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Drinking Water Engineering and Science Discussions

Interactive comment on "Metals releases and disinfection byproduct formation in domestic wells following shock chlorination" *by* M. Walker and J. Newman

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General comments

The paper presents interesting data on a subject of general relevance, for which there is little empirical data available. I agree with the main finding that residual chlorine can be an acceptable proxy for DBPs and metals which can be elevated during shock chlorination, and that simple pool strip type tests can be used to measure this. However, I am not convinced by the arguments that some of the changes in water chemistry were due to interactions with aquifer sediments; rather, I think it plausible that these reactions occurred within the well casing.

Specific comments

1) The volume of bleaching solution added to the wells was insignificant compared to the well volume, and as such is unlikely to cause advective transport of chlorine into surrounding sediments, as the authors note on page 187. I find the suggestion that chemical diffusion into aquifer materials has led to DBP formation and chlorine persistence unlikely, and suggest that it should be reconsidered. Rather, I suspect the observed persistence of various compounds are explained by differences in well construction and hydraulics.

2) As the authors note on p. 187, the discharge of well 142 was much lower than in other wells. This presumably results in a greater drawdown during purging. Thus, the volume of water in the well during purging, or a dynamic well volume (DWV), will be much less than the volume of a static well volume (SWV). I interpret the text on p. 182 lines 8-11 as indicating that a well volume was calculated as an SWV. The purging process is not complete plug flow: there is some mixing within the well bore which leads to tailing of dissolved constituents. My rough calculations suggest that if, for example, pumping induced a drawdown of 5 feet in well 142, the Well Volume would be reduced by about one third, and what is reported as purging of 1 well volume would actually be purging of 1.5 volumes.

3) The well which seems to have cleared the quickest is #142 – indeed free chlorine was no longer measurable after purging of only one pore volume. As noted above, this could be a hydraulic effect in that the effective volume of water in the well will have been replaced more than once during the purging of a single 'Well Volume'. It is also plausible that the slow pumping rate, and the fact that the 5 foot long screen covers a substantial part of the water column, may contribute to relatively rapid replacement of the well volume with aquifer water.

4) The well which shows the most persistence of DBPs and chlorine is #182. In the text (p. 187) the authors suggest that this is due to diffusion of chlorine into the surrounding

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gravel pack and sediments. There is an alternate plausible explanation due to well construction. From Table 1 I note that the well depth is 31 feet but the bottom of the screen is at 26 feet. So there is likely a five foot long section of dead pipe serving as a sand trap. If this volume of pipe was mixed during recirculation of chlorine, it could have served as a long-term source of chlorine (and DBPs) in subsequent purging.

5) Is there any explanation for the short-lived increase in Cu, Pb, and As in some samples? It seems to be that this is due to reactions happening within the borehole, rather than interactions with sediments.

Technical comments

A) page 184, line 21. Text reads 'five volumes' – should it be four?

B) page 186, line 18. I think with only one well each having stell and PVC casing, there should be no conclusions drawn about the impact of casing on DBP formation. Particularly since the DOC levels were higher in one well.

C) page 187, line 17: as suggested in my other comments, I suspect that DBP formation results from DOC (or suspended solids) within the well bore, not in associated sediments.

D) Table 1: consider shifting the water quality data in the second half of the table to table 4, for easier comparison.

E) Table 4: I think the column heading should be (4-IP)/IP rather than (IP-4)/IP.

F) Table 4: I read the interactive comment of 8 July which noted with surprise that pH reportedly decreased in wells 182 and 142 after shock chlorination. This does certainly seem implausible, and in the response by the authors of 22 August they acknowledge that the value reported with well 142 was in fact in error. They do not address the other comments including the question about pH change in well 182.

G) Tables 5/6: present wells in the same order as in previous tables

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H) Table 7: consider combining this table with Table 6

I) Tables in general: there seems to be some inconsistent use of acronyms. Is IP the same as PT? Is PC the same as 0 well volumes purged? Why is there an F in 4F?

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