How to release a sponge: relaxation of casein micelles fouling layers during ultrafiltration, a SAXS study

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This poster serves to underline the following:

- we use synchrotron radiation to measure local solids concentration in the membrane fouling layer (concentration *vs.* distance to the membrane with the spatial resolution of 20 µm); this measurement requires less than a minute;
- our method of fouling analysis is particular, but our conclusions are general;
- fouling is sensitive to all operating conditions – not only that that applied during the fouling formation, but also that applied during the fouling analysis;
- the fouling layer may change during the fouling analysis; this change is not immediate; this fact must be accounted in the fouling analysis (whatever is the method of analysis);
- all experiment conditions should be described properly at every stage of experiment (e.g. no such thing as “simple rinsing”);
- we observed very interesting behavior of membrane fouling layer – the fouling gel layer swelled after the filtration pressure relaxation (as it is expected for compressible gel), but the swelling was more intense near the membrane surface; this can be explained by filtrate uptake across the membrane; hence, membrane resistance may play important role in the fouling gel swelling – the higher is the membrane resistance, the slower is the gel swelling and the fouling removal.

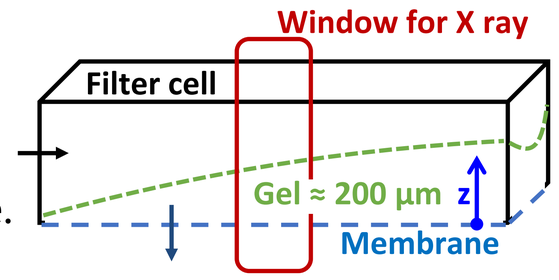
These statements originate from our work on the fouling (gel layer) analysis in the ultrafiltration of soft colloidal particles (casein micelles dispersions).

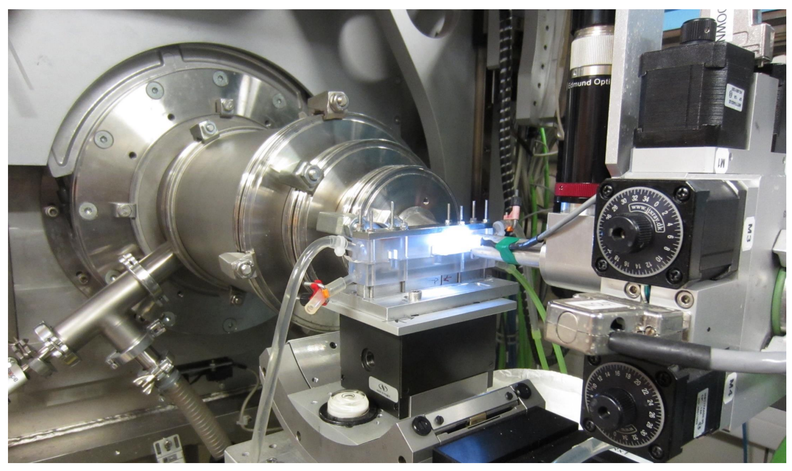
Our results were presented in next articles:

[1] Loginov et al. J. Membr. Sci. 595 (2020) 117498
[2] Doudiès et al. J. Membr. Sci. 618 (2021) 118700
[3] Loginov et al. J. Membr. Sci. 630 (2020) 119289

Some illustrations of our work on fouling analysis:

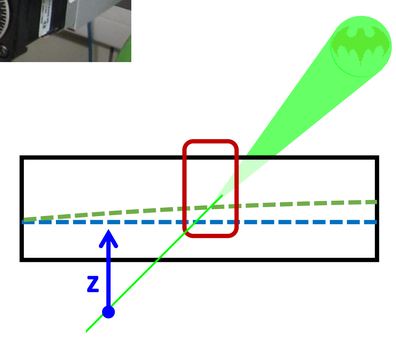
- Suspension is filtered and gel layer is obtained under controlled crossflow and transmembrane pressure.

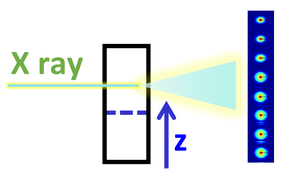




Actual photo of experiment (filter cell and SAXS chamber).

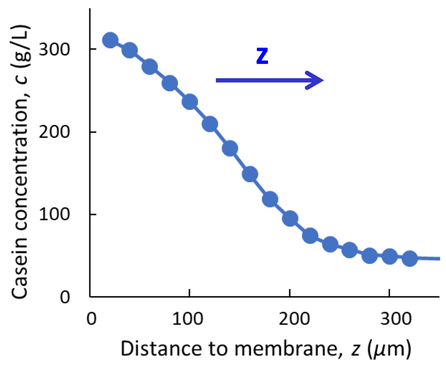
- Concentration polarization and gel layers are “scanned” through the window by narrow X-ray beam, and scattering patterns are registered.



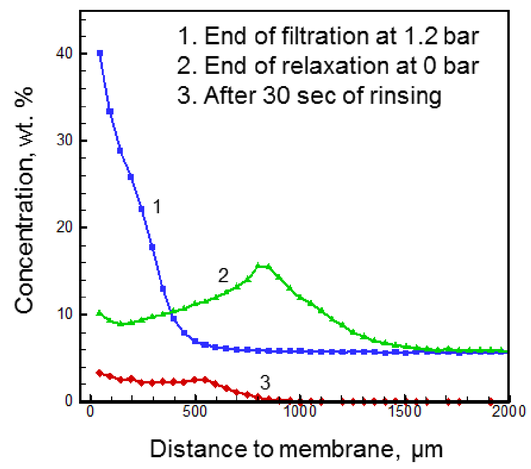


Side view of the filter cell and scattering patterns (SAXS patterns) obtained for different distances from the membrane surface.

- Patterns are analyzed and local casein concentrations are obtained for different distances from the membrane surface *z*; i.e. gel concentration profile is obtained: each distance z → one SAXS pattern → one local gel concentration; Local solids concentration distribution in the fouling layer is obtained



- This Figure studies the fouling layer evolution.
1. Filtration resulted in formation of a concentrated fouling gel layer on the membrane surface;
2. After the pressure removal this layer swelled, swelling was more intense near the membrane;
3. Rinsing removed the swelled layer.



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