Effects of Activated Carbon-based Amendments on the Bioavailability of Methylmercury from Marsh Sediments to Aquatic Invertebrates

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Background/Objectives. The Berry's Creek Study Area (BCSA) is located in Bergen County, New Jersey and is currently on EPA's National Priorities List. The site is the subject of an ongoing Remedial Investigation and Feasibility Study. Laboratory bioaccumulation studies were performed by the U.S. Army Engineer Research and Development Center (ERDC), in collaboration with Exponent and the Smithsonian Environmental Research Center (SERC). These studies were designed to evaluate the effects of activated carbon (AC) treatment on methylmercury (MeHg) bioaccumulation in amphipods exposed to BCSA sediments.

Approach/Activities. Studies were conducted to evaluate the effect of activated carbon (AC) amendments on the bioaccumulation of methylmercury (MeHg) in marsh sediments to Leptocheirus plumulosus, a representative benthic test organism. In one study, effects of two types of AC amendments—powdered AC and SediMite™ (a pelletized agglomerate of powdered AC)—were compared to an unamended control sediment. In another study, the effects of powdered AC in a newly amended sediment and a powdered AC-amended sediment aged under field conditions for 20 months were compared to an unamended control. Concentrations of MeHg in porewater were also examined as a measure of bioavailability. Sediment from each treatment was allocated to replicate test beakers, and redox conditions were re-established before adding test organisms. Samples were collected periodically for analysis of sediment (MeHg and sediment organic carbon), porewater (MeHg), and tissues (MeHg and lipids). Redox conditions and pH were monitored continuously. Sediment and porewater Hg, MeHg and related geochemistry were tracked carefully prior to and during exposure in both studies.

Results/Lessons Learned. In both experiments, concentrations of MeHg in porewater were significantly lower in all AC treatments compared to the unamended control. Larger reductions in porewater concentrations in comparison to the unamended control were observed in the freshly amended AC treatment (up to 50-fold) than in the aged AC treatment (up to 4-fold). Two- to three-fold reductions in tissue concentrations were observed in the freshly amended AC treatments and significant differences between freshly amended AC treatments and unamended controls were observed on Day 7 and 14 in one study, and on Day 21 in the other study. Concentrations of MeHg in tissue from the aged AC treatment were significantly higher than in the unamended control, possibly reflecting significant increases in MeHg in the aged AC treated sediment over the course of the experiment. After normalizing tissue concentrations to sediment concentrations (i.e., accounting for differences in sediment MeHg concentrations) results indicate that both fresh and aged AC decreased bioavailability of MeHg (up to ~3- to 4-fold) in comparison to the unamended sediment.