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Drinking Water Engineering and Science Discussions

Interactive comment on "Natural organic matter removal by ion exchange at different positions in the drinking water treatment lane" *by* A. Grefte et al.

A. Grefte et al.

a.grefte@tudelft.nl

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We would like to thank the referee for his comments.

Comment: What evidence do the authors have to suggest the slightly shorter contact time for FIX responsible for less DOC removal?

Response: Unfortunately, we have no evidence. We will change p384 line 22-24 to: Overall, MIEX showed a higher removal of NOM (fractions) than FIX. Possible explanations will be the longer contact time of the MIEX resin compared to the FIX (3 minutes for MIEX and 2.3 minutes for FIX), the smaller resin beads (approximately 150 um) for the MIEX resin (Drikas, 2002) in comparison to the bead size of 0.4 – 1.6 mm for

Lewatit VP OC 1071 (Lewatit product information) or the different operation conditions (the MIEX pilot was a continues process in one column, while every week one FIX column was regenerated and the effluent of three FIX columns were mixed.)

Comment: Biological Stability section is a bit hard to follow. Did IX decrease the biological growth potential of the treated water?

Response: To make this section more clear we would rewrite section 1 Introduction after line 26 p. 377 until line 10 p. 378 to make the definition of biological stability more clear:

The objective of this research is to improve the drinking water quality, including biological stability, by incorporating IEX for NOM removal. Different placement positions of IEX in the treatment lane are compared on water quality as well as costs. For this purpose the pre-treatment plant at Loenderveen and production plant Weesperkarspel (WPK) of Waternet, the water cycle company of Amsterdam (NL) and surrounding areas, were used as a case study. The treatment lane consists of coagulation, lake retention, filtration, ozonation, softening, activated carbon filtration and slow sand filtration. Assimilable organic carbon (AOC) values below 10 μgCl$-$1 have been derived as a reference value for biostable drinking water during distribution (van der Kooij, 1992), whereas current AOC concentrations are approximately 20 μgCl$-$1 (Baghoth et al., 2009) in the finished water. The biofilm monitor was developed as a tool to determine the biofilm formation characteristics of drinking water (van der Kooij et al. 1995). A biofilm formation rate (BFR) below 10 pg ATP/cm2.day reduces the risk of exceeding the Dutch guideline value for Aeromonas in the distribution system to less than 20% (van der Kooij et al. 1999). Thus, biologically stable water was defined in this study as having an AOC concentration lower than 10 ug C/L and a BFR below 10 pg ATP/cm2.day. By removing humic substances by IEX before ozonation it is expected that ozonation will form less biodegradable NOM than without IEX. IEX positioned after slow sand filtration is expected to lower the AOC and BFR values by itself. In both cases, a reduction in dissolved organic carbon (DOC) concentration in the finished water from approximately 2.7 to 1 mgCl−1 was aimed for.

Line 4-7 from p.282 will be removed, because this is explained in the introduction.

In Section 3.2 Biological stability the following will be changed/added:

p.358 line 15: 8 pg ATP cm-2 should be 6.6 pg ATP cm-2.

P.385 after line 27: The DOC concentration after the treatment lane was lowered from 4.3 to 2.3 mg C/L, due to FIX pre-treatment. MIEX after SSF decreased the DOC concentration from 4.3 to 1.8 mg C/L. Thus the biological stability of the water after the treatment lane, expressed as DOC, AOC and BFR, improved by extension of the treatment train with FIX. MIEX improved biological stability expressed as DOC and AOC, but results for BFR were obscured by spent resin. Unfortunately the values of DOC and AOC were not below the aimed concentrations of 10 mg C/L for AOC and 1 mg C/L for DOC, but will be lower when implementing FIX in the full-scale treatment. This can be concluded because the pilot plant was not as effective in DOC removal as is the full-scale treatment plant (Grefte, 2011).

Comment: A major cost not included in Section 3.4 is resin loss. The authors encountered the problem of resin loss in Section 3.2. The authors should discuss the effect of resin loss on cost.

Response: Resin loss as well as replacement of the resin is assumed to be independent of the NOM removal rate. In Table 3 it is part of the chemicals. Approximately 3% of the resin will be lost every year, but more important approximately every 5 year all resin has to be replaced. The total amount of resin is 200 m3. This divided by 5 years is 40 m3 resin per year should be replaced. This is shown in Table 3. The costs for resin loss and replacement are taken care of in the cost calculation.

Comment: The Environmental Impact section is qualitative and has no supporting data to give quantitative meaning. The authors should attempt to give the Environmental Impact section quantitative impacts.

Response: The referee is right that the environmental impact section is qualitative and not quantitative. The research done by Barrios et. al. (2008) gives quantitative data about the treatment of Waternet. Data from this article is used in Section 3.5 of this manuscript to make a comparison and give an indication of the further decrease of the environmental impact by IEX. Repeating the study of Barrios for the treatment with IEX is beyond the scope of this research.

Interactive comment on Drink. Water Eng. Sci. Discuss., 5, 375, 2012.