Behavior of iron and other metals in a lignocellulose-based biofilter for onsite wastewater treatment: Implications for metals cycling in the LI Upper Glacial Aquifer

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Eutrophication, harmful algal blooms, and severe deterioration of coastal environments is caused by the discharge of nitrogen, much of which is derived from small, residential discharges of wastewater. Many innovative / alternative onsite wastewater treatment systems (I/A OWTS) are being evaluated for their ability to remove nutrients such as N and P, and contaminants of emerging concern, but little research has been done to understand metals removal and/or mobilization. On Long Island, recent research by the NY State Center for Clean Water Technology on I/A OWTS known as a “nitrogen removing biofilters” (NRBs) indicated that Cr, Cu, Zn, Pb and Cd were not mobilized, although considerable amounts of dissolved Mn and Fe were present in the effluent post-treatment. Evaluation of the materials used in these systems indicated that woodchips contained very little Mn and Fe relative to sand, which was obtained from a local sand mine that dredges sand from the Upper Glacial Aquifer. Bench scale experiments in which columns were equipped with oxygen optodes support the hypothesis that Fe and Mn mobilization is likely due to reductive dissolution of Fe- and Mn-containing minerals in the anoxic carbon-rich denitrification layer composed of a sand / woodchips mixture. However, when Fe-rich effluent was introduced to unsaturated oxic columns, Fe was rapidly and quantitatively removed, likely through precipitation as iron oxides. These results suggest that, although some Fe is mobilized during wastewater treatment in the NRBs, it should be entirely removed when encountering the oxygen-rich conditions of the underlying aquifer downstream. The results of this study have implications not only for I/A OWTS, but also for Long Island mulching/composting facilities. Similar conditions are likely created beneath these facilities, i.e., reduced, carbon-rich conditions, which could mobilize natural Mn (and Fe?) associated with the glacial sands. Removal of Mn and Fe would also likely occur when oxygenated conditions are subsequently encountered. However, more research is needed to confirm this hypothesis.