TREATMENT OF WILDFIRE ASH IN DRINKING WATER

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INTRODUCTION

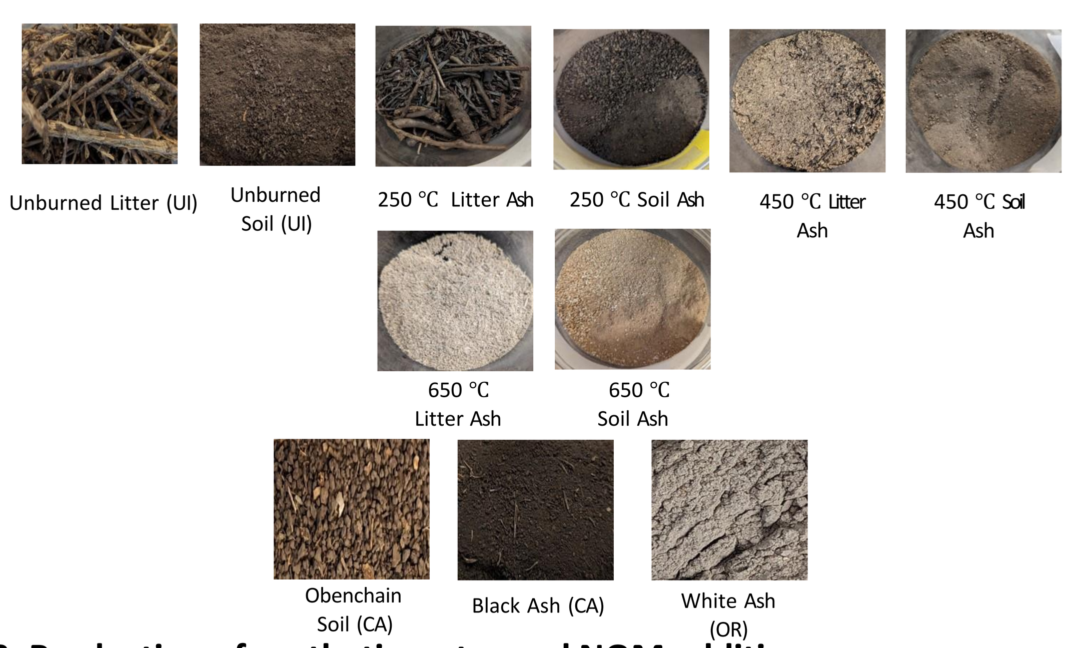
- The effects of climate change have allowed for increasing intensity and seasonal frequency in wildfires. As a result, more communities are becoming vulnerable and impacted by wildfires, which pose a threat to their respective water supplies due to ash contamination. This creates the necessity to find an effective means of treating ash-water for the health and safety of affected communities.
- Variables affected by ash contamination: turbidity, pH, electrical conductivity, zeta potential, and Specific Ultraviolet Absorbance (SUVA).

Objective: evaluate the performance of ACH in coagulation of lab and wildfire soil-litter samples.

MATERIALS & METHODS

1. Creation of laboratory ash and wildfire ash collection

- Unburned soil and litter samples were collected at the University of Idaho Experimental wildfire
- Laboratory ash was made in a muffle furnace at fixed temperatures of 250 °C, 450 °C, and 650 °C for 2 hours.
- Wildfire ashes and unburned soil were obtained from the South Obenchain fire (Oregon) and the Lightning Complex fire (California).



2. Production of synthetic water and NOM additive

- Synthetic surface water: milli-q water (5000 mL); magnesium chloride (0.1758 g); magnesium sulfate (0.085 g); potassium bicarbonate (0.015 g); sodium bicarbonate (0.0965 g); calcium carbonate (0.165 g)
- Natural organic matter (NOM): SRHA Standard III

3. Jar preparation

- 800 mL synthetic water, 32 mL NOM additive, and 4 g of sample (1:1 soil/litter ratio) poured into each jar.

Jars Prepared with Synthetic Water, NOM, and Sample

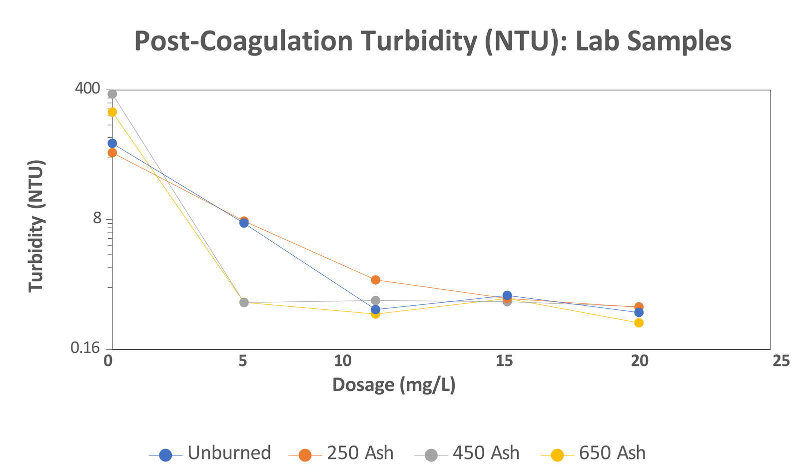
4. Jar testing and incorporation of ACH

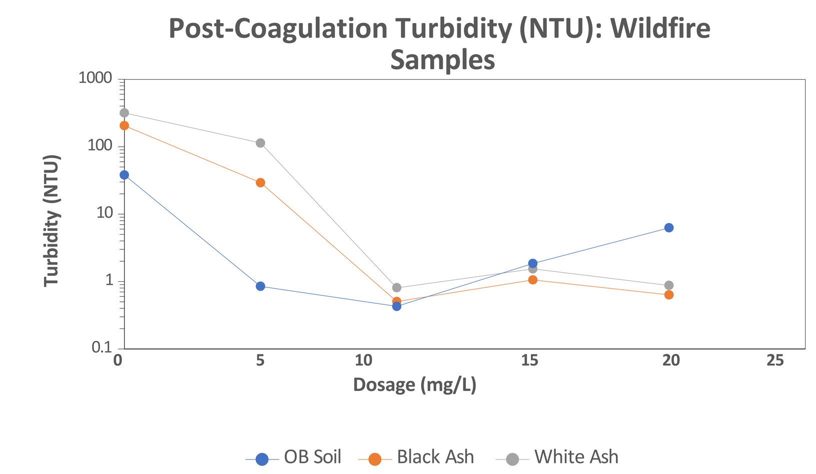
- Untreated water extraction (40-50 mL) per jar
- Jar Tester activated; doses of 5, 10, 15, 20 mg/L were applied to respective jars. Mixing conditions were as follows: rapid mix phase (1 min 30 secs, 300 rpm), two flocculation periods (10 min, 55 rpm and 10 min, 20 rpm), and a 30-minute sedimentation period.

5. Treated water analysis

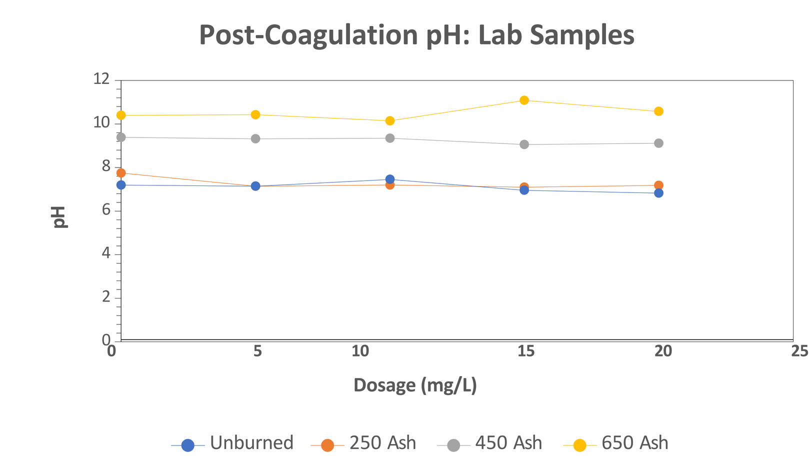
- Unfiltered: turbidity; pH; electrical conductivity
- Filtered: zeta potential; UV-VIS; TOC

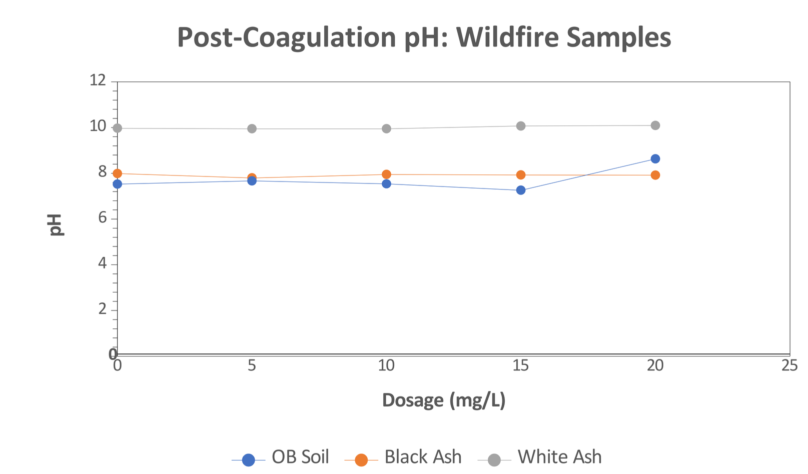
RESULTS



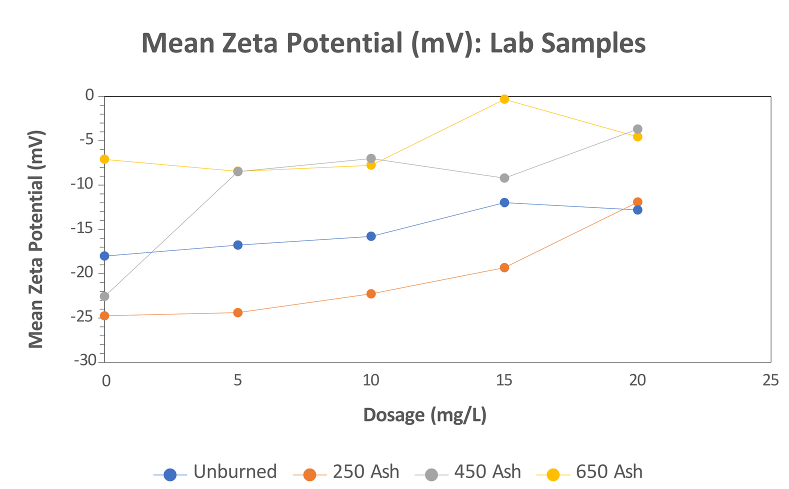


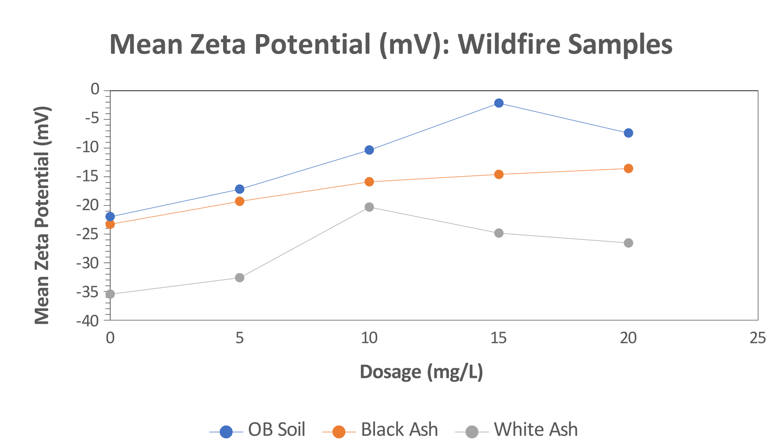
- Rapid decreases in turbidity values occurred among lab and wildfire samples post-coagulation
- 10 mg/L proved to be a critical dosage for achieving the lowest turbidity for all wildfire samples
- Particle re-stabilization occurred in some of the jar tests as a result of the higher dosage of ACH, particularly in wildfire samples, such as Obenchain Soil



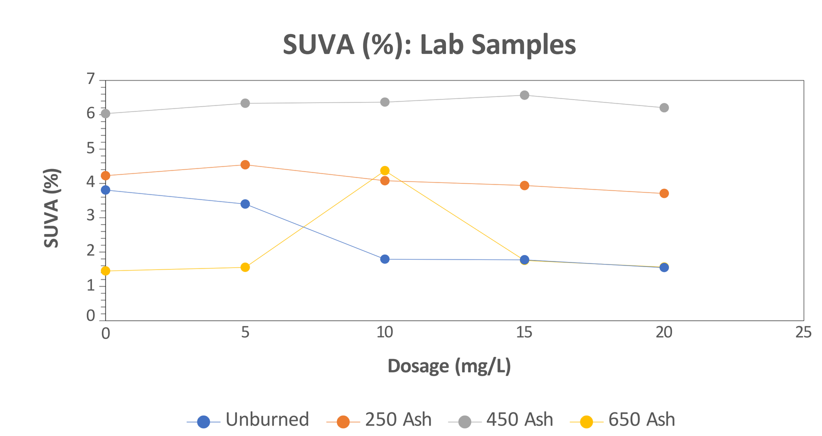


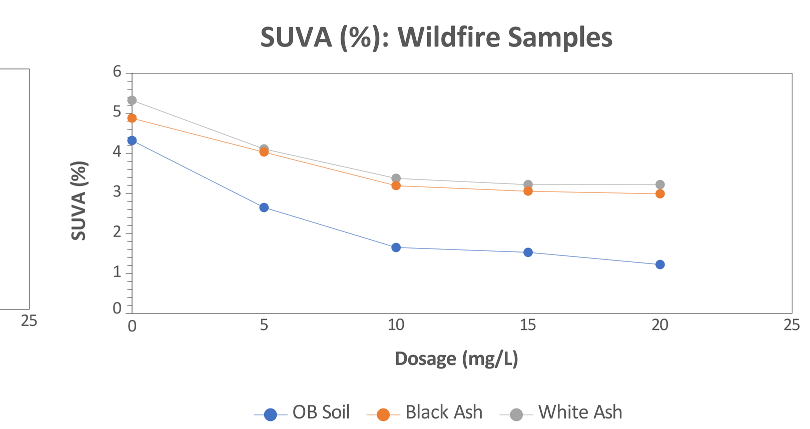
- pH values remained mostly constant for lab and wildfire samples post-coagulation
- Re-stabilization of particles, in higher doses of ACH, would cause small fluctuations in pH values





- Zeta potential values generally increased in value (decreasing zeta potential magnitude with increasing dosage)
- 650 °C lab ash was the closest to reach neutrality out of all lab samples; Obenchain Soil out of all wildfire samples
- Particle re-stabilization would sometimes cause zeta potential values to decrease and zeta potential magnitudes to increase

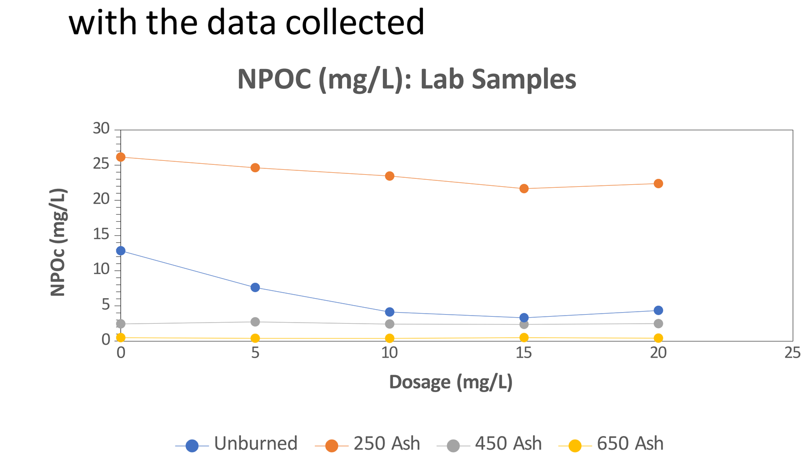


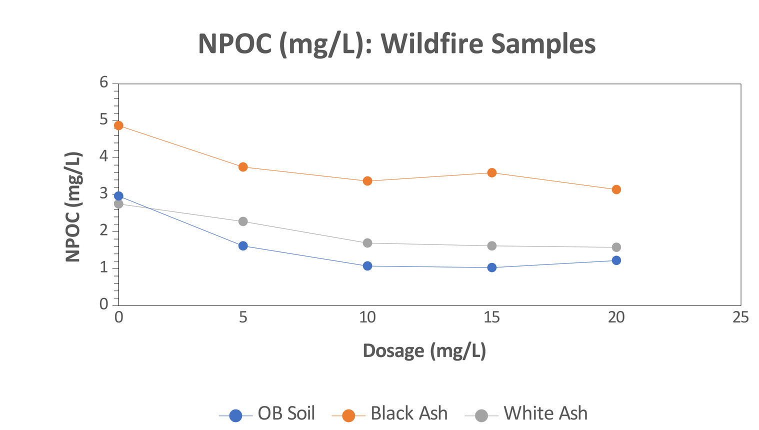


- SUVA (%) values did not change significantly for 250 °C and 450 °C lab ash; unburned soil/litter showed the best trend out of the four lab samples
- SUVA (%) spiked for 650 °C lab ash at a dosage of 10 mg/L
- SUVA (%) values decreased steadily among wildfire samples; curve of diminishing return expressed with the data collected

Table 1: Physical and Chemical Characteristics of Lab Ashes Produced at 250 °C, 450 °C, and 650 °C

Ash Type	Bulk Density (g/mL)	Soil Ash Color	pH	EC (µS/cm) [Pre-Shaking]	EC (µS/cm) [Post-Shaking]	Zeta (mV)
250 °C Ash	0.1786	10 YR 2/2 (very dark brown)	6.64	29.4	40.4	-23.58
450 °C Ash	0.15625	10 YR 5/3 (brown)	10.17	147.1	190.5	-20.19
650 °C Ash	0.17241	7.5 YR 6/4 (light brown)	10.92	50	173.4	-18.49





- NPOC concentrations slowly decreased with increasing dose for most samples
- 450 °C and 650 °C lab ashes experienced almost no change in NPOC concentrations
- Unburned UI soil and Obenchain soil displayed a better progression in the decline of NPOC with increasing dosage

SUMMARY

- ACH effectively reduces turbidity and zeta potential magnitudes in ash samples
- No significant changes in pH were experienced post-coagulation with ACH
- SUVA (%) is decreased steadily in most samples with greater success in wildfire samples
- NPOC concentrations were able to be reduced in most cases by adding more ACH to the contaminated water
- pH values increased with increasing temperature among lab ashes
- EC reached a maximum at a temperature of 450 °C for lab ash
- Narrow range of -23.58 to -18.49 mV was experienced among lab ashes for mean zeta potential

ACKNOWLEDGEMENTS

This work was supported by the National Science Foundation's REU program under grant number AGS-1757711. I would like to thank my Principal Investigator Shelley Pressley for her kindness and support throughout this experience. I would like to also thank my advisors Mrittika Rodela and Indranil Chowdhury for their patience, kindness, and support throughout this project. Thanks to the University of Idaho Experimental wildfire committee for providing the soil and litter necessary for making the lab sample studies possible.