Desalination and Water Treatment
www.deswater.com
47 (2012) 17–23
September
1944-3994/1944-3986
doi: 10.1080/19443994.2012.696390
Taylor & Francis
Taylor & Francis Group

The effect of fluctuation in flow rate on the performance of conventional and membrane water treatment for a smart water grid

No-Suk Park[a], Seong-Su Kim[a], Seon-Ha Chae[a], Suhan Kim[b,*]

[a]*Water Management & Research Center, K-water Institute, Jeonmin-Dong, Yusong-Gu, Daejeon, Korea*
[b]*Department of Civil Engineering, Pukyong National University, Yongdang-Dong, Nam-Gu, Busan, Korea*
Tel. +82 51 629 6065; Fax: +82 51 629 6063; email: suhankim@pknu.ac.kr

Received 2 December 2011; Accepted 6 February 2012

ABSTRACT

A smart water grid can save water and energy by delivering the water to consumers according to the time-dependent demands. One of the key water treatment technologies for a smart water grid is to control the water supply rate as per the consumers' demand. However, a conventional water treatment plant is designed for a constant production rate operation, which is not appropriate for a smart water grid. The present study focuses on the effect of fluctuation on the production rate of three water treatment technologies: i.e. (1) sedimentation followed by ozonation and coagulation/flocculation, (2) sand filtration followed by coagulation/flocculation and sedimentation, and (3) membrane process (microfiltration [MF]). For sedimentation and sand filtration processes, the pilot- and real-scale plant data were analyzed to investigate the fluctuation patterns of the flow rate and water quality. For the membrane process, an MF operation was simulated to investigate the effect of fluctuation flux on the membrane fouling rate. Two key findings emerged from the pilot and field data analyses and simulation results in the present study. First, there exists a time delay between the input and output flow fluctuations for sedimentation and sand filtration processes, and the water quality is changed during and after the time delay for the flow rate fluctuation. Second, in the MF process, the flow rate fluctuation does not have any significant effect either on the permeate water quality or on the fouling behavior.

Keywords: Smart water grid; Fluctuation in the flow rate; Conventional water treatment; Membrane water treatment

*Corresponding author.

Challenges in Environmental Science and Engineering, CESE 2011 25–30 September 2011, Tainan City, Taiwan