

Natural organic matter membrane fractionation of surface water – A new approach

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Introduction

Natural organic matter (NOM), contained in drinking water resources, negatively affects drinking water quality by acting as nutrients for bacterial regrowth in the distribution system. Chlorine is a common disinfectant to inactivate pathogens, but it also reacts with NOM during disinfection to form disinfection by-products, which are correlated with health issues such as cancer. To identify the precursors that are responsible for the formation of these by-products from the complex NOM mixture, the latter is split into smaller fractions with similar chemical or physical properties. Dead-end ultrafiltration membrane fractionation is the most commonly used technique to split NOM by size, but is unable to produce sharply separated fractions. Therefore, this research will seek for a new membrane fractionation method that separate NOM into biopolymers, humic substances and low, molecular weight compounds. Subsequently, their reactivity towards chlorine and the formation of disinfection by-products will be determined.

Material and Methods

During fractionation, both a normal filtration step and a diafiltration step is executed. A model was constructed that predicts the concentration change for a certain compound during these two steps and was validated with a nanofiltration (Dow NF270). The model will be used to determine the time needed to have a good separation of the organic compounds for a certain water source.

$$\ln \frac{C_{f,t}}{C_{f,0}} = -R * \ln \left(1 - \frac{Q_p}{V_0} * t \right) \text{ (normal filtration)}$$

$$\ln \frac{C_{f,t}}{C_{f,0}} = (R - 1) \frac{Q_p}{V_0} * t \text{ (diafiltration)}$$

With C_f the concentration of the compound in the feed tank, R the retention, Q_p the flowrate and V_0 the initial feed volume.

Results and Conclusion

Figure 1 clearly shows that the model fits the experimental data very well during normal filtration mode (a,b). The fit during diafiltration is less accurate, but is rather explained by experimental variation (discontinuous adjustment of feed volume). The model will be equally validated with NOM concentrations and used to optimize membrane fractionation conditions.

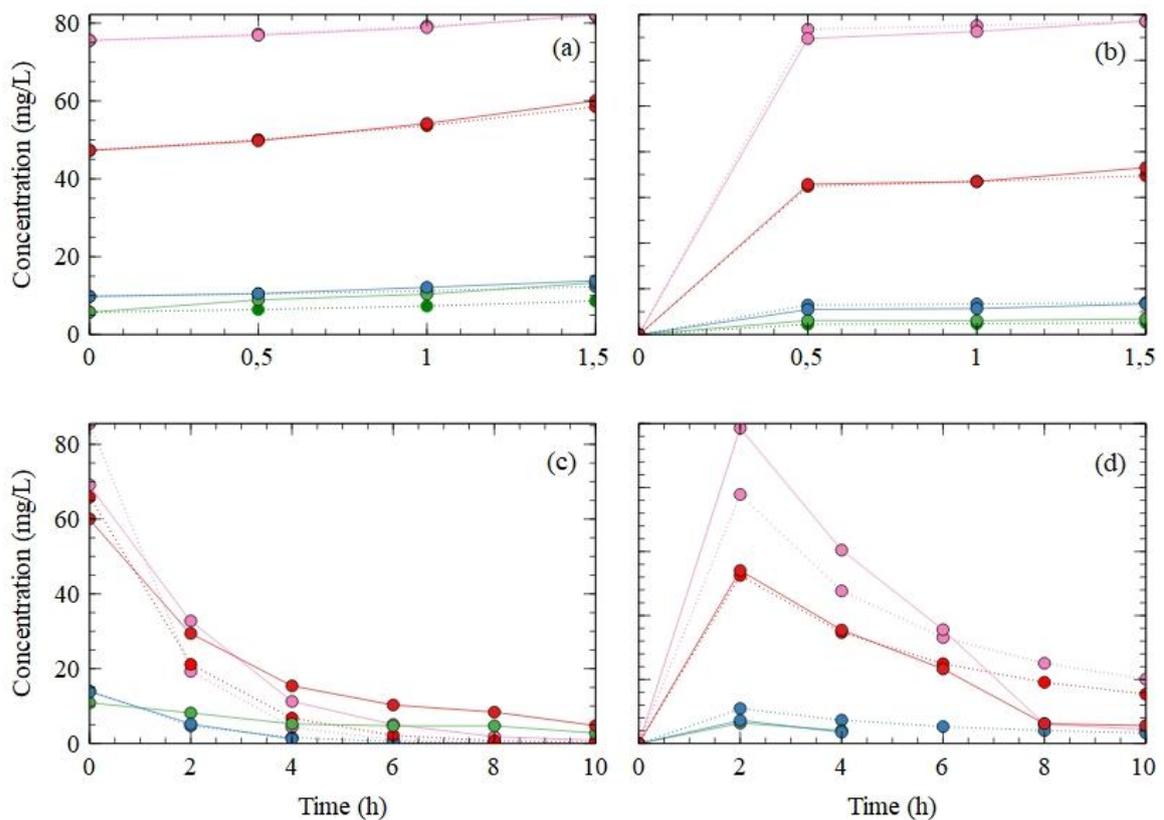


Figure 1: Ion concentrations in (a),(c) retentate and (b),(d) permeate during normal filtration ((a),(b)) and diafiltration ((c),(d)). Full lines represent experimental data, dotted lines predicted data of sodium (red), potassium (blue), magnesium (green) and chloride (pink).

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