Journal of Membrane Science and Research 7 (2021) S3-S7

Journal of Membrane Science & Research

journal homepage: www.msrjournal.com

Supplementary Information

The Synergistic Fouling of Ceramic Membranes by Particles and Natural Organic Matter Fractions using Different Surface Waters in South Africa

Welldone Moyo [1], Nhamo Chaukura [1,2], Machawe M. Motsa [1], Nomcebo H Mthombeni [3], Titus A.M Msagati [1], Bhekie B. Mamba [4], Sebastiaan G.J Heijman [5], Thabo T.I Nkambule [1,*]

[1] *Institute for Nanotechnology and Water Sustainability (iNanoWS), University of South Africa (UNISA), Johannesburg, South Africa*
[2] *Department of Physical and Earth Sciences, Sol Plaatje University, Kimberley, South Africa*
[3] *Department of Civil and Chemical Engineering, University of South Africa (UNISA), Johannesburg, South Africa*
[4] *College of Science, Engineering and Technology, University of South Africa (UNISA), Johannesburg, South Africa*
[5] *Department of Civil Engineering and GeoSciences, Technical University of Delft, Delft, the Netherlands*

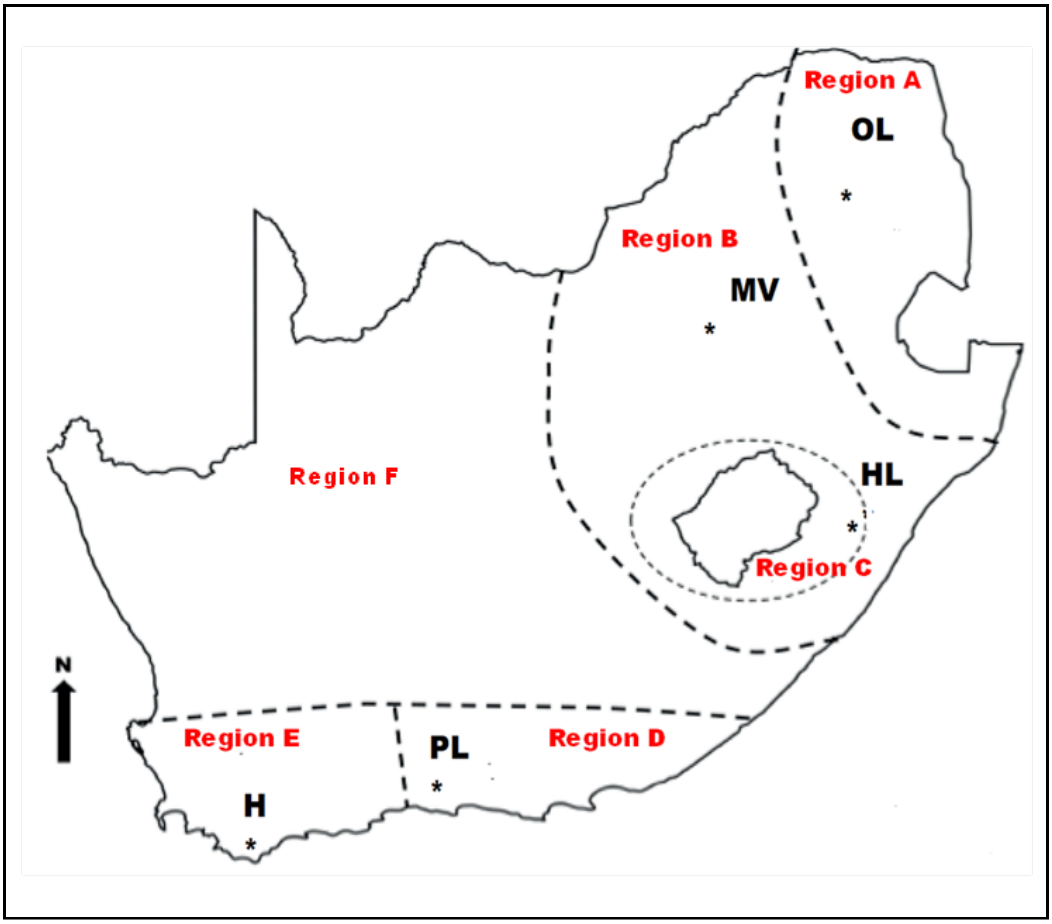

Fig. S1. The location of selected surface water sources representing different water quality regions of South Africa (adapted) (Chaukura et al, 2018).

© 2021 MPRL. All rights reserved.

* Corresponding author: nkambtt@unisa.ac.za (T.T.I. Nkambule)

Fig. S2. Disc shaped ceramic membrane used in the study.

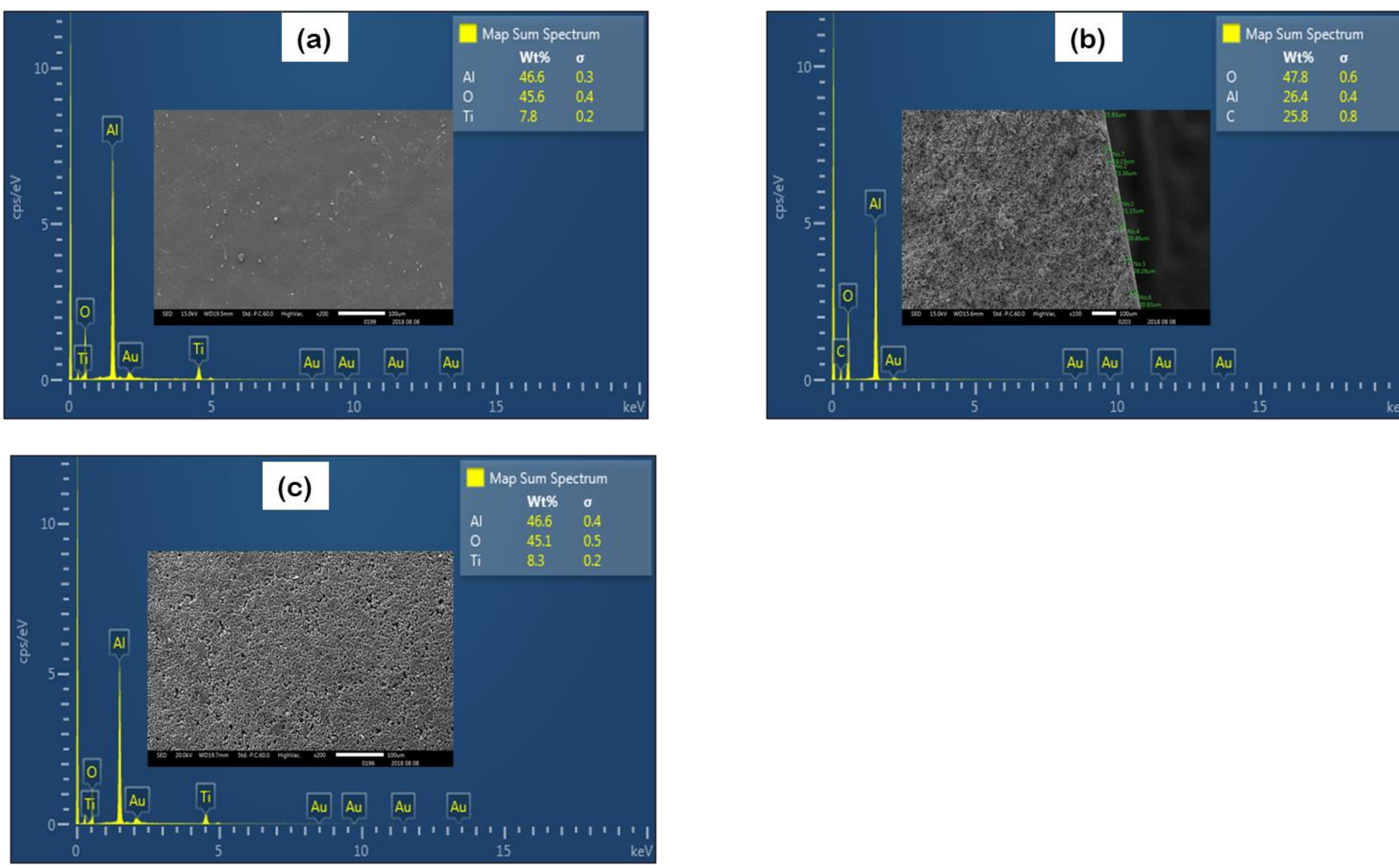

Fig. S3. Scanning micrographs of (a) active layer (b) cross sectional layer and (c) support layer.

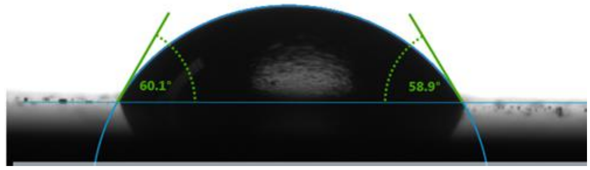

Fig. S4. Contact angle.

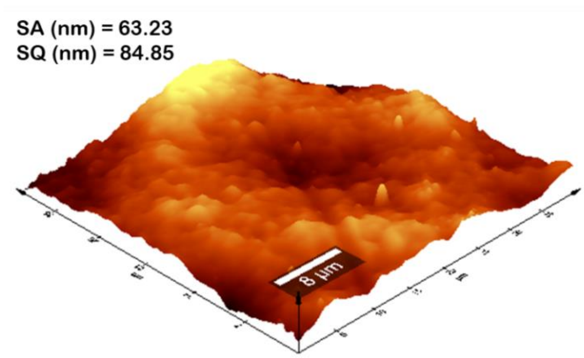

Fig. S5. AFM micrographs of the top surface of the membranes.

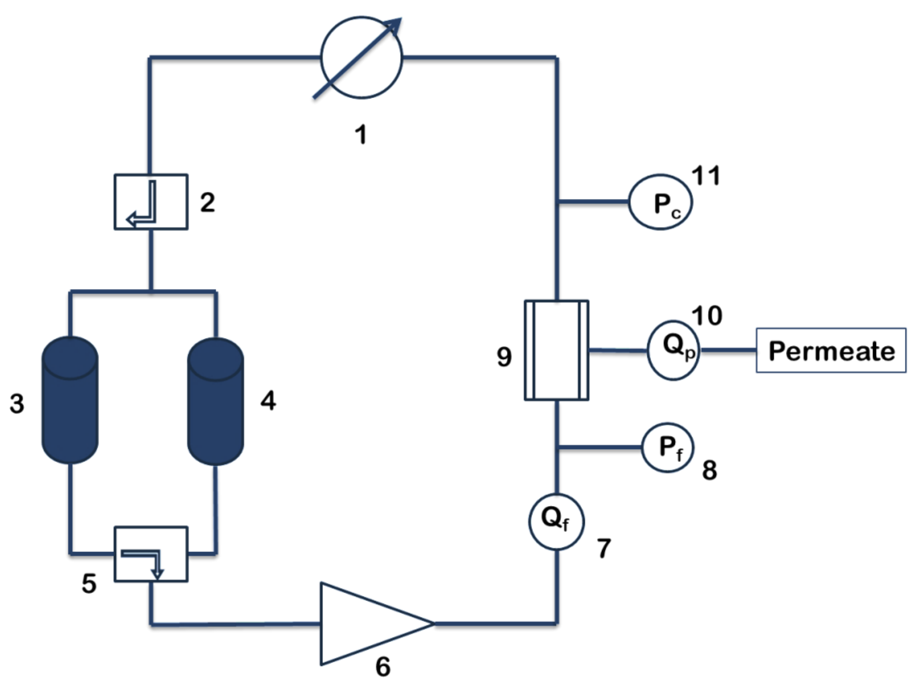

Fig. S6. The schematic layout of the filtration set up. The cross flow mode was maintained by opening the concentrate valve and equilibrating the TMP at 3 bars. (1-concentrate valve; 2-flow direction valve; 3-deionised water tank; 4-Feed water tank; 5-flow direction valve; 6-pump; 7-flow speed meter; 8-feed pressure meter, 9-membrane housing; 10-permeate pressure meter; 11-concerntrate pressure meter.)

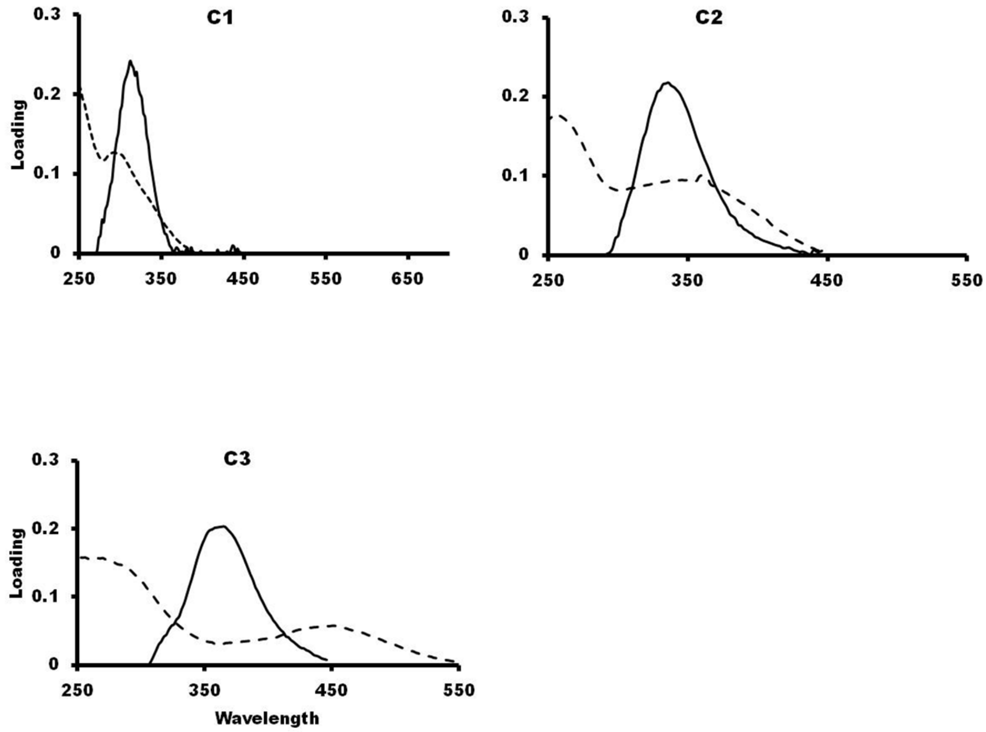

Fig. S7. Loadings for the four PARAFAC components of drinking water samples collected at source.

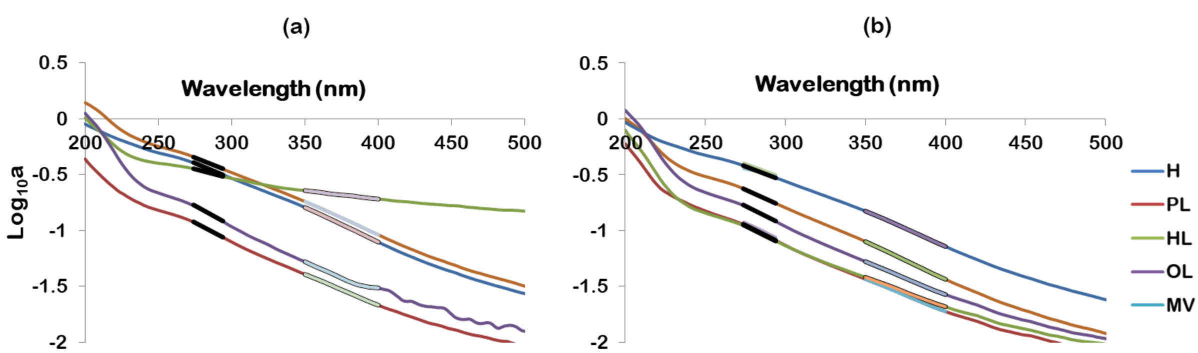

Fig. S8. Natural log-transformed absorption spectra for (a) unfiltered, and (b) 0.45 µm filtered samples with best-fit regression lines for two regions (275–295 nm and 350–400 nm); slope ratio (S_R) values are given for each log-transformed spectrum.

The fouling mechanisms were determined using the model equations in Box S1:

(1). $J = J_0 e^{-At}$ $A = K_A u_0$

(2). $J = \frac{J_0}{(1+Bt)^2}$ $B = K_B u_0$

(3). $J = \frac{J_0}{(1+At)}$

(4). $J = \frac{J_0}{\sqrt{1+Ct}}$ $C = (2R_r)K_c u_0$

Box S1

Models to describe fouling mechanisms: (1) complete blocking, (2) standard blocking, (3) intermediate blocking, and (4) cake filtration, respectively (Angelis et al., 2013). Where, J_0 and J are initial and final flux respectively; u_o average initial filtrate velocity; R_r is the ratio of resistance of the cake to the clean membrane; K_A is membrane surface blocked per unit of total volume permeated through the membrane; K_B is decrease in cross section area of the pores due to the particles deposited on the walls per unit of total permeate volume; K_C is total permeate volume per unit of membrane area.

Table S1

Fluorophores in natural water illustrating peak fluorescence positions (excitation and emission range) (Coble *et al*., 1996; Jiang *et al*., 2017).

Peak	Excitation wavelength range (nm)	Emission wavelength range (nm)	Component description	Source
A	260	380 – 460	Humic-like	Humic Terrestrial Allochtonous
B	275	310	Protein-like Tyrosine-like	Autochtonous, resembles tyrosine, free or combined amino acids
C	350	420 – 480	Humic- / Fulvic-like	Humic Terrestrial Allochtonous
T	275	340	Protein-like Tryptophan-like	Autochtonous
M	290 - 310	370 - 420	Humic-like	Autochtonous, microbial Autochtonous

Table S2

Summary of goodness of fit (R^2) on fouling mechnisms.

		Complete	Standard	Cake	Intermediate
OL	**Total**	0.94	0.93	0.80	0.95
	Organic	0.79	0.81	0.97	0.70
PL	**Total**	0.93	0.92	0.80	0.90
	Organic	0.95	0.95	0.75	0.66
H	**Total**	0.95	0.95	0.81	0.82
	Organic	0.58	0.60	0.76	0.52
HL	**Total**	0.95	0.90	0.52	0.88
	Organic	0.75	0.74	0.71	0.26
MV	**Total**	0.97	0.94	0.61	0.35
	Organic	0.91	0.91	0.76	0.95