

HORIZONTAL FLOW LIMESTONE BED (HFLB): AN EFFECTIVE AND VALUABLE PASSIVE TREATMENT SYSTEM COMPONENT FOR MANGANESE REMOVAL AND ALKALINITY GENERATION¹

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Abstract. Horizontal Flow Limestone Beds (HFLBs) are extremely useful and effective passive treatment system components that not only generate alkalinity, but also promote manganese removal. Generally, this component is placed at the end of a passive system in order to give the final effluent discharge an alkalinity boost and to remove additional metals. This component appears to be particularly effective in removing manganese. Although the manganese removal mechanism is not clearly understood at this time, processes such as auto-catalyzation and bacterial activity are suspected in addition to other related environmental conditions such as dissolved oxygen and dissolved iron concentrations. There does appear to be a lag time following the installation of the HFLB component when manganese removal is minimal, but after several months the removal rates increase. In some instances, up to 30 mg/L of manganese have been removed by this component and in some cases final effluent discharges with a pH of 7.5 or less possess less than 1 mg/L of dissolved manganese. Whether the lag time is due to the establishment of manganese-oxidizing bacteria and/or algal populations or due to the development of auto-catalytic processes or both, future research efforts should focus on a better understanding of these mechanisms and their role in passively treating acid mine drainage.

Additional Keywords: Passive Treatment Systems, Manganese, Horizontal Flow Limestone Bed

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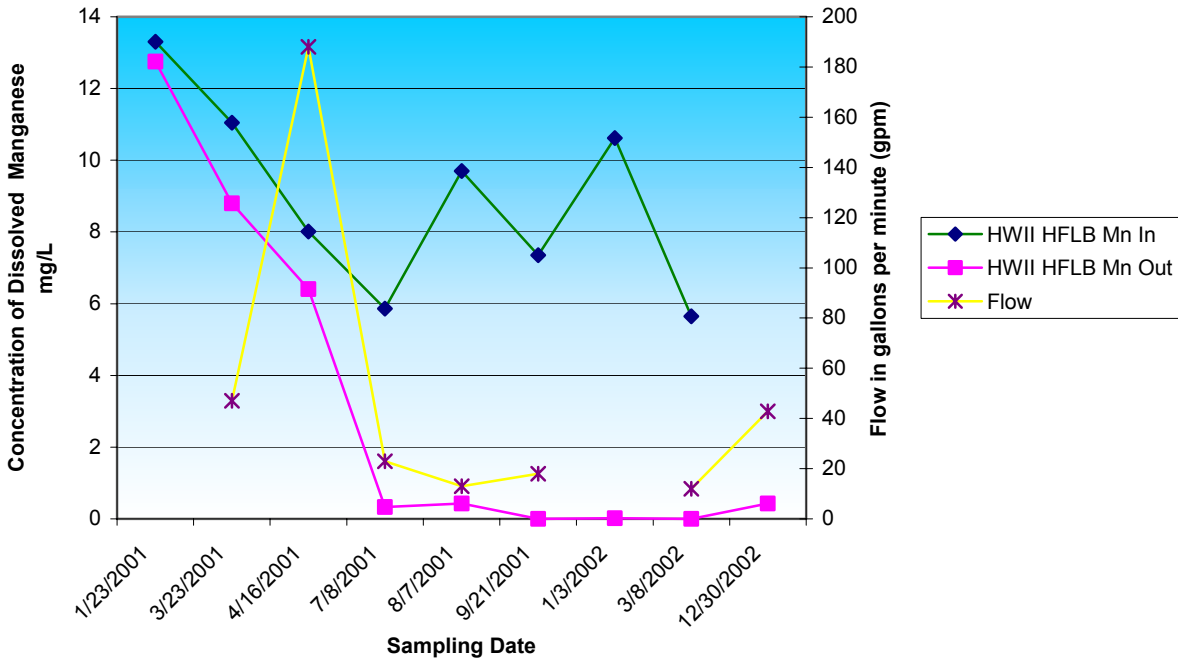
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Discussion

Horizontal Flow Limestone Beds (HFLBs) are valuable passive treatment components that can provide an additional alkalinity boost as well as further reduce dissolved metal concentrations within the final effluent discharge. Horizontal Flow Limestone Beds have been sampled at four passive treatment systems. These systems are Harbison Walker Phase I (HWI), Harbison Walker Phase II (HWII), De Sale Phase I (DSI), and De Sale Phase II (DSII). A review of the data for these four systems indicate that pH and alkalinity increase while dissolved metals generally decrease. Averaging of the data does tend to skew the performance of the components. For instance the DSII HFLB averaged data indicates that dissolved iron concentrations actually increase within the component. However, upon examining individual sampling events it can be seen that typical concentrations decrease to <1 mg/L of dissolved iron. One sample that was nearly 6 mg/L of dissolved iron on a particular sampling event significantly affected the averaged value since the sampling set is not exceptionally large. This skewed effect is especially true with manganese due to the apparent lag time for establishment of removal mechanisms. This lag time is quite noticeable in Figure 1 as manganese concentrations in the effluent of the HFLB slowly decrease for the first six months until reaching very low concentrations, which then level off. The first sampling event resulted in dissolved manganese concentrations to be about 13 mg/L while sampling events after 7/8/01 indicate concentrations of < 0.5 mg/L. Two of the Horizontal Flow Limestone Beds have been graphed comparing dissolved manganese concentrations in and out of the component over a period of time (Figure 1 and 2). The removal of dissolved manganese at or near a circum-neutral pH by a passive component instead of the high pH requirement needed for removal by an active treatment plant is extremely exciting to the mining and reclamation community. Additional research is needed to further document the success of this passive treatment component and also to better understand the removal mechanisms in order to improve upon its design.

Comparison of Dissolved Manganese Concentrations In and Out of the Harbison Walker Phase II Horizontal Flow Limestone Bed



Comparison of Dissolved Manganese Concentrations In and Out of the De Sale Phase II Horizontal Flow Limestone Bed

