2022 Americas Site Solutions Technology Transfer Conference

Title: Testing Carbon-Based Amendments in Treating PCB and Metal Contaminated Soils

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Key Topic: Use of carbon-Based Sorbents to Sequester Organic Constituents

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Client Name: RACER Trust (Confidential Client)

Project Name: General Motors – Inland Fisher Guide Operable Unit 2

Project Location: Syracuse, New York

Primary Ramboll Project Staff (Office): Syracuse, New York

ABSTRACT

Background/Objectives:

As part of the Record of Decision (ROD) amendment process, the addition of a carbon-based sorbent, such as biochar or activated carbon (AC), has been proposed as an alternative to soil excavation to reduce the bioavailability of PCBs and co-located metals in both wetland and non-wetland forested/inaccessible areas of the project site. If selected as the final remedy, the proposed in situ treatment would preserve over 11 acres of mature trees and is anticipated to save the client tens of millions of dollars based on the feasibility study cost model. Carbon-based amendments like AC have been used as a sorbent for organic compounds for more than a decade now, though less research has been done with biochar. Much of the early work with AC was conducted in sediment/sediment caps, with less work applying to soil systems. A preliminary lab study was performed in 2021 to evaluate the use of biochar in reducing the bioavailability of PCBs and metals in site soils. The objective was to provide a proof of concept using biochar as an amendment, given biochar has similar properties to AC as a sorbent for organic compounds, but has a lower carbon footprint and additional benefits of promoting soil aeration and plant growth. The study found that biochar applied at 15% by mass loading resulted in a higher percent reduction in both pore water and leaching PCB concentrations (80-90%) as compared to the 5% loading application (13-32%). It is expected that a 15% loading would present implementability issues in a full-scale application; therefore, a second study was conducted in 2022 to compare the performance of biochar to that of AC, given literature values of 3-5% AC have been reported to achieve 80-90% reduction in pore water PCB concentrations.

Approach/Activities:

In both studies, the effectiveness of carbon-based amendments were evaluated in test jars by measuring the pore water concentration of PCBs using polyethylene SP3™ passive samplers and by observing the leachability of PCBs and metals using Synthetic Precipitation Leaching Procedure (SPLP) testing. For the preliminary study, duplicate sample jars were prepared with two different biochars applied to soil collected from one sample location at 5% and 15% application rates in addition to unamended controls. In the second study, triplicate samples were prepared with one AC and one biochar applied to two different soil sample locations at 3%, 5%, and 7% application rates plus the unamended controls. The SP3™ samplers were deployed into sample jars for a 28-day tumbling period. A modified SPLP extraction was performed following the 28-day period. Samples of the starting soil were also analyzed to understand initial PCB and metal concentrations and total organic carbon (TOC) content.

Results/Lessons Learned:

Both studies demonstrated the effectiveness of carbon-based amendments in reducing the bioavailability of PCBs and metals in Site soils. TOC concentrations in both studies ranged from 2.9 to 6.4 percent likely indicating the area where samples were obtained contained sediment dredged spoils. While the results of the second study are still being reviewed, a preliminary evaluation of the data showed that AC outperformed the biochar, with over 99% reduction of pore water PCB

concentrations consistently observed for the AC applied to both soil sample locations and at all three application rates (3%, 5%, 7%). The biochar provided 10-39% reduction of pore water PCB concentration for both sample locations and all three application rates. The percent reductions for the leaching concentrations were more comparable between AC and biochar at the 3% application rate, though AC outperformed biochar at both the 5% and 7% application rates. Overall, AC resulted in a higher percent reduction and the data produced aligns with the literature values. The results of both studies will ultimately be used to design a field pilot study to further verify this technology if the remedy selection process favors the proposed treatment alternative.

Aspect of Work that Relates to Sustainability:

Given the limited work in applying carbon amendments in the soil system and the challenges that will come with distributing the amendment in a forested setting, this project is seeking an innovative remediation technology that will not only preserve a viable forested area that provides many functions and values (e.g., floodflow alteration, sediment and nutrient retention, shoreline stabilization, wildlife habitat), but also provide a cost-effective remedy in lieu of excavating and disposing of over 140,000 cubic yards of soil/dredged material to a landfill, which is anticipated to result in significant disruption to both the human and ecological communities. While there are many questions that still need to be answered and future pilot studies to be conducted, the project team hopes that this technology will lead to a better solution for this Site, contribute to the growing body of science and technology in this area, and be useful to practitioners facing similar issues at other sites.