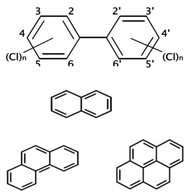

# Evaluation of Activated Carbon as a Reactive Sediment Cap Amendment for Feasibility Level Studies

**Group 1**

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## Background

Sediments on the bottom of waterbodies are sinks for toxic, bio-accumulative chemicals, such as PCBs and PAHs, that can be transferred to invertebrates, fish and humans via food webs. Practitioners are turning to in situ treatment of contaminated sediments with activated carbon (AC) amendments and reactive caps to reduce ecological and human health risks, as methods such as dredging have not always done so.

## Opportunity

To design reactive caps with activated carbon, engineering firms model cap configurations and predicted in situ performance using CAPSIM, an analytical and numerical model developed by Reible and Lampert[1]. These simulations are resource-intensive, time consuming and require expertise in analytical & quantitative modeling.

## Solution

A calculator that predicts AC performance and helps engineers efficiently design reactive caps.

## Project Description

- Partition coefficients were generated for different types of activated carbon in both deionized water and water spiked with 25 ppm of natural organic matter (NOM) using adsorption isotherms (Figure 1).
- CAPSIM simulations were run using lignite coal AC partition coefficients (25 ppm NOM) for target contaminants, including: naphthalene, phenanthrene, pyrene, PCB-18, PCB-52, PCB-77, PCB-101 and PCB-151.
- A calculator was developed that incorporates hundreds of CAPSIM simulations into a series of interactive HTML plots based on a neural net model (using JMP software) that has an $R^2$ value of 94% (highly predictive of CAPSIM).

## Acknowledgements and References

- The authors would like to thank Dr. Danny Reible, Tariq Hussain, Dr. Magdalena Rakowska, Xiaolong Shen, John Collins, Elena Leonova, Ian Smith, Jon Siddall, Roy Clackum for their contributions.
- [1] CAPSIM (https://depts.ttu.edu/ceweb/groups/reiblesgroup/downloads.html)

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**Figure 1**

Freundlich adsorption isotherm equation

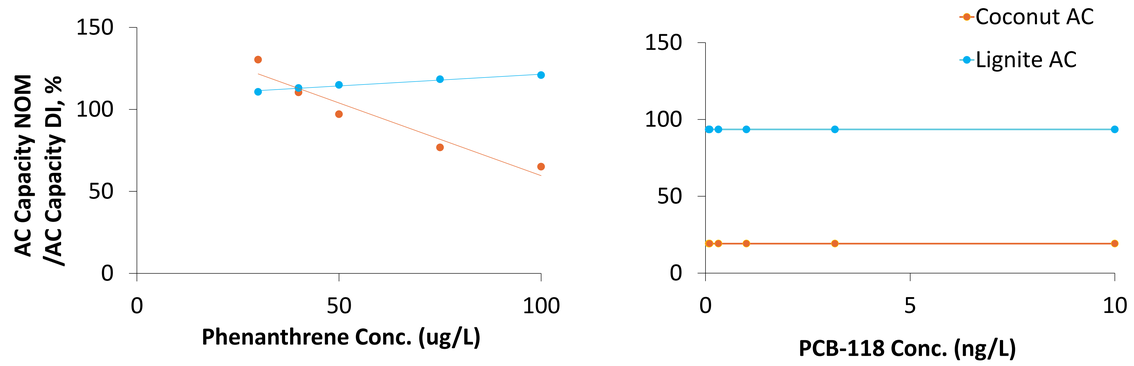
$C_{carbon} = k_f C_{water}^{1/n}$

$C_{carbon}$ = mass of hydrophobic organic contaminants (HOC) adsorbed on carbon

$C_{water}$ = equilibrium concentration of HOCs in sediment pore water

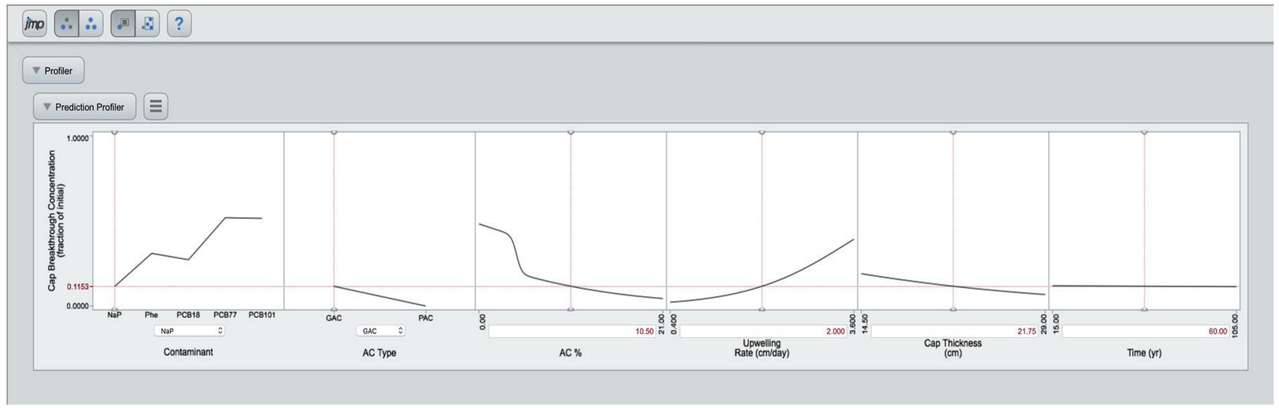
K and n are constants for a given HOC and activated carbon at room temperature

## Results




**Lignite coal-based AC is less sensitive to NOM than coconut shell AC**

**Cabot NORIT SedimentPure™ Activated Carbon Calculator**




## Conclusions

- The calculator is a robust, easy-to-use tool that provides early guidance to engineers for the potential solution set of reactive cap designs for a contaminated site using Cabot NORIT SedimentPure™ Activated Carbon.
- The calculator enables users to run “what if” scenarios in a fraction of time for a contaminated site by changing variables to determine the contaminant concentration in the sediment pore water at the top of the reactive cap at the designed cap life.