Research Project Summary

Project Details

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Title: **Erosion: Don't Let Soil Get Carried Away**
Keywords (3-5 words): Soil Erosion, wind erosion,

Background and Rationale

DESCRIBE THE BACKGROUND AND PROBLEM BEING ADDRESSED IN THE RESEARCH (ONE PARAGRAPH IN PRESENT TENSE)

Erosion is a set of natural processes that transport the surface materials from one location to another location by natural agents such as wind, water, or glacial ice. Although it is a natural phenomenon responsible for creation and modification of landforms, it does bring some unique challenges for earth and its inhabitants. Soil erosion decreases soil fertility, which can negatively affect crop yields. It also sends soil-laden water downstream, which can create heavy layers of sediment and ultimately leads to flooding. The fine dust particles in the air are also a health hazard and cause diseases such as valley fever and other respiratory diseases. To mitigate the issue, traditionally we have depended on methods such as growing trees and compacting soil with water. But neither of those are sustainable nor economical. Therefore, in recent years, scientists are trying to improve the soil surface strength by using bio-mediation methods such as enzyme induced carbonate precipitation and Using Fungus to strengthen soil.

Research Objectives

LIST AT LEAST ONE OBJECTIVE GUIDING THE RESEARCH (START WITH ACTION VERB)

- Discuss the hazards of soil erosion and how to mitigate the issue
- Prepare, test, and compare the application of different solutions for soil erosion.
- Study the performance of EICP solutions on mitigation of erosion on different soil types.
- Measure the amount of Carbonate content and Ammonia by using a calcimeter and perform SEM imaging and Optical Microscope.

Methods and Materials

For this experiment , diffrent types of soil were studied to determine how their physical properties impact the amount of soil loss during erosion. To study the impact of EICP, two sets of three columns with different batches of Ottawa 2030 Sand labeled B1 and B2.5 were created . These columns were treated with EICP and after 72 hours , their strength was tested using UCS (Unconfined Confined Strength) .For enhanced visualization SEM samples were prepared and studied using Scanning Electron Microscope.
To test the efficacy of EICP solution concentrations as a dust control method in Minnesota iron mine tailings, three pans were prepared: Pan 1 (control) was untreated; Pan 2 was treated with a 1M urea, 0.67M $CaCl_2$ EICP solution; Pan 3 was treated with a 1.5M urea, 1M $CaCl_2$ EICP solution. Samples were let dry for 72 hours . Soil

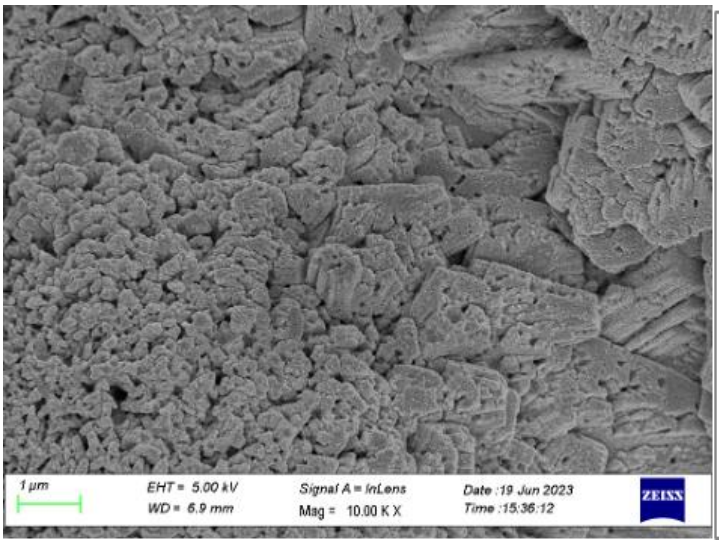
surface strength and carbonate content measurement of the crust on each pan were done using a penetrometer testing and a calcimeter.

Experimental Results

Describe results from summer research experience (one paragraph in past tense)

Ottawa 20/30 B-2.5 and B-1 treated soil sample columns showed significantly different stress responses as measured by UCS testing. Ottawa 20/30 B-2.5 (EICP milk B-2.5) samples supported less stress (x= 253.67 kpa) than Ottawa 20/30 B-1 (EICP milk B-1) samples (x= 462.12 kpa). Examination of Ottawa 20/30 B-1 (EICP milk B-2.5) SEM prepared samples revealed carbonate precipitate crystals (Fig. 1), which were not visible in untreated samples. Pan crust soil sample

penetration test results showed that EICP treatment is three to four times stronger in treated Minnesota iron mine tailing soils (Fig.2). Untreated soil (Pan 1) supported the least stress (20 kpa); EICP 1.5M urea, 1M CaCl2 EICP treated soil (Pan 3) supported less stress (80 kpa) than EICP 1M urea, 0.67M CaCl2 treated soil (Pan 2) (105 kpa). Untreated soil showed the least displacement (0.01 cm) when compared to treated soils (0.2 cm).



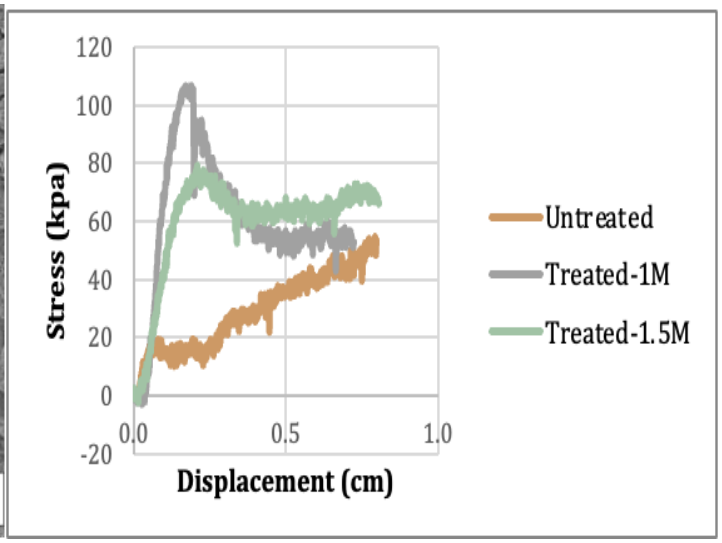


Figure 1: SE micrograph of carbonate precipitate crystals in treated Ottawa 20/30 EICP-milk B-2.5 soil samples	**Figure 2:** Stress values (kpa) for untreated and treated Minnesota iron mine tailings soils

Research Conclusions

We noticed that the soil particle size as well as angle of slope impacts the amount of soil loss . The finer soil erodes easily and if the slope is higher , the soil loss increases. Ottawa 20/30 B-1 EICP treated soil sample columns exhibited a much higher stress response (x= 462.12 kpa) to unconfined compression than Otawa 20/30 B-25 EICP treated samples (x= 253.67 kpa). Minnesota iron mine tailings soil pan crust untreated samples were three to four times less strong than EICP treated samples. 1M urea, 0.67M CaCl2 EICP solution soil samples exhibited the highest stress response (105 kpa), as determined by penetrometer testing.

Acknowledgements

This material is based on work primarily supported by the Engineering Research Center Program of the National Science Foundation under NSF Cooperative Agreement Number EEC-1449501. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect those of the NSF.

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