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Pilot-Scale In Situ Treatment of PCB-Impacted Sediments by Bioaugmentation

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Background/Objectives. In situ treatment with granular activated carbon (GAC) has been used successfully to sequester aromatic POPs such as PCBs in sediments, effectively minimizing their interaction with the biological food chain. The objective of this research was to develop and test the efficacy of a bioamended form of GAC embedded with microorganisms to concurrently sequester PCBs from the food chain and dechlorinate and degrade weathered PCBs in sediments. A pilot study was initiated in April 2015 to demonstrate and validate this environmentally sustainable technology at a PCB-impacted DoD field site. The project goal was to: 1) evaluate the efficacy of bioaugmentation for the complete degradation of weathered Aroclors in situ; and 2) evaluate the efficacy of a delivery system for deploying bioamendments through a water column into PCB-impacted sediment with minimum disruption to the environment.

Approach/Activities. The innovative aspect of the technology is the application to sediments of anaerobic organohalide respiring bacteria and aerobic PCB degrading bacteria with selected activities using a GAC agglomerate (SediMite™) as a delivery system. The bioamended SediMite serves as a solid substrate for: 1) delivery of microorganisms into sediments, 2) formation of microbial biofilms, and 3) sequestering the concentration of hydrophobic PCBs in close proximity to the biofilm of PCB transforming bacteria. Treatability tests conducted in mesocosms using sediment from Abraham's Creek in the Quantico Marine Base demonstrated that the approach reduced PCB levels in sediments and porewater by 78% and 97%, respectively, after 375 days. Based on these results a pilot field study was initiated at the site in 0.1 acre plots. The effectiveness of the approach was evaluated by monitoring changes in total PCB concentration and congener distribution, porewater concentrations with passive samplers, sustainability of the bioamendments and impact of treatment on the indigenous microbial community.

Results/Lessons Learned. Technical challenges for the pilot field study included production-level scale-up of the microorganisms without residual POPs, production of SediMite modified as a carrier for the bioamendments, development of an inoculation system to introduce active PCB-transforming microorganisms into SediMite pellets during deployment at the site, and maintaining viability of the anaerobes and aerobes during the deployment process. PCB levels in sediments and porewater were reduced by up to 51% and 76%, respectively, in bioamended plots in the first 12 months, whereas PCB levels in untreated plots showed no significant change. Methodology, challenges associated with deployment and final one year post-treatment results for total and porewater concentrations of PCBs, sustainability of the bioamendment and effect on indigneous microbial populations will be discussed. Overall results of the study demonstrated that *in situ* treatment by bioaugmentation has the potential to significantly reduce PCB levels in the environment with minimal environmental impact in terms of sediment disruption, energy use, waste management and habitat restoration.