Hunter Point Shipyard

Polymeric Sampling Devices and Semipermeable Membrane Device (SPMD)

Summary

Media:	Porewater
Study Type:	In situ
Technology:	Accumulation
Peer Reviewed:	Yes
Publication Date:	March 2012

Study Description

The study reports the results of five years of posttreatment monitoring following in situ activated carbon (AC) placement for stabilization of PCBs at an intertidal mudflat adjacent to Hunters Point Shipyard, San Francisco Bay, CA, USA:

- The treatment involved in situ blending of approximately 3% dry weight of AC into a 30-cm layer of sediment. This process was conducted at Plot A in August 2004 and at Plot D in January 2006.
- The long-term effectiveness of AC amendment was evaluated by deploying in situ SPMD samplers (28-day) within the top 10 cm of sediment at Plot A, at intervals of 1 month, 7 months, and 5 years following AC application.
- A study of the local AC dosage response was carried out at Plot A, 5 years posttreatment, using in situ PE samplers (28-day) deployed at depths of 5–10 cm, 10–15 cm, and 15–20 cm below the sediment surface.
- Ex situ measurements of aqueous PCB concentrations (not by passive sampler) were conducted by mixing water and sediment for 14 days in rotated bottles. These measurements were taken at Plot D at 6 months, 18 months, and 3.5 years after AC application, and at Plot A at 5 years post application.
- Total organic carbon (TOC) in the sediments was analyzed at both millimeter-scale (approximately 100 mm^3 sediment) and within 5-cm-long core segments to determine the AC dosage.
- Porewater velocities were derived using an inverse heat transfer analysis as described in Cho et al., 2010.
- No nonequilibrium corrections were applied to the passive sampler results.

Remedial Phase

Feasibility study (field demonstration)

Outcome

AC stability: After five years, AC levels in sediment cores remained consistent, indicating stability under field conditions.

PCB reduction in porewater: PCB uptake in passive samplers decreased by up to 73% with a 3.7% dry weight AC dose after five years.

Effectiveness of AC treatment over time: The reduction of in situ SPMD porewater PCB concentrations increased with AC-sediment contact time, suggesting slower mass transfer of PCBs to the AC under field conditions and that the thermodynamic sorption equilibrium wasn't fully reached within the monitoring period.

Ex situ vs. in situ observations: Ex situ aqueous PCB concentrations showed greater reductions than in situ concentrations, suggesting that continuous ex situ mixing enhanced the mass transfer.

Effectiveness of AC treatment was reduced by NOM fouling, slower porewater velocities (i.e., slower PCB transfer from sediment to AC), and heterogeneous AC distribution. For example, to obtain an average 80% reduction of PCB 101 in sediment porewater took only one year with a homogeneous AC distribution but 6 years with poorly distributed AC.

Case Study Source

Cho, Yeo-Myoung, David Werner, Yong Ju Choi, and Richard G. Luthy. 2012. Long-Term Monitoring and Modeling of the Mass Transfer of Polychlorinated Biphenyls in Sediment Following Pilot-Scale In Situ Amendment with Activated Carbon. *Journal of Contaminant Hydrology* 129–130: 25–37. https://doi.org/10.1016/j.jconhyd.2011.09.009.

References

Cho, Y.-M., Werner, D., Moffett, K.B., Luthy, R.G., 2010. Assessment of advective porewater movement affecting mass transfer of hydrophobic organic contaminants in marine intertidal sediment. Environmental Science & Technology 44 (15), 5842–5848. https://doi.org/10.1021/es903583y