The Role of Solar-Powered Float-Mix Aerators on Iron Oxidation Rates in Passive Treatment Oxidation Ponds[1]

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Abstract: In the passive treatment of net-alkaline mine drainage, oxidation ponds are typically the primary cell for iron retention. Oxidation ponds are designed to promote iron oxidation, hydrolysis, and precipitation, which may also increase trace metal removal via sorption. Iron oxidation kinetics may be accelerated by supplemental aeration techniques including dissipation of energy from hydraulic head and use of diffusers and floating aerators. The purpose of this study was to investigate the effectiveness of two custom-designed, float-mix aerators with regard to ferrous iron oxidation rates in a passive treatment system oxidation pond. The study site was the Southeast Commerce passive treatment system at the Tar Creek Superfund Site, the Oklahoma portion of the abandoned Tri-State Lead-Zinc Mining District. This study examined oxygenation of the water column and resulting iron oxidation, hydrolysis and precipitation from multiple perspectives: (i) with respect to depth, (ii) spatially with respect to the aerator and (iii) spatially within the entire pond. It was hypothesized that more oxygen would be driven into the water column nearer to the water surface and closer to the aerators resulting in greater iron removal from the water column. In-situ measurements, including dissolved oxygen, pH, specific conductance, and oxidation-reduction potential, were taken every 15 minutes throughout the multi-day study periods. Water samples were collected at the beginning, middle, and end of each study at specified depths and locations. Samples were returned to the laboratory and analyzed for total and dissolved metals (EPA methods 3015 and 6010) and total suspended solids (EPA method 160.2) concentrations. Each study was performed both with the aerators on and off to examine the overall performance of the aerators. Future studies will further examine the roles of aeration on ferrous iron oxidation, ferric oxyhydroxide precipitation, solids settling, carbon dioxide exsolution, and resultant bulk water quality changes.

Additional Key Words: net alkaline water, acid mine drainage, passive treatment systems

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3. Work reported here was conducted near 36°55’34.04”, 94°52’30.98”.