Fouling study on novel nanofiltration membranes for water treatment (Thesis or Internship)

Project Supervisor: Ettore Virga, PhD Candidate

Wetsus, European Centre of Excellence for Sustainable Water Technology

Motivation

Water is essential in our daily life, and, as a consequence, the need to improve and preserve its quality is growing continuously. A re-use of water appears highly necessary in this context. This re-use can be possible and feasible if polluted water streams, such as surface water and industrial water, are efficiently treated, for instance, using membranes based processes. Indeed, membrane technology is one of the few techniques that can successfully remove micro-pollutants, the smallest (<10 m) and most stable oil droplets, solid particles, salts and metals from water streams. From the other side, membrane technology also has clear downsides, such as membrane fouling [1]. Since the water to treat can be a complex mixture, many of its components can foul the membrane, leading to very substantial decreases in the flux of treated water, thus bringing to an increase in operative costs. We propose the development of a novel nanofiltration (NF) membrane, with a surface chemistry optimized towards a low fouling propensity in water treatment (Fig. 1). Since the water to treat may vary drastically from an application to another one, the research studies focused on the development of stable nanofilitration membranes based on crosslinked polyelectrolyte multilayers. A large benefit of LbL technique is its versatility, allowing us to control the chemistry of the membrane surface, and the membrane geometry on which the layer is applied [2]. In this way, it also becomes possible to study membrane fouling in water treatment from a very fundamental viewpoint, by careful variation of chemistry and geometry.

Tasks

The candidate will work on the analysis of membrane fouling by oil in water emulsion by looking at parameters such as water-flux decline, oil permeation, and membranes clean ability. In particular, the tasks of the candidate will be:

- Membrane coating with PEM;

- Hollow fibers (Fig. 3) bundles modules assembling and realization;

- Modules performances testing (ions retention, oil molecules retention and stability towards certain agents) and fouling study by looking at the parameters above mentioned;

- Testing membrane fouling and performances in real surface water treatment.

Requirements

The candidate needs to full-fill the following requirements:

- Be a EU citizen or foreigner studying in the Netherlands;

- Background (MSc or BSc) in chemical engineering, water technology, enviroemntal engineering or related fields. Relevant lab experience is an advantage;

- Knowledge and experience in porous membranes based processed is an advantage;

- Highly motivated, enthusiastic, and can work independently;

- Can bring new ideas and initiatives into the project;

- Good experimental and analytical skills;

- Fluent in English language (speaking and writing) and able to work in an international environment.

How to apply

The applicant is invited to send a motivation letter (max. 1 page) and a CV (max. 2 pages) to Ettore Virga (ettore.virga@wetsus.nl). If suitable, a skype-interview will be scheduled.

Additional information

- Allowance: 350€/month
- Location: Wetsus, Leeuwarden, The Netherlands
- Duration: minimum 6 months

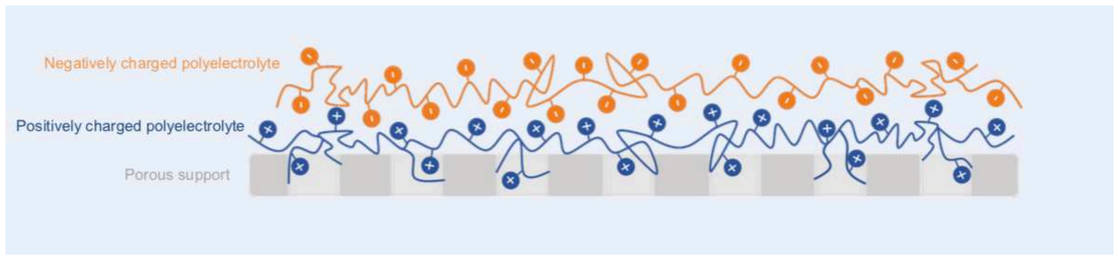

Figure 1: Schematic illustration of a low fouling NF membrane prepared by polyelectrolyte layer-by-layer deposition on ultrafiltration membrane

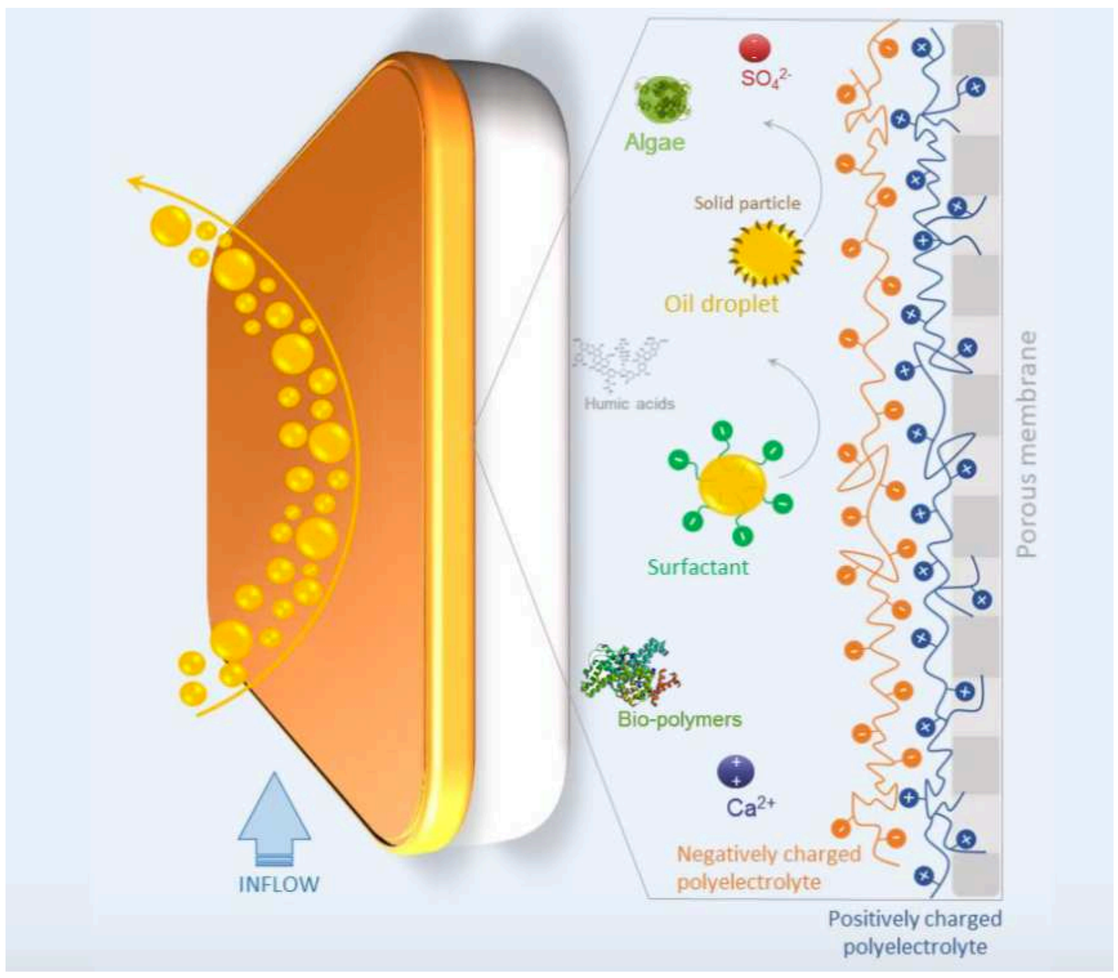

Figure 2: Schematic illustration of a low fouling NF membrane prepared by polyelectrolyte layer-by-layer deposition on ultrafiltration membrane.

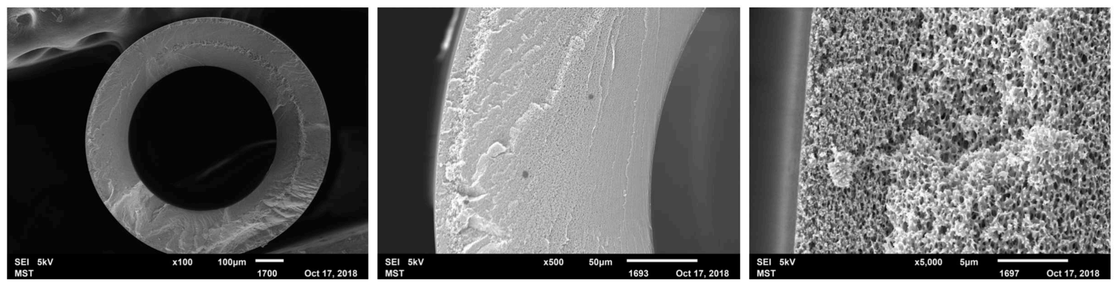

Figure 3: SEM pictures of the prepared membranes

References

[1] T. Nguyen, F. A. Roddick and L. Fan, "Biofouling of Water Treatment Membranes: A Review of the Underlying Causes, Monitoring Techniques and Control Measures", Membranes, 2012, 2, 804-840;
[2] J. de Grooth, R. Oborny´, J. Potreck, K. Nijmeijer and W.M. de Vos, "The role of ionic strength and odd–even effects on the properties of polyelectrolyte multilayer nanofiltration membranes", Journal of Membrane Science, 2015, 475, 311-319.