Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2013.781000

51 (2013) 6392–6400
September

Taylor & Francis
Taylor & Francis Group

Iron oxide nanoparticle-impregnated powder-activated carbon (IPAC) for NOM removal in MF membrane water treatment system

Sungsu Kim[a], Jintae Kim[b], Gyutae Seo[c,*]

[a]*Doosan Heavy Industries & Construction, 22, DoosanVolvo-ro Seongsan-gu, Changwon, Gyeongnam 642-792, Korea*
[b]*Korea Industrial Complex Corporation, Guro-Digital 32gil 29, Guro-gu, Seoul, Korea*
[c]*Department of Environmental Engineering, Changwon National Univ., 63 Sonamoo 5Gil, Changwon, Gyeongnam 641-773, Korea*
Tel. +82 55 213 3746; Fax: +82 55 281 3011; email: gts@changwon.ac.kr

Received 16 October 2012; Accepted 16 December 2012

ABSTRACT

A novel powder-activated carbon (PAC) by surface modification with iron oxide nanoparticles was applied to microfilter (MF) membrane system for stable operation and removal of natural organic matter (NOM) in water. Two types of PAC (wood-based and coal-based) were used for the preparation of the iron oxide nanoparticle-impregnated PAC (IPAC). The impregnation of the iron oxide nanoparticles played a role to increase the pH_{PZC} of the PACs which means that the IPAC has higher basicity and larger adsorption capacity than the virgin PAC. From the experimental results of size exclusion chromatography (SEC) and $SUVA_{254}$, there was no specific selectivity in adsorption of NOM on the IPAC. The saturated magnetization value of the IPAC was in the range of 6.75–8.04 emu/g that was enough to separate the IPAC particle from aqueous solution by magnetic force. An IPAC column followed by MF membrane system was operated to investigate NOM removal and membrane fouling control. A magnetic ring on the column above the IPAC bed surface could effectively hold the overflowing discrete IPAC particles. The system performance was compared with other similar MF membrane systems (PAC column-MF, high concentration PAC-MF (HCPAC-MF),and single MF) in terms of trans-membrane pressure (TMP) increase and NOM removal. For a 30-day operation, TMP of the MF membrane system could be maintained stably at 13 kPa with the IPAC column pretreatment, while the TMP of other membrane systems increased to the operation limit (40 kPa). Dissolved organic compound (DOC) and UV_{254} removal by the IPAC-MF system were 85.3 and 79.6%, respectively. And the removal efficiency of turbidity was more than 80%. With similar removal efficiency of DOC and UV_{254}, the IPAC-MF process showed much more stable operation for longer periods compared to the other hybrid MF membrane systems (HCPAC-MF and PAC column-MF).

Keywords: Adsorption; Iron oxide nanoparticle; Magnetization; Microfiltration membrane; Natural organic matter (NOM); Powder activated carbon (PAC)

*Corresponding author.

Presented at The Fifth Desalination Workshop (IDW 2012), October 28–31, 2012, Jeju, Korea