Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-196-AC2, 2016
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Use of column experiments to investigate the fate of organic micropollutants – a review" *by* Stefan Banzhaf and Klaus H. Hebig

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Received and published: 22 August 2016

We appreciate the comments provided by Referee #1 on our manuscript and will first provide a reply to the more general comments and then one-by-one replies to the specific comments.

Reply to general comments:

The referee asks for "general rules or behaviors" of pharmaceuticals and pesticides for the "interested readers". We really would like being able to provide these general rules. However, as also stated in the manuscript be cannot provide more than we already did in terms of generalization of column experiments due to very diverse behavior of the

discussed organic compounds. The "classical" parameters like pKa, pH, KOW, and organic content of the aquifer material and ratios of them can be used to estimate the behavior of some organic micropollutants (see also the cited papers by Schaffer & Licha, 2014; 2015).

Reply to specific comments:

Comment 1: CHAPTER 1 (add question mark to the title)

Reply: Changed accordingly

Comment 2: CHAPTER 2: Add also biodegration, and not only chemical reaction, as a tool of transformation of micropollutants Be careful, because uranine is not a perfectly conservative tracer (sensible to sun light for example and slightly retarded on fine sediments). Only inorganic anions are very near to be conservative. Hydrodynamic dispersion leads not only to a broadening of the breakthrough curve at a particular observation point during flow through a porous medium but also to the dilution of the concentration and to the formation of a tailing due to the pore size distribution effects (correct the red line in Fig.1) Also the curve for retardation must be corrected (lowering of concentration and even more pronounced tailing due to flushing effects and consequent desorption)

Reply: Added: "Biodegradation and chemical reactions, resulting in oxidation . . ." The curves presented in Figure 1 are indeed modelled using the advection dispersion reaction equation, but are plotted at a constant distance (outlet of the column) and shifted for better illustration of the process. However, a strong retardation can deform the curve in a way that dispersion might look bigger than it actually is (i.e. that it looks as if the red curve has undergone less dispersion than the blue one). This is one reason for applying conservative tracers; since they allow for a separation of this effect. To avoid unclear interpretation of the figure we remodeled the figure and plotted the concentrations at a distinct time point (time step 100). The transport parameters used for the forward modelling of the curves are added to the caption: "Figure 1: Schematic

representation of solute transport in groundwater, taking into account the main transport processes of advection, hydrodynamic dispersion, retardation, and degradation. BTCs were modelled using the CXTFIT code (Toride et al., 1999). Model was setup as Deterministic equilibrium CDE with flux-averaged concentration and dimensionless parameters. Characteristic length was set as 100. The initial values are: v = 1, D = 0.1*10-7, R = 1, μ = 0 (grey box, only advective transport); v = 1, D = 15, R = 1, μ = 0 (red curve, advective + dispersive transport); v = 1, D = 15, R = 3, μ = 0 (blue curve, retarded transport); v = 1, D = 15, R = 3, μ = 0.01 (green curve additional degradation). Breakthrough was modelled as multiple pulse input with a concentration of c = 1 between time step 10 to 50. The position of the curves within the column are plotted for the time step 100. " Figure 1 was recalculated and the respective parameters added to the figure caption.

Comment 3: Pag.6,r.24: I suggest to use the term of "large specific surface" for organic matter

Reply: Changed accordingly

Comment 4: Pag.6,r.32: what's the meaning of the term "zwitter"? Explain now and not after

Reply: This was rectified by moving the respective sentence ("The behavior of organic compounds during transport in groundwater is therefore clearly dependent on their speciation neutral, anionic/acid, cationic/basic, anionic-cationic/zwitter-ionic") to the end of the paragraph.

Comment 5: Pag.7,r.22: Chemdraw is not in the references

Reply: Formatting issue of the reference list: the reference is there but not formatted correctly. Wil be corrected.

Comment 6: Pag.8,r.11: edit in the proper way the notations of ions with apex in the right position

Reply: This was messed up during the last formatting and will be corrected.

Comment 7: p.24 r.14: the citation of cambridgesoft.com doesn't seem to be in the main text

Reply: Formatting issue of the reference list: the reference is there but not formatted correctly. Wil be corrected.

Comment 8: p.33 r.25: Schirmer, 2008, is not cited in the main text

Reply: The reference is cited in the main text: due to the layout of the reference list it might look like that "Schirmer 2008" is a separate reference, which is not the case. The reference is: "Strauch, G., Moder, M.,Wennrich, R., Osenbruck, K., Glaser, H. R., Schladitz, T., Muller, C., Schirmer, K., Reinstorf, F., and Schirmer, M.: Indicators for assessing anthropogenic impact on urban surface and groundwater, J. Soils Sediments, 8, 23 -33, 25, 2008."

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