Hello, this is Kevin O'Donovan, and I'd like to welcome you to the National Institute of Environmental Health Sciences Superfund Research Program monthly Research Brief podcast.

This month, we're discussing bioavailability changes in sediments and bioaccumulation in fish.

The Research Brief, Number 252, was released on December 2, 2015, and was written by SRP contractor Sara Mishamandani in conjunction with SRP-supported researcher Upal Ghosh.

Changes in uptake of polychlorinated biphenyls (or PCBs) in fish after remediation of their aquatic environment may be predicted, according to researchers at the University of Maryland, Baltimore County. They measured freely dissolved concentrations of PCBs in water and applied mathematical models to predict the effectiveness of sediment remediation. The study is one step toward understanding how PCB bioavailability changes in sediment as a result of activated carbon amendments, a method to sequester PCBs, can influence transfer of PCBs to fish.

PCBs are a family of chemical compounds that were widely used in industrial applications and still persist in the environment in air, water, soil and sediments, and foods. Activated carbon amendments have been demonstrated to reduce porewater concentrations of PCBs, but little is known about how these changes affect bioaccumulation in fish. Within aquatic ecosystems, PCBs accumulate up the food chain. Fish consumption is a primary source of PCB exposure in people.

The study, led by Dr. Upal Ghosh, evaluates the use of activated carbon, the same technology employed in many water filters, to bind contaminants in sediment, reducing availability in the aquatic ecosystem. Researchers performed laboratory aquarium experiments and compared their results to model predictions to explore how PCBs affect exposure pathways and bioaccumulation in fish.

They measured PCBs using passive sampling, an effective method for measuring freely dissolved concentrations in water, and found that PCBs were reduced by more than 95 percent with activated carbon. They also saw a 99 percent reduction in PCB concentrations in sediment porewater. They measured PCBs in fish tissue lipids and found that the amendment reduced PCB uptake in fish by 87 percent after 90 days. These results show that bioavailability changes in sediment are reflected in uptake in fish.

The researchers then tested two existing aquatic bioaccumulation models that may predict PCB uptake changes after sediment is treated with activated carbon. While the equilibrium and kinetic models are available, there is limited knowledge on their ability to predict levels in fish after treatment of sediment to reduce PCB exposure.

They found that the kinetic model was a better predictor and generally within a factor of two for total PCBs measured in fish. Based on these results, the researchers concluded that this bioaccumulation model can be linked to other existing fate and transport models to predict effectiveness of sediment remediation in reducing PCB uptake in fish over time. After validation, these types of models can also be used as a reliable means of back-calculating the activated carbon amendment dose required to optimize the desired end point in recovery of fish tissue PCB levels.

This study also helps show the effectiveness of remediation using activated carbon and may spur translation of the technology to the field. SediMite, an activated carbon amendment technology developed by Ghosh, is currently being used in the remediation of sediments contaminated with PCBs. The product packages activated carbon with clay and sand into pellets that are convenient to handle and deliver. It slowly breaks up over time and mixes through natural processes when added to the water column.

A project at Mirror Lake in Dover, Delaware is the first full-scale implementation of activated carbon amendment into sediments. Mirror Lake and downstream areas have been in decline for several decades because of stormwater runoff contamination from chemicals, excess nutrients, bacteria, and invasive plant species. If left untouched and with no further contamination, the Delaware Department of Natural Resources and Environmental Control (or DNREC) forecasts it would take several decades for the lake to clean itself naturally and for fish in the lake to be safe to eat. With the technology, DNREC scientists anticipate a reduction of PCB contaminants in fish tissue to below consumption advisory levels within a few years.

The U.S. Environmental Protection Agency, in its recent notice of action for the Housatonic River Superfund Site, has also asked that activated carbon amendment to sediment be considered as part of the final remedy. This study helps to show how activated carbon affects PCB uptake in fish and how researchers can make reasonable assessments of long-term recovery of fish stocks.

If you'd like to learn more about this research, visit the Superfund Research Program website at www.niehs.nih.gov/srp. From there, click on "Who We Fund" and follow the links to the University of Maryland, Baltimore County research summary. If you have any questions or comments about this month's podcast or if you have ideas for future podcasts, contact Maureen Avakian at avakian@niehs.nih.gov.

Join us next month as we discuss more exciting research and technology developments from the Superfund Research Program.