DWRG
DRINKING WATER RESEARCH GROUP

Working together for innovation in drinking water quality, treatment, and distribution

Optimizing Ultrafiltration Performance

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Collaborators:
General Electric
Regional Municipality of Peel

Funding Source:
Natural Sciences and Engineering Research Council of Canada
General Electric
Regional Municipality of Peel

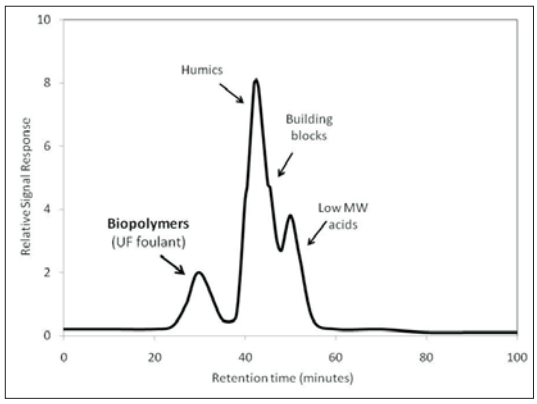

Figure 1: Example of LC-OCD chromatogram with major NOM fractions identified

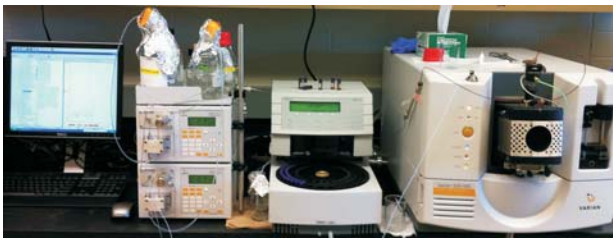

Figure 2: LC-MS-MS for analysis of pharmaceuticasl in water

The use of low pressure membrane filtration in drinking water treatment has increased rapidly in the past 10 years. Hollow fiber ultrafiltration (UF) membranes are commonly implemented into newly constructed or upgraded water treatment facilities because their pore sizes (0.001 – 0.1 µm) effectively remove bacteria and particulates in a smaller footprint than conventional treatment. The main barrier to ultrafiltration use is membrane fouling by natural organic matter (NOM). Studies have identified the main UF foulants as biopolymers, which are hydrophilic in nature and of high molecular weight (>10 kDa). Additionally, UF membranes alone are ineffective at removing emerging contaminants, such as pharmaceuticals, from water. The overall objective of this study is to optimize UF performance by applying pre-treatment methods to remove foulants (biopolymers) and simultaneously improve the removal of pharmaceutical compounds.

We are developing UF hybrid processes with pre-treatment of coagulation, powdered activated carbon (in micro- and nano-sized particles), ion exchange resin, and combinations of multiple technologies. Promising treatment scenarios are being examined at bench and pilot-scale using small hollow fiber UF modules with automated continuous permeation and backwash cycling. Several natural water matrices, representing a range of NOM fingerprints are being studied. Source waters from many locations in Ontario are also being spiked with pharmaceutical compounds of interest. Biopolymer concentrations are measured using liquid chromatography with organic carbon detection (LC-OCD); pharmaceutical concentrations are measured using liquid chromatography-tandem mass spectrometry (LC-MS-MS). Results of this study can be used to inform utilities of pre-treatment scenarios to improve membrane performance as well as to enhance the removal of emerging contaminants.

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