

Waterloo Biochar Program Update

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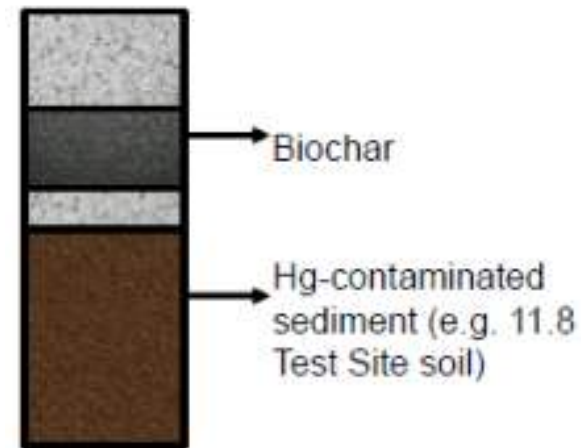
2016 – 2017 Program

- Focus on testing new chars (alternatives to Cowboy Charcoal) and support of field pilots.
- Deep dive into char data to help evaluate chars for different applications.
 - ★ Bank remediation
 - ★ Floodplain Field Pilot



New Chars

- Alternatives to Cowboy Charcoal
 - Alt En
 - Digestate
 - Distillers Grain
 - BioChar Now
- Tests:
 - Leaching characterization
 - Hg Sorption in batch systems
 - Hg sorption in flow-through systems



Results for Alt En and Biochar Now products: Leaching and Batch Studies

- Leaching Profiles
 - Chars exhibited different profiles in leaching tests
 - Pre-washing of chars may control leaching of nutrients and sulfur oxyanions.
- Hg removal characteristics
 - Biochar Now less effective at removing $<0.45 \mu\text{m}$ Hg (90.3%) compared to Activated Carbon (99.6%) or Cowboy Charcoal (96.9%)
 - Alt En Digestate biochar removed $>98\%$ of mercury, similar to Activated Carbon and Cowboy Charcoal.
 - Alt En Distillers char (as both 100% and 50/50 blend) was less effective in removing Hg (circa 60% as compared to Cowboy Charcoal) .

Results for Alt En and Biochar Now products: Column Studies

- Biochar Now (3% wt, char in sand, HgCl_2 spiked water)
 - Maximum mass of Hg on biochar was not approached
 - Effective removal of Hg at ~3.3% wt. biochar
 - MeHg concentrations were relatively low
 - Hg removal comparable to Cowboy Charcoal in parallel tests
- Alt En Chars (layered columns with Hg leaching from SR sediment)
 - Increases in sulfate and pH were transient (could be addressed with pre-wash?)
 - Digestate char showed best Hg removal (better than Cowboy Charcoal). Distiller char was comparable to Cowboy Charcoal.
 - MeHg analyses pending



Data Mining Exercise: Can we predict char performance from data in hand? A first pass...

- Batch Studies

- Compared % Hg removal with: pH, alkalinity, $\text{PO}_4\text{-P}$, $\text{NH}_3\text{-N}$, acetate, propionate, formate, DOC, sulfate, nitrate, Mn, Fe in SRW+biochar batch tests, and surface area
- Best biochars in general:
 - High temperature, low $\text{PO}_4\text{-P}$, lactate, acetate, propionate, formate, DOC, Fe
- Worst biochars:
 - Low temperature, surface area, sulfate

- Columns

- The percent Hg removal in the batch test corresponded to performance in a column setting for Alt En 100% Digestate

However,

- Parameters from batch test could not predict the small difference between Cowboy Charcoal and 100% Distiller's Grain observed in the flow-through columns

Conclusions:

- Both biochar now and Alt En products appear suitable for application to bank remediation scenarios (pending final MeHg measurements on Alt En layered columns)
- Batch studies appear to underestimate performance in flow through columns but overestimate performance in co-blending conditions.

Next Steps:

- Further review and data mining of screening studies and previous co-blending experiments
- Potential additional co-blending char studies to support Floodplain pilot:
 - Effect of char particle size
 - Effect of char application rate
 - Effect of added fertilizer (for crops)