Solvent-free production of low-fouling, chemically stable tubular filtration membranes SOLFROTUBES

Berghof Membrane Technology GmbH offers a full line of tubular membranes for filtration and separation of industrial effluent and process streams. These membranes deliver the resilience and robustness necessary to handle challenging treatment applications in various industries including dairy, food and beverage, chemical, pharmaceutical, mining, landfills and petrochemicals.

THE CONTEXT

Berghof Membranes applies for a demo-case, because we see the necessity to develop tubular membranes by means of salt-dilution induced phase-separation (SIPS) to provide chemically stable low fouling polyelectrolyte complex (PEC) based membranes. The SIPS technique provides the opportunity of water-based production membranes. There are four objectives for this project:

1. Solvent-free production : remarkable reduction in use of solvents is expected.
2. Low-fouling : this is beneficial to the end users and decreases the environmental footprint.
3. Chemical stability : long-term application of these robust membranes by end users. Optimized cleaning is possible, which decreases chemicals as well as energy consumption.
4. PFAS-free : there is a clear need to reduced fluoropolymers and similar substances.

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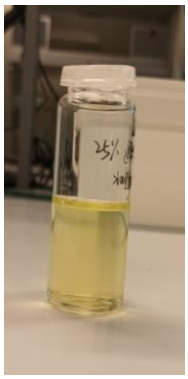
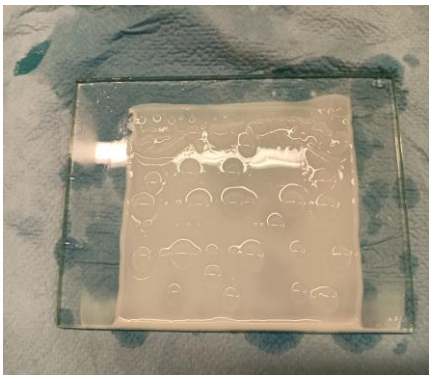
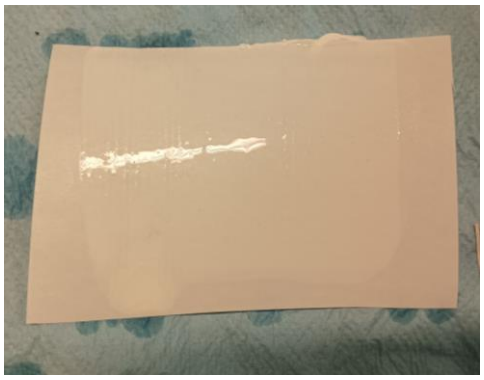
THE CHALLENGE

The membrane forming technique by SIPS is relatively new in comparison to the established non-solvent induced phase separation (NIPS). Although the membrane formation and processing are relatively similar, the following challenges are expected:

- Mechanical stability of the formed membrane.
- Post-treatment (crosslinking) of the membrane, in case the mechanical stability is insufficient.
- Membrane pore size and its pore size distribution.
- Long-term stability (chemical, mechanical) is not proven for SIPS.
- Recycling or disposal of membrane manufacturing process streams.
- Conversion from R&D stage to manufacturing level.
- Market acceptance.

THE RESULTS AND CONCLUSION

The non-woven support has a smooth and a rough side of which the rough side was chosen for the coatings.

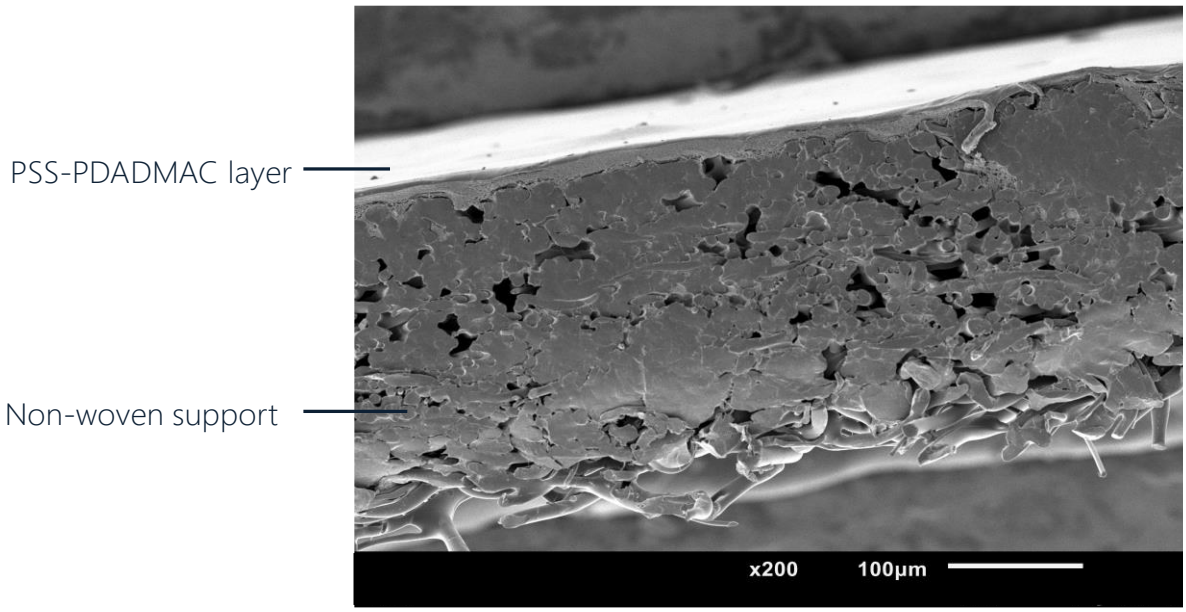
From the SEM images it is quite evident that the coating is well integrated on the support.

Polyelectrolyte solutions with PSS and PDADMAC in the stoichiometric ratio of 1:1.2 was prepared and additionally to these solutions additives like PEGs were also added.

Pure water permeability tests were carried out for these membranes and the permeability for these membranes varied in the ranges of 5-11 LMH/bar.

Salt retention tests were carried out with $MgSO_4$ and the retentions were less than 5%.

Molecular weight cut-off were carried out with PEG. The results showed a MWCO higher than 35000 Da.



Cross-section image of 1:1.2 PSS-PDADMAC coated on non-woven support

TECHNIQUES USED

In the SOLFROTUBES, the following characterization techniques were used:

Polyelectrolyte solution preparation, Flat sheet casting of free-standing and supported membranes, Pure water permeability tests, Crossflow filtration of salts, Molecular weight cut-off (MWCO) measurements, Gel permeation chromatography (GPC), Scanning electron microscopy (SEM).

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