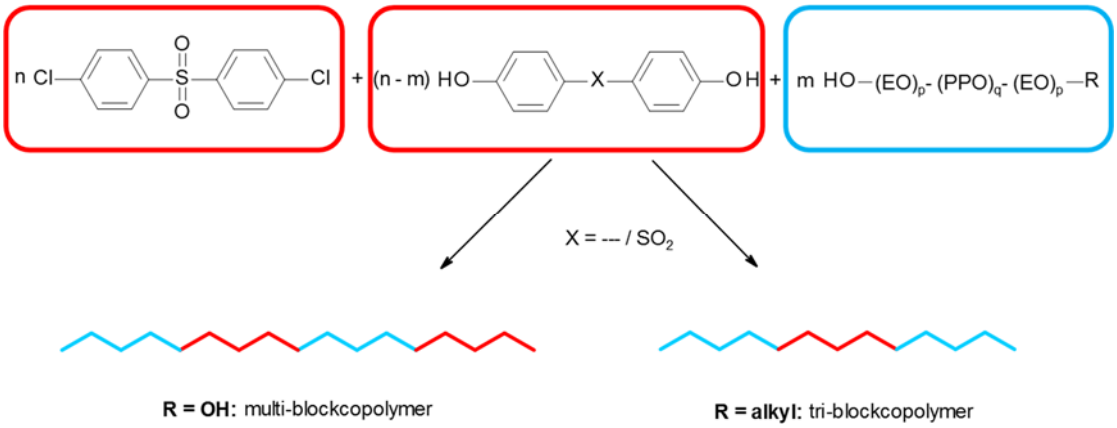

Figure 1. Synthesis of MABMEM additives with multiblock and triblock structures

As hydrophobic blocks polyethersulfone (PESU) and polyphenylenesulfone (PPSU) were combined with hydrophilic polyethyleneoxide (PEO) and polypropyleneoxide (PPO) moieties. Depending on the functionality of the polyalkylene compound multi- and triblockkopolymers were obtained. The additives were successfully integrated in the polymer dope solution used for the preparation of improved single bore ultrafiltration membranes by non-solvent induced phase conversion (NIPS) methodology. The UF-membranes obtained having higher pure water permeability and reduced fouling propensity compared to a non-modified polyethersulfone membranes. Flower soil was used as testing matrix for evaluation of the membranes fouling propensity. All membranes with additives tested so far showed higher initial permeability compared to standard membrane in one time filtration and 24 cycles filtration. In one time filtration experiments, all the membranes with additives were more easily backwashable compared to standard membranes. Figure 2 shows these findings for polyethersulfone ultrafiltration membrane modified with triblock PPSU-polyethyleneoxide additive compared to a standard PESU ultrafiltration membrane as the example.

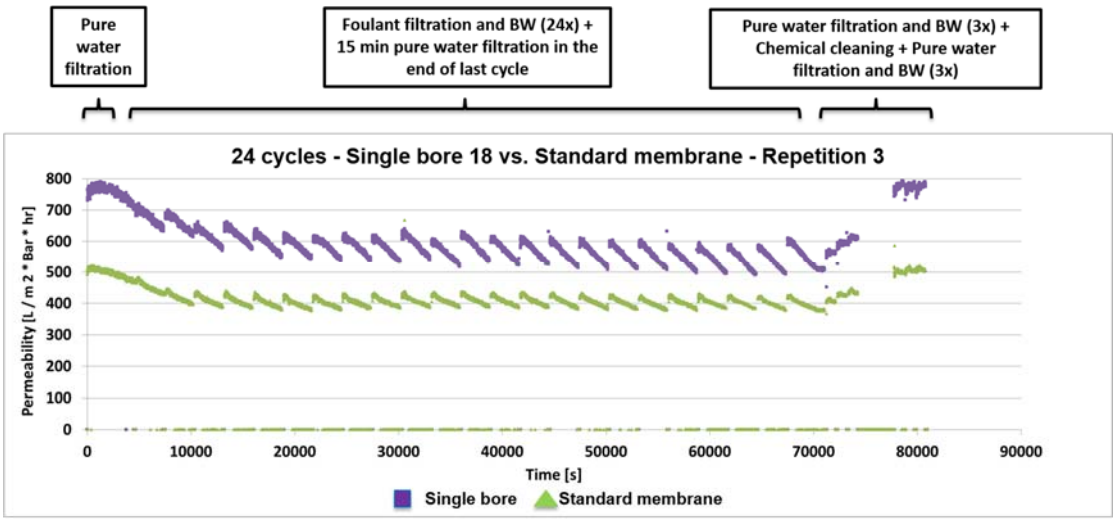

Figure 2. Fouling evaluation of polyethersulfone UF membrane modified with triblock PPSU-polyethyleneoxide additive compared with polyethersulfone standard membrane.

Conclusions

The integration of blockcopolymer additives in the ultrafiltration membrane production process based on non-solvent phase inversion allows transport of these additives in the membrane separation layer and therefore improvement the main membrane properties such as permeability and fouling propensity.

References

Weber M. et. al, *Process for making membranes*, WO patent 2016/023765 A1, 2016 February 18.

Paper prepared for: *Euromembrane 2018; 9th July – 13th July, 2018; Valencia, Spain*

DOI: 10.17185/duepublico/49393
URN: urn:nbn:de:hbz:464-20201127-171516-3