Characterization of Natural Organic Matter and Trihalomethane Formation Potential for NOM Fractions Isolated From Two Surface Water Sources in Manitoba

By

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.
Abstract

The objective of this study was to evaluate the removal of natural organic matter (NOM) fractions, from the Portage la Prairie water treatment plant (PPWTP), which uses the Assiniboine River as a source, and the Morris water treatment plant (MWTP), which takes water from the Red River, to establish the NOM removal efficiency. The PPWTP sample set for total DOC removal by the plant found the granular activated carbon (GAC) filter was inefficiently removing dissolved organic carbon (DOC) from the water, often with concentrations increasing post-GAC. It was found that one sample set from the MWTP showed that NOM was not being removed by the nano filter with NOM increasing post-nano filtration, from 8.7mg/L to 10.2 mg/L. However, it was found that most of the time the nano filter was operating as manufacturer design showing a reduction of NOM post nano filter to <0.5mg/L.
Acknowledgements

I would like to thank my friends and family, especially Miss. Lesley Sellwood for all her patients with the many long hours away from home and for taking care of the numerous duties I left unattended during the experimentation and writing of this thesis.

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Thank you.
Dedication

I would like to dedicate this work to the environmental chemists and engineers who dedicate their lives to improving the quality and safety of our drinking water.
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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>µg</td>
<td>Micrograms</td>
</tr>
<tr>
<td>Act Ar-R</td>
<td>Activated Aromatic Ring</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>BDCM</td>
<td>Bromodichloromethane</td>
</tr>
<tr>
<td>CIP</td>
<td>Clean In Place</td>
</tr>
<tr>
<td>ClO⁻</td>
<td>Hypochlorite anion</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter</td>
</tr>
<tr>
<td>d</td>
<td>day</td>
</tr>
<tr>
<td>D/DBPR</td>
<td>Disinfectant/Disinfection By-product Rule</td>
</tr>
<tr>
<td>Da</td>
<td>Daltons</td>
</tr>
<tr>
<td>DBCM</td>
<td>Dichlorobromomethane</td>
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<tr>
<td>DBP(s)</td>
<td>Disinfection By-Product(s)</td>
</tr>
<tr>
<td>DOC</td>
<td>Dissolved Organic Carbon</td>
</tr>
<tr>
<td>DOM</td>
<td>Dissolved Organic Matter</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FTIR</td>
<td>Fourier-Transform Infrared Spectroscopy</td>
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<tr>
<td>GAC</td>
<td>Granular Activated Carbon</td>
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<td>GCDWQ</td>
<td>Guidelines for Canadian Drinking Water Quality</td>
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<td>GC-ECD</td>
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<td>HAA(s)</td>
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<td>HPLC</td>
<td>High Pressure Liquid Chromatography</td>
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</table>
PAS  Polyaluminum Sulfate
POM  Particulate Organic Matter
ppb  Parts per billion
ppm  Parts per million
PPWTP  Portage la Prairie Water Treatment Plant
PVDF  Polyvinylidene Fluoride
RO  Reverse Osmosis
s  Second
SDWA  Safe Drinking Water Act
SEM  Scanning Electron Microscope
SPE  Solid Phase Extraction
SUVA  Specific Ultraviolet Absorbance at 254 nanometers
TBM  Tribromomethane
TCM  Trichloromethane
TCU  True Color Unit
TDI  Total Daily Intake
TDS  Total Dissolved Solid
TFE  Tetrafluoroethylene
THM(s)  Trihalomethane(s)
THMFP  Trihalomethane Formation Potential
TMP  Trans-membrane Pressure
TOC  Total Organic Carbon
TOX  Total Organic Halide
TTHM  Total Trihalomethane
UF  Ultrafiltration
USA  United States of America
USEPA  United States Environmental Protection Agency
UV  Ultraviolet
UV$_{254}$  Ultraviolet Absorbance at 254 nanometers
WHO  World Health Organization
| WTP(s) | Water Treatment Plant(s) |