Do In Situ Caps/Covers Work? Where is the Science?

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Background/Objectives. A former mining site has been the subject of intensive restoration for the past few years, with significant focus on disconnecting mine spoils from groundwater and managing the quantity and quality of runoff. An investigation was conducted to compare the efficacy of selected cover materials for decreasing Zn dissolution during periods when the hypolimnion is anoxic and acidic (pH=5.5).

Approach/Activities. Cover materials were selected based on results from laboratory batch testing and included AquaBlok, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Limnocorrals (LC) to isolate water columns above various cover treatments, simulating lake-mesocosms. Simultaneous in situ and ex situ toxicity tests were conducted using *Daphnia magna*, *Hyalella azteca*, and *Chironomus dilutus*. Test organisms were protected from temperature shock by pre-acclimating over 24 hrs and then deploying the test chambers in a Toxicity Assessment Container System (TACS), which protected the organisms from warm surface waters until reaching the bottom sediments and colder water. Test organisms were exposed to surficial sediments and overlying water in the reference (no cover) LC and in the two LCs containing surficial sediments plus cover materials. Ex situ testing was conducted in waters and/or sediment cores collected from the bottom of each LC, and these tests were done at the same temperature as the in situ TACS exposures (15 to 19 C, depending on deployment period). Laboratory tests involved a series of acute toxicity tests and water chemistry sampling conducted in core microcosms created from site-collected sediment.

Results/Lessons Learned. Results from in situ testing demonstrated the usefulness of the TACS and provided similar results to the ex situ testing. Overall, there were no differences in biological responses/endpoints between treatments involving sediment cover materials, and this was true in both the field and laboratory tests. This was likely due to the fact that dissolved Zn concentrations in the surface water were below-threshold levels in all treatments. All treatments (AquaBlok, limestone, and limestone + bonechar) successfully reduced Zn release from the sediment, although some may be less effective under certain hydrologic conditions. Results provided for more effective decision-making, with reduced uncertainty, than standard laboratory and chemistry-only approaches. Follow up testing will examine zinc release delay via dissolution rates.