Site Name: East Branch Grand Calumet River (EBGCR)
Location: Calumet, Indiana
Type of Site: River
Contaminants of Concern: PAHs, metals
Remedy: Dredging and reactive cap
Current Site Status: Long-term monitoring

Case Study Objectives: Demonstrate methodology and testing of amendments placed in a reactive cap

Site Description:

East Branch (Zone B) of the Grand Calumet River:

- 1.8-mile stretch of the river from Indianapolis Boulevard to Holhman Avenue
- 350,000 cubic yards (cy) of sediment were removed
- A reactive cap was placed over the dredged sediment
- Near-shore habitats were restored with native plants

Site Investigation and Conceptual Site Model Summary:

Total PAH sediment concentrations in the BAZ of 27 milligrams per kilogram based on dry weight. An active layer was modeled based on concentrations with two different effective adsorption partition coefficients based on two contaminant concentrations in different reaches of the river. The design and modeling was intended to provide a cap life of 100 years until breakthrough. The organoclay was specified to have a documented partition coefficient (K_d) of at least 50,000 liters per kilogram (L/kg) for lightweight PAHs (e.g., phenanthrene) and 350,000 L/g for midweight to heavyweight PAHs (e.g., pyrene).

Remedy Design and Construction:

A 6-inch-thick reactive cap layer was designed with two loadings of organoclay. The organoclay was designed to be applied such that the loading is a minimum of 4.1 kilograms per square meter per centimeter (kg/m^2/cm) (21.45 pounds per cubic feet [lb/cf]) in Area A and 1.37 kg/m^2/cm (8.5 lb/cf) in Area B. AquaGate+®Organoclay was selected as the material for the following reasons: higher bulk density provided positive placement through moving water, capability to adsorb approximately 15% by weight, and uniform distribution of organoclay in cap layer. Approximately 16,600 tons of material was delivered to the site in 2,500-pound bulk supersacks. Material was installed by J.F. Brennan's patented broadcast capping system within a 5-month time frame. The approach provided the following benefits: accurately place material over soft sediment with limited intermixing; limit resuspension of in situ sediments; record thickness, volume, and position of material placement using the onboard tracking system; and accurately spread materials in very thin lifts, while achieving even distribution. During installation, catch pans and columns were used to verify the thickness of the placement and allow for a visual check of the horizontal and vertical distribution of the organoclay within the capping layer.

Post-Construction Design Verifications:

Post-placement QA/QC was undertaken to verify that the design specification regarding both the quantity and properties of the amendment were delivered as intended. Material collected in catch pans was transported to the AquaBlok laboratory, and a detailed analysis was performed to determine the dry weight of the organoclay placed in the reactive layer. For the higher amendment dose layer (A-Cap), the target application of organoclay was 21.45 lb/cf, and the actual weight of organoclay in the reactive layer was determined to be 23.95 lb/cf. For the lower amendment dose layer (B-Cap) the target application of organoclay was 8.5 lb/cf, and the actual weight of organoclay in the reactive layer was determined to be 9.14 lb/cf. Although this answered the question regarding the quantity of organoclay contained in the reactive layer, the analysis was carried forward to evaluate and confirm that the as-placed material properties also achieved the specification targets as well as the adsorption properties utilized in modeling. To accomplish this, two sets of independent lab analyses were performed on the post-placement organoclay recovered. For comparison, each of these analyses were performed on three separate samples:

1. raw samples—the as-received organoclay from the manufacturer
2. the coating material from the AquaGate+®Organoclay (prior to placement)
3. the as-placed organoclay recovered from the post-placement layer verification.

The first test was performed by the manufacturer of the organoclay (CETCO). This test is their standard in-house oil adsorption test. Results of the test indicated oil adsorption (as a percent of dry weight) of 69.7%, 63.7%, and 62.2%, respectively, for raw manufactured organoclay, AquaGate+®Organoclay coating material (prior to placement), and post-placement recovered organoclay from the reactive capping layer. According to the manufacturer, these values all exceed the organoclay material specification of 50% oil adsorption by dry weight. The final question that was to be addressed with testing related to the partition coefficient used in the modeling/design: Does the actual value (K_d) for the as-placed material meet the specification and the assumptions used for the design? For this testing, duplicate samples to those tested by CETCO (i.e., raw material, as-manufactured, and as-placed organoclay) were sent to Texas Tech University to perform the isotherms needed to determine the partition coefficient. Measured octanol-water partition coefficients of phenanthrene and pyrene and partition coefficients (standard deviation in estimate for the three tested organophilic clays) achieved the values as specified and used in the modeling and design.

Reference:

Hull, J.H., J. Collins, S. Collins, J. Jersak, T. Lee, and E. Hritsuk. 2015. Quality Control Aspects of Active Cap Materials & Placement at East Branch Grand Calumet River: Evaluation of Sorption Characteristics of AquaGate+Organoclay™ Coated Materials. Sediment Management Work Group Fall Meeting, 2–3 December, Arlington, Virginia.