Surface Property of Organic Sorbent Derived from Coffee Grounds

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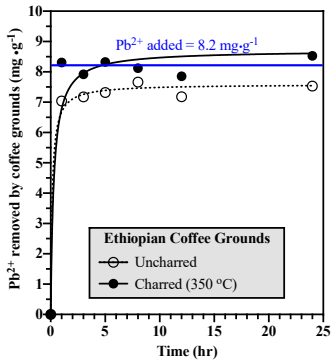
Introduction

- Every day, Americans generate an average of 11.4 million kilograms of coffee grounds per day, equivalent to the weight of a thousand school buses.
- Most of the coffee grounds are discarded and end up in a landfill.
- When recycled, coffee grounds can be used as a pest repellent or garden fertilizer.
- Coffee grounds can also be used as a sorbent to remove water contaminants.
- Recent research conducted at Texas Christian University shows that charred coffee grounds can effectively remove lead contamination from water

Pb^{2+} removal by Ethiopian Coffee Grounds

For both charred and uncharred grounds, lead was rapidly adsorbed during the first hour and lead sorption did not increase significantly after.

Charred grounds adsorbed 13.2% more lead than uncharred grounds in 24 hours.



- This study will further explore this by identifying the specific properties of charred coffee grounds that allows for lead removal along with the optimal temperature for producing charred coffee grounds for water filtration.

Research approach

This study was conducted by:

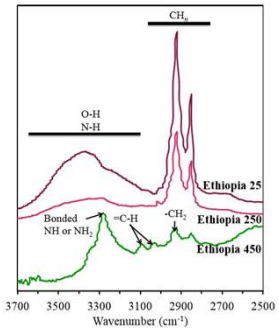
Charring and char characterization

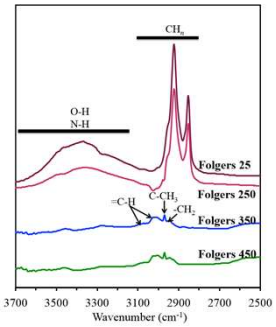
- Spent coffee grounds originating from 2 different types of coffee: Ethiopia and Folgers
- Samples of each were charred at 250°C, 350°C, and 450°C
- Charred and uncharred samples of each were characterized by elemental composition (C, N, H, S, O) and ash content (TGA)
- Samples were then analyzed with the FTIR spectroscopy to find the OH and CH stretch. This is an area where water containments will be absorbed and remove from the water.

Research findings

OH and CH Stretch of Ethiopia and Folgers Coffee Grounds

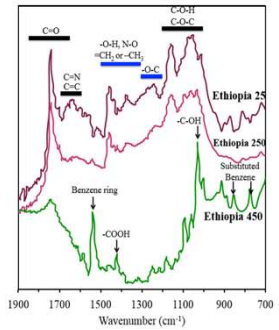
- For both coffee grounds at 450°C, The peaks of the –CH bonds are less intense than the peaks at 25°C and 250°C.

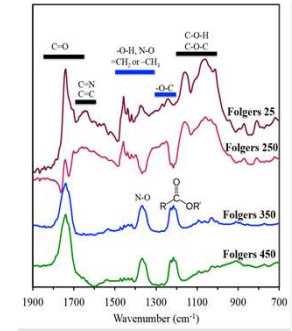




Fingerprint Region of Ethiopia and Folgers Coffee Grounds

- For both coffee grounds, the peak intensity of the associated functional groups decreases as the temperature increases. This shows as the coffee grounds are charred at a higher temperature, the amount present will decrease.

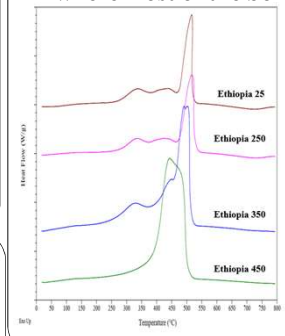


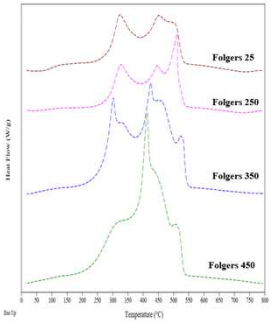


Research findings (continued)

DSC Analysis of Ethiopia and Folgers Coffee Grounds

- The peak intensities in both graphs show the temperature where most of the bond breakage occurs.





Conclusion

- As the burning temperature of the coffee grounds increased, the peak intensity for the OH and CH stretch decreases. This indicates that bonds are weakening and breaking apart.
- Normally, the peaks would shift to the right as the burning temperature increases. However, the graphs shows it shifting to the left. This implies that the nitrogen rings are weakening and forming nitrogen chains. The formation of such chains allows the attachment of Pb^{2+} to the surface of the charred coffee grounds, essentially removing it from water.

Ongoing and Future Work

- Detail characterization of surface and sorptive properties of all materials. Methods will include surface area measurements, TGA and DSC analysis, and FTIR spectroscopy.
- Examine sorption for higher amounts of added lead and other water containments. (x=8.2 mg g^{-1}, 2x, 4x, 8x)

References

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