

# RE-AERATING OFF THE GRID: IMPROVING PASSIVE TREATMENT SUCCESS WITH SOLAR AND WIND ENERGIES<sup>1</sup>

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**Abstract:** Hundreds of passive treatment systems have been constructed to address abandoned mine water quality problems. In some cases, system performance has been less than adequate due to lack of understanding of site-specific water quality or quantity characteristics, required treatment mechanisms or the limited maintenance necessary to sustain operation, all of which may result in poor performance. In this study, passive treatment effectiveness was evaluated by examining, understanding and improving aeration in both oxidation (designed for oxidative iron retention) and re-aeration (designed to re-aerate waters after passage through anaerobic conditions in vertical flow bioreactors) ponds. Methods to enhance aerobic treatment are necessary to not only improve performance, but to decrease passive treatment system size and thus reduce construction and maintenance costs. Relatively simple, renewable energy-driven re-aeration devices requiring limited operation and maintenance may effectively enhance aerobic passive treatment processes by re-oxygenating and mixing the water column, thus positively affecting iron oxidation and retention rates and/or sulfide and biochemical oxygen demand (BOD) removal. The efficacy of two different re-aeration devices (wind- and solar-powered) were evaluated specifically as to their effect on oxygen mass transfer, carbon dioxide exsolution, and the kinetics of both iron oxidation, hydrolysis and settling, and sulfide/BOD removal. Water quality changes and hydraulic performance of two passive treatment systems both with and without additional aeration were comprehensively evaluated. Both enhanced iron retention performance of oxidation ponds and oxygenation performance of re-aeration ponds was assessed through design, installation and monitoring of sustainable aeration devices. In addition to enhancement of water quality improvement performance, operation and maintenance concerns were also evaluated.

**Additional Key Words:** Aeration, iron oxidation, sulfide removal, biochemical oxygen demand removal, renewable energy

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