EVENT-DRIVEN METAL TRANSPORT DYNAMICS IN THE INITIAL OXIDATION CELLS OF A PASSIVE TREATMENT SYSTEM[1]

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Abstract: Iron oxidation, hydrolysis and settling are key processes promoted in passive treatment systems to remove iron from influent acid mine drainage (AMD). For net alkaline mine waters, an initial oxidation cell is typically used to remove and store large amounts of precipitated iron oxyhydroxides prior to water flowing through additional treatment cells. Regular monitoring of influent and effluent water quality is suitable to determine overall decreases in metals concentrations due to treatment. However, intense storm events have been observed to resuspend precipitated iron oxyhydroxide solids, thus making them more available for transport out of the retention pond and into the following treatment cells or receiving waters. The purpose of this study was to investigate effluent total metals transport between the initial oxidation cell and the secondary surface flow aerobic wetland cells with respect to rainfall intensity at a large passive treatment system at the Tar Creek Superfund Site, Oklahoma, USA. The oxidation pond had a mean iron mass loading of 106 kg/day and an average removal rate of 25 g m^{-2} day^{-1} based on one year of system operation. It was hypothesized that there is a direct correlation between rainfall intensity and total metals transport that can be used as a predictive tool for solids management. Auto-samplers were installed at the effluent of the preliminary oxidation cell, as well as at the effluent of the secondary aerobic wetland cells to collect total metals samples based on rainfall-triggered storm events. Baseline samples of were collected during placid periods of no rainfall once per day for 24 consecutive days to determine total metals transport under non-storm system operation. Storm disturbance sample collection was trigged when rainfall intensity exceeded 0.250 cm/hour and were collected over increasing time intervals for a total of 39 hours. Laboratory determination of total metals (EPA methods 3050 and 6010), was conducted to construct a series of transport curves for events with increasing rainfall intensity. Preliminary results indicate variability in the total iron transported from the retention ponds and wetlands, with additional emphasis on how rainfall event intensity impacts total metals transport. Storm-induced transport of precipitated iron oxyhydroxides may have long term ramifications on solids storage, accumulation, and sustainability within the preliminary oxidation cells of passive treatment systems.

Additional Key Words: iron oxidation, lead-zinc mine drainage, total metals transport

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