Biochar Optimization for Water Treatment Using Coffee Byproducts

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Introduction

Water Quality

- Organic contaminants that are not removed in conventional water treatment are often present in drinking water sources.
- Specifically, pesticides and pharmaceuticals often go unnoticed and can impact water quality for those that use it.
- Developing countries typically have fewer environmental regulations and low access to expensive treatment measures

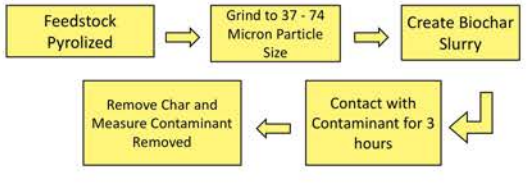
Biochar

- Adsorptive media used in water treatment, similar to activated carbon
- Cheaper and easier to make than alternatives used today
- Organic material with high porosity and surface area
- Made by pyrolysis (high heat in absence of oxygen)
- Can be made from any organic material

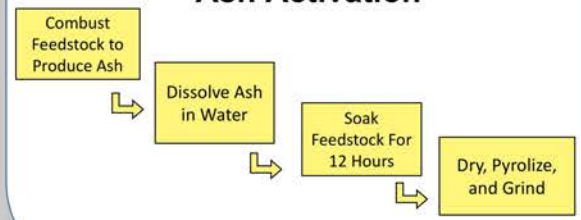
Objectives

- Explore possibility of making biochar using coffee byproducts
- Determine which coffee feedstock produces superior biochar
- Experiment with pretreament applications to improve biochar sorption of a pesticide and pharmaceutical
- Test biochars in different waters to compare effectiveness

Biochar Production & Test



Ash Activation



Materials

- Biochar made from coffee byproducts that have limited commercial use
- Coffee cherry and parchment used as feedstocks for biochar production
- Ash made from both feedstocks to test sorption improvements

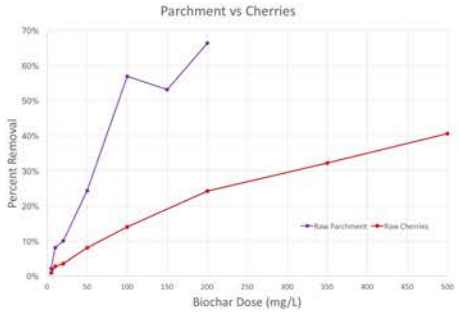
Coffee cherries are analagous to peanut shells
Coffee parchment is similar to papery material around peanut (coffee bean)

Results

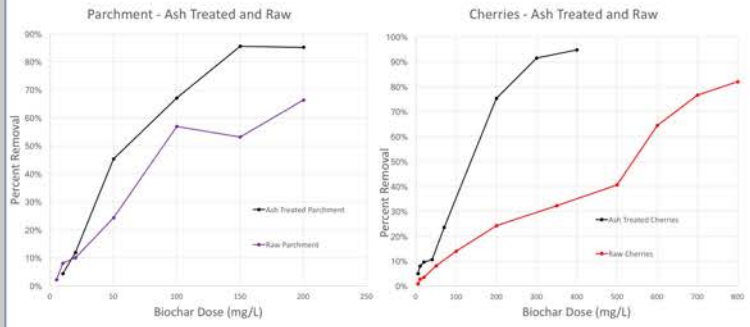
Coffee Parchment Biochar > Coffee Cherry Biochar

Parchment **3x** more effective than cherries for contaminant removal

Lower dose needed for contaminant removal



Ash Treatment Improves Sorption for Both Materials



Ash Treatment improved Coffee Cherry Biochar by more than **3x**
Ash Treatment improved Coffee Parchment Biochar sorptive capacity by **~2x**.

Discussion

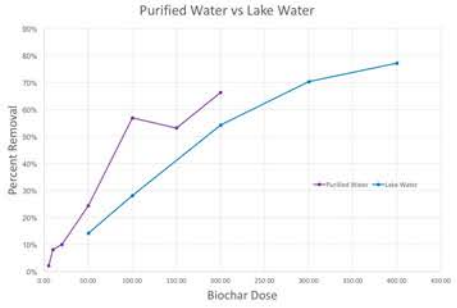
Applications

- Given minimal uses for coffee byproducts, applications in water treatment are feasible
- Removal of contaminants such as pesticides and pharmaceuticals is difficult and often unaddressed in many water treatment facilities
- Developing countries could benefit from biochar treatment of drinking water sources (i.e. lake and river water)

Future Work

- Examining how biochars perform in other water sources (lake water, stormwater, wastewater, rivers, etc.)

Initial test in lake water showed reduced removal rates compared to purified (DI) water



Conclusion

- Biochar from coffee byproducts shows promise for a material that is largely unused on a global scale
- Coffee is grown worldwide, utilizing coffee byproducts to effectively treat contaminated water is highly sustainable
- Developing communities would benefit greatly, given that activated carbon is less accessible

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