Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2022-376-RC1, 2023

Comment on hess-2022-376

Anonymous Referee #1

Referee comment on "Improving soil aquifer treatment efficiency using air injection into the subsurface" by Ido Arad et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-376-RC1, 2023

Review of Improving soil aquifer treatment efficiency using air injection into the subsurface

Ido Arad1, Aviya Ziner1 Shany Ben Moshe1, Noam Weisbrod2, and Alex Furman1

The presented study investigated the effect of air injection on infiltration rate, biogeochmical processes and effluent quality in long (200 cm) column experiments that simulated the recharge and treatment of secondary treated wastewater in a soil-aquifer treatment (SAT) system. Different air injection frequencies and durations were tested and compared to the normal operation of SATs, which consists of well defined wetting-drying cycles. The manuscript is well written and clearly presents the experimental setup and results of the experiments. Tradeoffs in pollutant removal vs. infiltration rate are discussed for major constituents such as nitrogen species, DOC, and contaminants of emergent concern (e.g. ibuprofen). The results clearly indicate that air injection can increase the wastewater volume that can be recharged and treated with SAT if air is injected into the subsurface as the injected air breaks down crusts, biofilms and creates new preferential flowpaths. The study is clearly of interest to the hydrologic science community as groundwater recharge is growing in demand worldwide. I recommend publication of this paper after minor revisions.

Specific comments

Line 18, abstract: Please add the length of the columns in the column description (e.g. after six long column…)

Line 24: “doubled the infiltration time” might be misleading as wording. Suggest changing to “double the time during which infiltration was possible”

Line 27: What is SLPM?

Lines 59-62: Could you please state threshold values or value ranges for oxygen for some of the processes listed here? What do you consider aerobic conditions? Under what oxygen conditions does the ammonification rate decrease substantially? Is there a threshold that can be defined as clear tipping point? Does nitrification assume the same oxygen

conditions (same number ranges)?

Line 72: What is the mechanisms behind the higher removal of CECs during longer drying periods? Is it just the aerobic conditions?

Line 82: The column description is a bit confusing. Was the column only 200 cm long with the top 30 and the bottom 30 cm kept empty to provide room for flooding and drainage. That would suggest only 140 cm were effectively filled with soil? Also what are the 20x10x10 modules? How were they connected? How did you pack the column and avoided capillary boundaries between the layers/modules?

Line 108: By "surface pressure head" you mean the hydrostatic pressure of the ponded water?

Line 158: SLPM still not defined …but finally given in Table caption for Table 1.

Line 196: Why calculate a mean ORP for the profile if there is clearly a gradient with depth?

Line 199: Why did you choose to use glucose, which is a very digestible form of carbon? What forms of carbon are typically found in the wastewater?

Line 283: The fast developing clogging effect is really striking! Have you thought about adding soil microbial analysis to investigate whether the abundance of bacteria is increasing supporting the idea of biofilm formation?

Line 385: These results suggest that the air perhaps should be injected even deeper (>1m) in the profile? Air buoyancy will ensure that air rises to the top of the profile but perhaps the deeper injection can address some of the low oxygen concentrations in the deeper profile.

Line 465: It seems maintaining aerobic conditions in the upper profile provides suitable conditions for mineralization and nitrification and having low oxygen and reduced conditions in the deeper profile creates the right environment for denitrification. Often natural soils show a huge decrease in microbial abundance from the top 10 cm of the soil profile to 1 m. What is the microbial abundance on denitrifiers in the deeper soil profile that can actually reduce large amounts of nitrate?