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Evaluating the Effectiveness of Biochar for Treating WSU Parking Lot Runoff

Alan-Christian Thomas
Wayne State University, fp5853@wayne.edu

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College of Engineering

Alan-Christian Thomas Dr. Timothy Dittrich Civil & Environmental Engineering

OPPORTUNITY AND SIGNIFICANCE

Various pollutants including pesticides, herbicides, automotive fluids, and excess nutrients from fertilizers are found in high concentrations in urban runoff. There are many technologies that can be used to control and redirect the water flow such as retention basins, constructed wetlands, and rain gardens; however, these methods are specifically focused on controlling water and not necessarily the nutrients and contaminants in the water. There has recently been an increased interest in the potential for using additional materials (e.g., compost, charcoal) to enhance the pollution treatment ability by either adding them to the soil or by engineering prefilters to remove pollutants from urban runoff before the water enters the biosphere.

TECHNICAL OBJECTIVES

This project will investigate the capability of biochar, a relatively inexpensive form of charcoal, at removing pollutant concentrations from urban runoff. Various biochar materials will be tested with differing copper concentrations to understand which material is optimal.

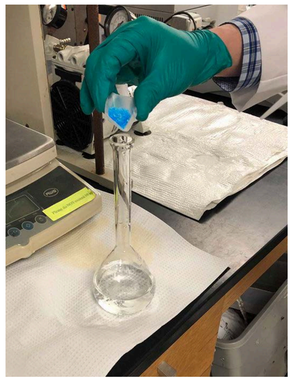
RELATED WORK AND STATE OF PRACTICE

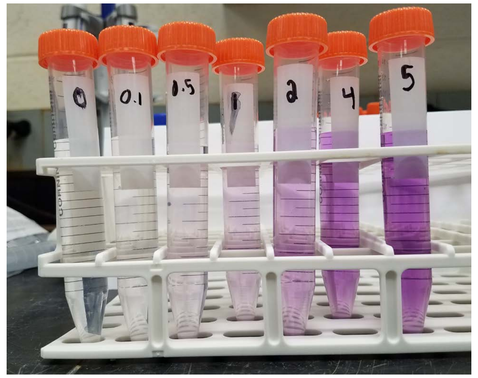
In 2017, Detroit Biodiversity Network installed a bioswale near the new Integrated Biosciences building on Wayne State's campus. This project could integrate biochar as a material for urban bioswales.

Thank you to Research Opportunities for Engineering Undergraduates (ROEU) Program for funding

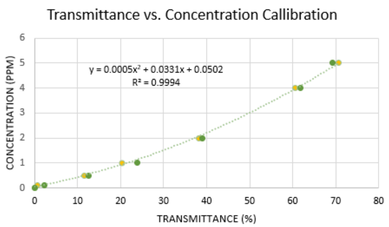
TECHNICAL APPROACH, ACCOMPLISHMENTS, AND RESULTS

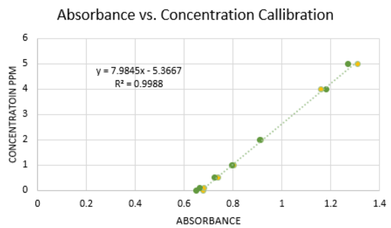
Copper is an urban pollutant that is commonly used as an analog for metal contamination in urban runoff . Several copper solutions were created by mixing copper salts with purified water. Solutions of varying concentrations (0, 0.1, 0.5, 1, 2, 4, 5ppm) were made. CuVer1 was mixed with the solutions which changed the solution to shades of purple depending on copper concentration.





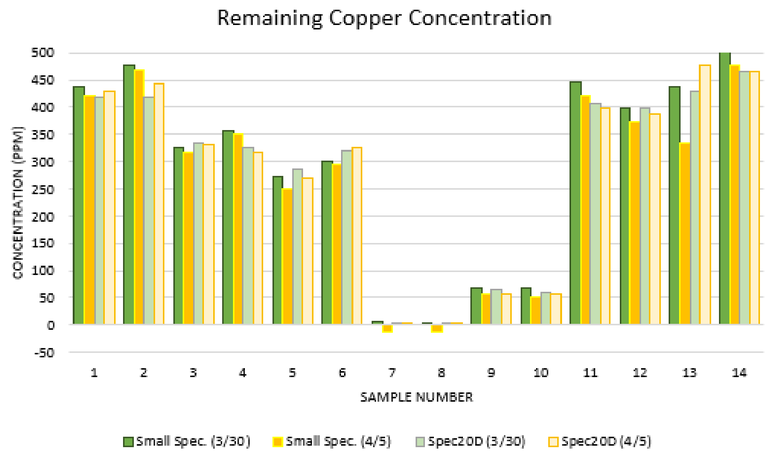
The mixed solutions were run through two different spectrophotometers and a linear regression was conducted to establish calibration curves based on transmittance and absorbance.





Seven different types of biochar were mixed with the a 500 ppm copper solution. Each type of biochar was tested in duplicate to account for uncertainty.

Spectrophotometer measurements were taken after 2 and 3 weeks to ensure equilibrium was reached. Best fit equations from the calibration curves were used to estimate final copper concentration.



Results from the coconut char showed the best copper removal with a copper concentration of 0 ppm and from the zeolite clay with around 10% copper remaining.

NEXT STEPS FOR DEVELOPMENT AND TESTING

For future research, the coconut char and zeolite clay could will be tested to determine the capacity that can be adsorbed. Additionally, other urban pollutants such as oil or fertilizer will also be tested.