Capping for Management of Contaminated Sediments and Dredging Residuals

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Introduction: Traditionally, caps for in situ contaminated sediments and dredged material in confined aquatic disposal cells have been designed for long-term isolation by using very thick layers of capping materials. In some circumstances, the thickness presents unacceptable impacts on navigable depth, limiting the range of projects and areas that can be remediated by isolation capping. Great savings and flexibility could be obtained by designing for reduction in bioavailability instead of isolation.

Methods: The computer model, RECOVERY [1, 2] is used to assess the long-term impact of contaminated bottom sediments on surface waters. The model couples contaminant interaction between the water column and the bottom sediment, as well as between the contaminated and clean bottom sediments. The physical representation of a system consists of a well-mixed water column underlain by a variably contaminated, vertically-stratified sediment column. Processes incorporated in the model are sorption, decay, volatilization, burial, resuspension, settling, bioturbation, and pore-water diffusion.
The assessment consisted of a parametric evaluation of various capping designs using the RECOVERY model. Two cap conditions for PCBs and metals contaminated sediments were considered: a thin (15-cm) cap representing the short-term isolation and surficial sediment dilution condition and a thick (100-cm) cap representing the long-term isolation condition. All the evaluations were performed with a mixed layer of 5 or 10 centimeters bioturbation zones and two capping media (sand and an adsorptive media). Three cap thicknesses and four capping media as shown in the table were evaluated for managing residuals from PCBs and acenaphthylene contaminated sediments. Minimization of the cap thickness while limiting contaminant exposures to acceptable levels is desired to provide significant cost savings.

Results and Discussion: Traditionally, caps have been designed to reduce the surficial concentration of contaminants to decrease the exposure to receptors. Thick isolation cap reduces the surficial sediment concentration the most, then thin isolation caps, and thin caps. Long-term concentrations of the sorptive caps are lower than all of the sand caps. From the

Parameters	Values
Cap Thickness	0, 5, 10, 20 cm
Capping Media	Sand Topsoil Carbon Sand (CS) Mixture Sand over CS Mixture
Contaminant	Acenaphthylene
Kow	5010

standpoint of bioavailability, the sorptive caps perform the best. The thick isolation cap performs better than the other sand caps and the thin cap performs only slightly worse than the thin isolation cap. With high deposition rates, the difference between all three sand caps becomes small.
As shown in Fig. 1, thin residuals caps (5-cm) reduce bioavailability as a function of carbon content in the capping media; increasing carbon content reduces bioavailability. Minimal isolation caps (10-cm) reduce exposure 1 order of magnitude more than a thin cap for mobile contaminants (acenaphthylene). Full isolation caps (20-cm) reduce exposure 2 orders of magnitude more than minimum isolation caps for mobile materials. The reductions for immobile contaminants (such as PCBs) would be greater and would be a strong function of carbon content.

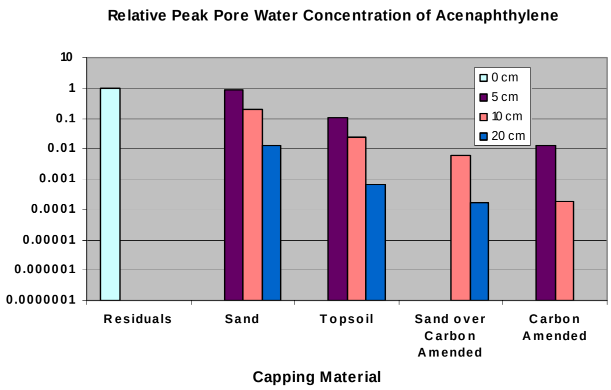

Fig. 1: Surficial concentrations for capped residuals.

References: [1] Ruiz et al. (2001) *Environmental Modeling & Assessment*. **6**: 151-158; [2] Ruiz et al. (2007) *Proc. of the 4th Int. Conf. on Remediation of Contaminated Sediments*, Battelle.