

History of Passive Treatment Technology Development in the United States

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Abstract

The concept of passive treatment of acid mine drainage (AMD) was conceived in the early 1980's based on the observations of scientists in Ohio and West Virginia. They noted that the quality of AMD was improved after passing through a natural aerobic wetland and they postulated that oxidation reactions, filtering, and settling of sludge particles caused the improvement. Among the first to construct and report on constructed wetlands were researchers at the US Bureau of Mines (Kleinmann, Hedin, Nairn, and Watzlaf) but many others reported designs and results. By 1989, more than 150 wetlands had been constructed for mine drainage treatment in OH, PA, VA, and WV.

Coating of limestone particles renders limestone ineffective for dissolution and alkalinity generation. Researchers found that AMD passing through limestone in an anoxic state did not coat the limestone with iron oxides and the concept of anoxic limestone drains (ALD) was born.

To extend the use of limestone treatment of oxidized mine-influenced waters (MIW), an idea was developed to pre-treat MIW with organic matter to decrease oxygen in the water before introducing the water into an ALD. Successive Alkalinity-Producing Systems (SAPS) was the original term for these systems, but they are now called vertical flow wetlands (VFW).

Treatment with armored limestone soon was discovered to be an effective, albeit inefficient method. Coated limestone dissolution was 60 to 80% less than fresh limestone dissolution. Open limestone channels (OLC) were developed to treat MIW but require longer contact times.

By 1995, these five technologies (aerobic and anaerobic "compost" wetlands, ALDs, SAPS, and OLCs) formed the basis for construction of thousands of passive treatment systems throughout the world. Further discoveries and refinements include VFWs, slag/limestone leach beds, flushable limestone beds, bioreactors, low-pH Fe-oxidation channels, and hybrid systems that incorporate several types in series for treating acid drainage on a site.

Keywords: Historical Perspective, Wetlands, Anoxic Limestone Drains, Limestone Beds

Bibliography

Skousen, J., C. Zipper, A. Rose, P. Ziemkiewicz, R. Nairn, L.M. McDonald, and R.L. Kleinmann. 2017. Review of passive systems for acid mine drainage treatment. *Mine Water Environ.* 36: 133-153. DOI 10.1007/s10230-016-0417-1

Full Paper

A full paper on the results of this study will be published in an upcoming issue of the "Mine Water and the Environment" journal. If you have further interest or questions in the meantime, please contact the authors.