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Comment on hess-2021-455

Anonymous Referee #1

Referee comment on "Continuous monitoring of a soil aquifer treatment system's physico-chemical conditions to optimize operational performance" by Tuvia Turkeltaub et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-455-RC1>, 2021

The manuscript "Continuous Monitoring of a Soil Aquifer Treatment System's Physico-Chemical Conditions to Optimize Operational Performance" presents a study on the impact of duration of wetting and drying cycles on the treatment efficiency in a soil aquifer treatment (SAT) facility. The study includes extensive high-resolution measurements of water content, gaseous oxygen (O₂), and redox (Eh) in multiple depths across the upper part of the vadose zone (<1.5) under the flooding area of a ~20 m deep unsaturated zone. Information on the variations in hydraulic, physical and oxidation conditions in the soil, combined with flow model during the wetting and drying cycles in both winter and summer were used to define optimal operation condition of the infiltration ponds. The manuscript is well written and definitely merit publication in HESS. Yet there are few issues that should be addressed prior to publication.

Description of the wetting process that follows the flooding events, as measured by the water content sensors, is described and further analyzed as development of saturation conditions in the vadose zone. Yet the data, as presented in figure 2, which is well in line with many other publications on infiltration under flooding conditions, shows that saturation is achieved only in the very shallow part of the vadose zone, in between 25 to 50 cm. Under that shallow layer the conditions are unsaturated, even though percolation continues further down, and the wetting front keeps flowing under that layers. Infiltration that is limited by shallow layer has been observed regardless the potential clogging by organic matter effluents characteristics. It has been observed even for infiltration of fresh water in uniform sandy formations.

Obviously, prevailing of unsaturated conditions immediately below the shallow saturated layer would impact dramatically the oxidation conditions as well as the analysis of the percolation conditions. The impact of the gas phase in the unsaturated layer very close to the surface, is well reflected through the O₂ and Eh sensors at 50-100 cm, as can be observed in figures 4 and 6. Obviously these are the most important parameter for efficient water treatment. However in the is manuscript, most of the analysis that refers to the treatment efficiency refers mainly to 25 cm which is in the very shallow saturated part

(e.g. information presented in figure 7 8 and 9), ignoring the hydraulic and oxidizing conditions under that layer. Accordingly, I believe that the authored should elaborate on the potential impact of the unsaturated conditions that prevail vary close to the shallow saturated part, on both the infiltration and treatment conditions.

One more aspect which is rather technical refers to the structure of figure 9. It is a very strange presentation where O₂ concentration is presented Vs depth in multiple times, while the depth is constant and the time is variable. The data should be presented as O₂ concentration Vs time in single or multiple depths.