In Situ Treatment of Polychlorinated Biphenyl-Impacted Sediments with Bioamended Activated Carbon

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Background/Objectives. Polychlorinated biphenyls (PCBs) are a widespread contaminant in sediments in the U.S. and a frequent cause of fish consumption advisories. Lab-scale and pilot-scale studies have demonstrated the effectiveness of activated carbon (AC) amended with PCB-degrading microorganisms for reducing the inventory of legacy PCBs in sediments while also reducing bioavailability to aquatic wildlife. The objective was to conduct in situ treatment of several PCB-impacted sediment sites with bioamended AC. The field sites, application methods and efficacy of the treatments for reducing PCB levels will be discussed.

Approach/Activities. The innovative aspect of the technology is the application of large numbers of PCB-transforming microorganisms to supplement the low populations of indigenous PCB-degrading bacteria normally observed in the environment. Anaerobic organohalide respiring bacteria and aerobic PCB-degrading bacteria are grown in production-scale bioreactors and applied to sediments as a co-culture using a pelleted AC agglomerate (SediMite™) as a delivery system. The bioamended AC serves not only as a solid substrate for delivery of the microorganisms but also adsorbs and concentrates hydrophobic PCBs in close proximity to a biofilm of PCB transforming bacteria. Using the optimal cell titer and AC loading rates, we conducted field applications of bioamended AC at sites in the U.S. The effect of treatments was monitored by measuring total PCB concentrations in sediment cores and in porewater using passive samplers.

Results/Lessons Learned. Methods were successfully developed for scale up of the microorganisms without residual POPs and development of an on-site inoculation system to deploy bioamended AC for full-scale treatment of PCB-impacted sediments. Bioamendments were successfully deployed on AC pellets using a modified venturi air mover, pellet broadcaster or conveyor belt. Depending on the treatment site bioremediation was effective at reducing total PCB levels by up to 80% and dissolved PCB levels by up to 99%. Methodology, challenges associated with deployment and the effect of treatment on PCBs concentrations in sediments and porewater at individual sites will be discussed. The results demonstrate successful in situ treatment of PCB-impacted sediments using a co-culture of anaerobic halorespiring and aerobic PCB degrading bacteria. These field studies show the promise of bioremediation as a sustainable and minimally invasive approach to help address the widespread need to reduce contamination of the aquatic wildlife from exposure to sediment-bound PCBs.