

Phosphate limitation in reverse osmosis: An option to control biofouling?

Judith D. Jacobson^a, Maria D. Kennedy^{a*}, Gary Amy^{a,b}, Jan C. Schippers^a

^aUNESCO-IHE, Institute for Water Education, Westvest 7, 2611 AX Delft, The Netherlands

Tel. +31 15 215 1715; Fax: +31 15 212 2921; email: m.kennedy@unesco-ihe.org

^bDelft University of Technology, Stevinweg 1, 2628 CN Delft, The Netherlands

Received 15 October 2008; Accepted 25 February 2009

ABSTRACT

The focus of this study was to develop and evaluate a method to measure phosphate down to a level of 1 µg P/L or lower, and to make an inventory of the concentration of phosphate in reverse osmosis (RO) feed water. In addition, the phosphate concentration was measured before and after various pre-treatment steps in three integrated membrane systems (IMS), and the pre-treatment steps were evaluated and compared in terms of their ability to remove phosphate. An existing method was modified to allow phosphate to be measured to levels below 1 µg P/L. After modification, the limit of detection was approximately 0.2 µg P/L. The phosphate concentration was monitored in three IMS. The feed water to all four systems was surface water, and the pre-treatment scheme comprised the following steps: (in-line) coagulation, UF/MF followed by antiscalant and/or acid addition prior to the RO units. The level of phosphate in the feed water (surface water) varied from 7–115 µg P/L. In pre-treatment systems without in-line coagulation, no phosphate removal was observed. The combination of in-line coagulation and UF reduced the phosphate level by 75–98%, to 0.2–2.8 µg P/L. However, after the addition of phosphonate antiscalant and/or acid, the phosphate concentration increased by 48 to 680% to 0.6–1.4 µg P/L in three IMS.

Keywords: Phosphate limitation; Integrated membrane systems; Bio-fouling; Antiscalants

* Corresponding author.