

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

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A thesis submitted to the Faculty of Graduate Studies of  
The University of Manitoba

In partial fulfillment of the requirement for the degree of

MASTER OF SCIENCE

Department of Civil Engineering

University Of Manitoba

Winnipeg, Manitoba

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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.

I would like to thanks to my colleagues at the University Of Manitoba Department Of Civil Engineering: *Mr. Victor Wei, Mr. Justin Rak-Banville, Mr. Steven Cho,* and *Mr. Arman Vahedi* for their invaluable input into the preparation of this work. I would also like to thank my many friends and professors at the University Of Winnipeg Department Of Chemistry for giving me the tools and experience needed to conduct this research.

I would like to give special thanks to my advisor, *Dr. Beata Gorczyca* (University of Manitoba), *Dr. Peter Hombach* (Orsono Enterprises Inc.), *Dr. Housseini Coulibaly* (Manitoba Office of Drinking Water), *Dr. Charles Wong* (University of Winnipeg), *Mr. Jake Fehr* and the operators at the Pembina Valley Water Cooperative Inc, *Mr. Kelly Braden* and *Mr. Doug Campbell* (Portage la Prairie Water Treatment Plant), *Mr. Ken Anderson* and *Mr. Jeff O'Driscoll* (Associated Engineering), *Mr. Morley Nagle* (Manitoba Aboriginal and Northern Affairs) and *Mr. Don Michalyk* (Manitoba Office of Drinking Water) for providing me with the guidance, time, and valuable insight into this project.

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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## List of Abbreviations

µg	Micrograms
Act Ar-R	Activated Aromatic Ring
AWWA	American Water Works Association
BDCM	Bromodichloromethane
CIP	Clean In Place
ClO <sup>-</sup>	Hypochlorite anion
cm	Centimeter
d	day
D/DBPR	Disinfectant/Disinfection By-product Rule
Da	Daltons
DBCM	Dichlorobromomethane
DBP(s)	Disinfection By-Product(s)
DOC	Dissolved Organic Carbon
DOM	Dissolved Organic Matter
EU	European Union
FTIR	Fourier-Transform Infrared Spectroscopy
GAC	Granular Activated Carbon
GCDWQ	Guidelines for Canadian Drinking Water Quality
GC-ECD	Gas Chromatography Electron Capture Detection
GDWQ	Guidelines for Drinking Water Quality
HAA(s)	Haloacetic Acid(s)
HCl	Hydrochloric Acid
HOCl	Hypochlorous Acid
HPI	Hydrophilic
HPIA	Hydrophilic Acid
HPIB	Hydrophilic Base
HPIN	Hydrophilic Neutral
HPLC	High Pressure Liquid Chromatography

HPO	Hydrophobic
HPOA	Hydrophobic Acid
HPOB	Hydrophobic Base
HPON	Hydrophobic Neutral
IARC	International Agency for Research on Cancer
ICR	Information Collection Rule
IDSE	Initial Distribution System Evaluation
IMAC	Intrim Maximum Allowable Concentration
IS	Internal Standard
kg	Kilogram
L	Liter
MAC	Maximum Allowable Concentration
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
M-DBP Cluster	Microbial-Disinfectants/Disinfection By-product Cluster
MeOH	Methanol
mg	Milligrams
min	Minute
ML	Megaliters
mmol/L	Milli-mole per Liter
mol/L	Mole per Liter
MRDLG	Maximum Residual Disinfectant Level Goals
MS	Missouri
MWTP	Morris Water Treatment Plant
NF	Nanofiltration
nm	Nanometer
NOM	Natural Organic Matter
NTU	Nephelometric Turbidity Unit
NY	New York
OH	Hydroxyl group
PACl	Polyaluminum Chloride

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
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 <sub>254</sub>	Ultraviolet Absorbance at 254 nanometers
WHO	World Health Organization

WTP(s)

Water Treatment Plant(s)