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Combined TiO_2 membrane filtration and ozonation for efficient water treatment to enhance the reuse of wastewater

Yaoxin Hu[a,b], Nicholas Milne[b], Stephen Gray[b], Gayle Morris[c], Wanqin Jin[a], Mikel Duke[b], Bo Zhu[b,*]

[a]*State Key Laboratory of Materials-Oriented Chemical Engineering, Nanjing University of Technology, Nanjing, P. R. China*
[b]*Institute for Sustainability and Innovation, Victoria University, Melbourne, Australia*
Tel. +61-3-99198281; Fax: +61-3-99197696; email: Bo.Zhu@vu.edu.au
[c]*Research Services Office, Flinders University, Adelaide, Australia*

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ABSTRACT

A mesoporous titania (TiO_2) membrane on an alumina support was successfully fabricated via the sol–gel processing method. The effects of combined ozonation and TiO_2 membrane filtration on the permeate flux and permeate quality were investigated. Ozone injection into the feed water during the filtration resulted in an increase in the permeate flux within the first 0.5 h. Ozonation decreased the fouling on the membrane surface. However, at the end of 2 h filtration, ozonation did not significantly impact on the permeate flux. It is likely that there would be minimal ozone residual remaining in the feed after 2 h filtration, which is why fouling was evident after this time, probably in the form of an organic film on the membrane surface reducing the flux. Under the hybrid ozonation-membrane filtration system, the removal of colour, A_{254} (UV absorbance measured at a wavelength of 254 nm) and total organic carbon (TOC) was found to be 88.5%, 75.4% and 48.7%, respectively. Membrane filtration or ozonation alone did not achieve the degree of reduction obtained with hybrid ozonation-membrane filtration. Increasing the ozonation time from 2 min to 10 min gave no consistent trend in the percent removal of the colour and UV-254 absorbing compounds. Even at low ozonation time, there was a significant decrease in the UV-254 and colour. However, increasing the ozonation time beyond a threshold value (2 min) had a negative effect on reduction of TOC. Ozonation of organic matter is known to result in a decrease in the molecular weight of the organic matter, which would then result in these compounds passing through the membranes giving arise this effect.

Keywords: Ceramic membrane; Titania; Membrane filtration; Ozonation; Advanced oxidation processes; Membrane fouling; Wastewater reuse

*Corresponding author.

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