Optimization of chemical cleaning condition for microfiltration process using response surface methodology

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Received 19 November 2014; Accepted 5 January 2015

ABSTRACT

Microfiltration (MF) processes are used in a variety of separation and concentration applications. Since membrane fouling is inevitable, membranes must be regularly cleaned to remove both organic and inorganic material deposited on the surface and/or into the membrane bulk. Optimization of the cleaning conditions for MF membranes is especially important. If the dose of cleaning chemical or cleaning time is inadequate, the membrane permeability is not recovered. If a dose of the chemical or the time is excess, irreversible damages in membrane properties occur. However, it is difficult to find the optimum conditions for chemical cleaning of MF. In this study, response surface methodology (RSM), a facile tool for optimization, was employed to determine the optimum conditions for chemical cleaning of MF. The Box–Behnken center-united experimental design was used to quantify the effects of respective chemicals (citric acid and sodium hypochlorite) dose and treatment time on fouling control and organic removal. The dose of citric acid and sodium hypochlorite ranged from 1,600 to 2,400 ppm and from 200 to 1,400 ppm, respectively. The treatment time was also conducted from 1 to 5 h. After the chemical cleaning treatment, transmembrane pressure data of distilled water were compared with them before the chemical cleaning treatment. Experimental results indicated that the efficiency of chemical cleaning is sensitive to the concentration of cleaning chemicals (citric acid and sodium hypochlorite) as well as cleaning time. Nevertheless, the dependency of cleaning efficiency on these parameters was different. The cleaning efficiency, which is expressed as the recovery of membrane permeability after cleaning, varies from 0 to 72%. The RSM analysis could suggest the optimum conditions for membrane cleaning.

Keywords: Microfiltration; Coagulation; Water treatment; Response surface methodology; Optimization

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Presented at IDW 2014 — the 7th International Desalination Workshop, November 5–8, 2014, Jeju, Korea

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