# Supplementary Material

# Pilot Study on the Combination of Different Pre-Treatments with Nanofiltration for Efficiently Restraining Membrane Fouling While Providing High-Quality Drinking Water

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**Table S1.** Test water quality.

| Measurement | Units | Raw water | SF | $O_3$-BAC | SF+NF | SF+$O_3$-BAC+NF |
|---|---|---|---|---|---|---|
| Turbidity | NTU | 2.4±2.3 | 0.143±0.023 | 0.119±0.028 | 0.055±0.011 | 0.051±0.010 |
| Conductivity | μm/S | 387.6±38.5 | 355.9±11.1 | 424.0±24.3 | 19.34±3.16 | 10.23±0.8 |
| TDS | mg/L | 189.4±19.0 | 178.1±5.4 | 212.0±11.9 | 9.67±1.6 | 5.15±0.4 |
| $UV_{254}$ | $cm^{-1}$ | 0.0537±0.003 | 0.0374±0.004 | 0.0199±0.003 | 0.0016±0.001 | 0.0008±0.001 |
| DOC | mg/L | 3.82±0.30 | 2.91±0.18 | 2.37±0.20 | 0.138±0.137 | 0.098±0.140 |
| SUVA | L·$mg^{-1}$ $m^{-1}$ | 1.41±0.09 | 1.30±0.08 | 0.85±0.16 | 1.26±0.811 | 0.948±0.994 |
| BDOC | mg/L | 1.69±0.34 | 0.95±0.02 | 0.19±0.07 | 0.06±0.01 | 0.01±0.01 |

**Table S2.** Component analysis of various water constituents based on region A, B and C [1, 2].

| Region | Molecular Weight | Components | Fraction | Functional Groups |
|---|---|---|---|---|
| Region A | 0.22-4kDa | Protein, Tyrosine | Hydrophilic Base | Purines, pyrimidines, low MW alkyl amines |
| Region B | 4-30kDa | Humic, Fulvic Acids | Hydrophobic Acid | Aromatic acids, high MW alkyl mono-, di-carboxylic acids |
| Region C | 30-100000kDa | Proteins, Amino Acids, polysaccharides | Hydrophobic Base | high MW alkyl amines |

**Table S3.** Analysis of cleaning solutions at different stages in the acid-base washing process.

| Combined process | Washing time (min) | $UV_{254}$ ($cm^{-1}$) | DOC (mg/L) | Cond. (μm/s) | TDS (mg/L) | pH | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|
| | Acid 20min | 0.0171 | 1.877 | 919 | 458 | 2.92 | 0.135 |
| | Acid 40min | 0.0202 | 2.078 | 729 | 364 | 3.10 | 0.138 |
| | Acid 60min | 0.0201 | 2.694 | 658 | 329 | 3.21 | 0.104 |
| SF+NF | Alkaline 20min | 0.0192 | 4.958 | 457 | 228 | 11.12 | 2.850 |
| | Alkaline 40min | 0.0301 | 7.215 | 451 | 225 | 11.03 | 2.650 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Alkaline 60min | 0.0496 | 11.401 | 431 | 215 | 10.99 | 2.260 |
| | Acid 20min | 0.0450 | 5.657 | 996 | 483 | 2.97 | 0.273 |
| | Acid 40min | 0.0556 | 6.989 | 880 | 439 | 3.04 | 0.246 |
| SF+O$_3$- | Acid 60min | 0.0615 | 7.823 | 820 | 410 | 3.10 | 0.269 |
| BAC+NF | Alkaline 20min | 0.1227 | 19.64 | 775 | 387 | 11.43 | 3.790 |
| | Alkaline 40min | 0.1522 | 29.00 | 742 | 371 | 11.40 | 4.570 |
| | Alkaline 60min | 0.1707 | 31.92 | 728 | 364 | 11.37 | 4.600 |

**Table S4.** Spectral characteristics of the five components identified by PARAFAC analysis and the correlation with the fraction of HPSEC for all samples.

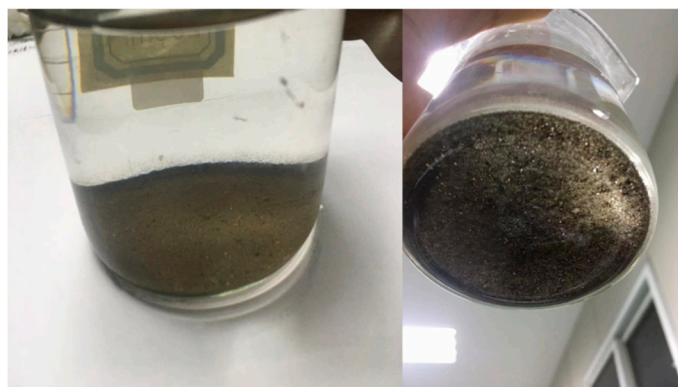| Component | MW | R$^2$ | Description and probable source |
|---|---|---|---|
| C1 | Region-A-DOC | 0.558* | tryptophan-like substances |
| C2 | Region-B-UV | 0.806** | amino acids |
| C3 | Region-A-UV | 0.891** | humic-like components |
| C4 | Region-A-DOC | 0.235 | tyrosine-like substances |
| C5 | Region-B-DOC | 0.972** | tryptophan-like substances |



**Figure S1.** The accumulation of powdered activated carbon in the security filter.

**References**

1. Brezinski, K., & Gorczyca, B. (2019). An overview of the uses of high performance size exclusion chromatography (HPSEC) in the characterization of natural organic matter (NOM) in potable water, and ion-exchange applications. Chemosphere, 217, 122-139.
2. Teixeira, M. R., & Sousa, V. S. (2013). Fouling of nanofiltration membrane: Effects of NOM molecular weight and microcystins. Desalination, 315, 149-155.