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Drinking Water

Engineering and Science

Discussions

Interactive comment on "Conversion of organic micropollutants with limited bromate formation during the Peroxone process in drinking water treatment" *by* A. H. Knol et al.

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Dear Referee #1,

Thank you very much for your compliment and comments. Point by point we will respond to your remarks.

Page 23, line 8-10: It is good that Dunea complies to the Dutch drinking water standards, but that is not relevant for this manuscript.

The authors agree. However, we choose for publishing in DWES to make knowledge easy accessible. To our customers not to worry, there is no reason to (yet), we find it

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important to emphasize that the water quality is not at steak.

Page 24, line 26-28: The authors indicate that even if a maximum of 1 ug/l bromate is reached after peroxone, these concentrations will be lower after artificial recharge. Is this solely due to concentration averaging, or can biological degradation of bromide also be expected? If so, what are the limits of this system? Could this imply that bromide concentrations > 1 ug/l in the peroxone effluent/ MAR influent could be acceptable as well?

The statement is based on levelling of the concentrations. However, a small part of the infiltrated water passes areas with an anoxic environment. Under this condition, reduction of bromate till bromide is expected. This is subject of investigation (PhD study).

Page 26, line 14: an additional AOP is used to treat peroxone effluent before discharge. Is this sufficient? It is to be expected that OMPs that are poorly degraded in the peroxone AOP would also be resistant to degradation in the subsequential AOP.

To be sure that the discharge didn't contain OMPs in worth mentioning concentrations, lower than the detection limit, the peroxone effluent was circulated several times while treated with UV/H2O2 AOP. In practice the effluent was circulated about 16 times overnight. Based on analyses, about 10 circulations were sufficient. We propose to replace "The treated water was collected in a 10 m3 storage tank and treated by additional AOP before discharge." by "The treated water was collected in a 10 m3 storage tank and treated several times by additional AOP by circulation till the OMP concentrations were lower than the detection limit before discharge."

Page 27, line 16: OMP concentrations were varied, based on their limit of detection. The OMP concentration could also affect their degradation efficacy, and as such, makes it harder to compare between the degradation of different OMPs. An alternative approach would be to select the critical concentration (e.g. 30 ug/l) for all OMPs.

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We agree that the individual and total concentration of the spiked OMPs could influence the degradation. By spiking the OMPs in a concentration till about 95 times the detection limit, we limit the increase of the DOC concentration. The applied OMP concentrations are expected to be sufficiently low to prevent interaction between the OMPs, as well as to assure that the degradation is independent of initial concentrations (Wols, 2013). Wols performed oxidation with UV/H2O2 with a cocktail of 40 OMPs with a total concentration of about 60 μg/l, nor only with pre-treated Meuse river water, but also with mili-Q water.

P7, line 21, we propose to add: "The applied OMP concentrations are expected to be sufficiently low to prevent interaction between the OMPs, as well as to assure that the degradation is independent of initial concentrations (Wols, 2013)". P18, line 12, we propose to add: "Wols, B.A., Hofman-Caris, C.H. M., Beerendonk, E.F., Degradation of 40 selected pharmaceuticals by UV/H2O2, Water Research (2013), http://dx.doi.org/10.1016/j.watres.2013.07.008

Page 31, line 6: Be more clear here if this figure is based on lab experiments under controlled conditions (where only one parameter is varied), or that these are measured values in the surface water matrix. Only further in the manuscript, it becomes clear that it is the latter.

We propose to replace: "To appoint the responsible parameter(s) for the variation in bromate concentration, water temperature, bromide, bicarbonate and pH are plotted against bromate of setting 6/2.0 from August 2011 up till and including March 2012, Fig. 6." by "To appoint the responsible parameter(s) for the variation in bromate concentration, the measured values of water temperature, bromide, bicarbonate and pH of RSF are plotted against bromate of setting 6/2.0 from August 2011 up till and including March 2012, Fig. 6."

Page 29, line 13/14: Why is Atrazine used as a proof of principle for the peroxone test? Would this imply that, if peroxone would be unable to degrade atrazine, it would also

be unable to degrade the other OMPs that were tested?

We knew from earlier performed AOP research with RSF, with UV based AOP, that atrazine was hard to degrade. If degradation of atrazine was successful, it is expected that the ozone based AOP was sufficient to degrade most other compounds. Next to it, degradation of atrazine could be used to compare both AOPs, especially in terms of energy demand.

Page 31, line 20-21: Is bromide mainly formed due to reactions with ozone, hydroxyl radicals, or both equally?

Both ozone and hydroxyl radicals play a role in the bromate formation. Investigation to which extent they were responsible for bromate formation was not in the scope of the research.

Figure 2: why is there a bypass for the first two injection points?

The loop reactor was connected with sequenced UV based AOP. In this way investigation of peroxone or peroxone with UV-AOP was made possible. Due to the hydraulic resistance of the loop reactor with 6 IPs, in combination with the connected pipes to the UV-reactor and the UV-reactor itself, the pressure at IP 1 was higher than the output pressure of the ozone generator. With 4 IPs this problem was solved. Thus the choice of 4 IPs was a practical one. On P6, line 18-20, this is mentioned.

Figure 3, 4: Please also mention the relevant water quality parameters during these tests (bromide concentration, HCO3-, DOC, temperature).

We agree that would be valuable information. We propose to add in the under script of Fig. 3 "(Br- 124 μgL-1, HCO3- 158 mgL-1, DOC 3,70 mgCL-1, water temperature 11.9 °C)" We propose to add in the under script of Fig. 4: "(Br- 126 μgL-1, HCO3- 159 mgL-1, DOC 3,26 mgCL-1, water temperature 9.7 °C)"

Figure 5, 9: The x-axis of these figures in no unit, but a category (peroxone settings, OMP type). As such, it is not correct to draw a curve between the datapoints, as these

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are independent of each other.

We agree that it is probably not common to present the results in this way. However, we think that the interpretation of the figures is improved by this presentation. We propose to add in the under script of Fig 5 and 9: " data points are connected to improve the interpretation".

Figure 6: Investigate the correlation between these parameters. In Figure 7, it is indeed found that HCO3 and water temperature are correlated. How about the other parameters, e.g. bromide concentration or pH? If there are not other correlations, that should also be mentioned.

We agree that would be valuable information. There are no other correlations. A correlation between pH and water temperature and/or HCO3 could be expected, but probably the variation in pH is too small. P12, line 5, we propose to add: "No other correlations were found between the parameters water temperature, pH and the concentrations of bromide and bicarbonate under tested conditions."

textual page 22, line 7: "the height of the ozone dose" is a Dutch sentence construction that is not common in English

We agree. We propose to replace: "The height of the ozone dose is the main factor….." by "The ozone dose is the main factor……".

page 23, line 17: I would use a different word than "structurally", e.g. "consistently". I don't think that "structurally" is used in English to indicate consistently, and moreover, it can be confusing in this sentence, as it could also refer to detecting chemical structures of pharmaceuticals and pesticides. We agree. We propose to replace "structurally" by "consistently".

On behalf of the co-authors, Antonie Knol