

## ***Interactive comment on “Low-cost multi-stage filtration enhanced by coagulation-flocculation in upflow gravel filtration” by L. D. Sánchez et al.***

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Received and published: 1 August 2012

Sánchez et al. (2012) have revisited the topic of direct (or contact) gravel filtration and have presented results on its full-scale application. The results clearly demonstrate the higher treatment efficiencies obtained when resorting to the use of coagulants to enhance the performance of the upflow gravel pre-filters. These results are largely in line with other studies on this form of pre-treatment for slow sand filters (e.g. Ahsan, 1995; Ingallinella et al., 1998; Mahvi et al., 2004; Dorea and Clarke, 2006a; Ahn et al. 2007; Khan and Farooqui, 2011). However, one important aspect of this topic escaped their examination.

I agree with Reviewer #1 that the Discussion of results has scope for expansion (and clarification); particularly with regards to the protective effects of such pre-treatment on

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slow sand filtration performance. The goal of pre-treatment is to lessen the contaminant load on downstream slow sand filters and also protect them from premature “clogging” (i.e. excessive headloss due to particulate loading). Sánchez and colleagues have cited a previous study (Dorea and Clarke, 2006b) in which it was demonstrated that without a careful control of the coagulation step, the coagulant-enhanced pre-filtration is actually detrimental to slow sand filter protection even though turbidities of less than 10 NTU are achieved. That is, overall treatment was better, but the aluminium hydroxide precipitates caused a higher headloss development in the (coagulant pre-treated) slow sand filters than the control filters (without coagulant). Despite the control filters having received an influent with turbidities many times higher than the 10 NTU design rule-of-thumb. However, this significant finding was largely ignored in their Discussion.

This sort of analysis is essential in order to validate and bolster the significance of their results on a full-scale system. From what can be gathered, Sánchez and co-workers did make aluminium residual and turbidity determinations as well as (slow sand filtration) headloss measurements. Thus, a critical evaluation of the protective effects of such intervention (i.e. coagulant-enhanced pre-filtration) can be performed. Here, they may find that aluminium residuals (coupled with pH) are a key parameter. In that sense, their aluminium residual results could benefit from stating in which fraction was being measured (i.e. total or dissolved/filtered aluminium) in the Materials and Methods. Moreover, their chosen method of for aluminium analysis (i.e. Eriochrome Cyanine R Method) is known to suffer from interference from polyphosphates; underestimating actual concentrations. Given that the rural study area is under a heavy influence of (apparently non-optimal) human activity, the presence of such an interferent is a plausible concern.

I also agree with Reviewer #1 that some of their figures are confusing, particularly with regards to turbidity. Fig.6 and 7 are not very clear (i.e. colour choice does not permit a good visualisation). Differences between operation with and without coagulants would possibly be best demonstrated on a side-by-side comparison format. Overall, the “over-

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descriptive” nature of their results undermines their importance. Better use of tables and graphs could yield a better and clearer contribution.

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