University of Tabriz

Journal of Civil and Environmental Engineering
Volume 53 (2023), Issue 2 (Summer), 119-135

EXTENDED ABSTRACT

Investigation of the Effect of Biological Modification on Increasing the Resistance of Alkaline Silty Soils in Arid and Semi-Arid Regions Against Water and Wind Erosion (Case study: Miqan Desert)

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Received: 05 November 2021; **Review:** 13 February 2022; **Accepted:** 17 March 2022

Keywords:
Biocrust, Silt, Alkali, Wind tunnel, Surface erosion, Durability, Microstructure.

1. Introduction

In the present paper, results of a study on the use of Bacillus pasteurii to reduce wind and water erosion in alkaline silty soils are presented (Kim et al., 2014). The treated soil specimens were prepared in different periods and different concentrations and amounts of bacteria on different surfaces and were exposed to a wind tunnel constructed and calibrated for the present study and their surface erosion was measured. For further analysis of the samples, melting and freezing tests, cone penetration, electrical conductivity, pH and SEM, XRD, and EDS analyzes were also performed on the treated and untreated specimens. The results of this study showed that the use of MICP as a surface crust is an effective and environmentally friendly process to control dust caused by wind erosion in the Meighan Wetland.

2. Methodology

2.1. Experimental study

The treated soil specimens were prepared in different periods and different concentrations and amounts of bacteria on different surfaces and were exposed to a wind tunnel constructed and calibrated for the present study and their surface erosion was measured. For further analysis of the samples, water erosion test (Gao et al., 2020), freeze and thawing test (Qi et al., 2006), cone penetration, electrical conductivity, pH and SEM, XRD, and EDS analyzes were also performed on the treated and untreated specimens. To compare the stabilization method with bacteria and conventional stabilizers, surface stabilized samples were prepared by spray method (Ivanov & Stabnikov, 2016) of cement and lime and exposed to wind tunnels and surface erosion was measured.

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3. Results and discussion

3.1. Effect of bacteria on reducing wind erosion

The results of this study showed that the use of MICP as a surface crust is an effective and environmentally friendly process to control dust caused by wind erosion in the Meighan Wetland. With this method, the surface resistance of 28-day-old samples can be increased up to 95% and the rate of wind erosion can be reduced to 89.8%.

3.2. Effect of bacteria on water erosion

The formation of biological crust in a scouring cycle by 98.59% has reduced the surface scouring, which can indicate the stability of this crust against water erosion in the study area.

3.3. Effect of bacteria on freeze and thawing cycles

Freeze and thawing cycles do not cause surface crust loss and increase wind erosion in bacterial-modified soil samples.

4. Conclusions

The use of bacteria to improve the soil and create a biological crust by spraying has shown a significant effect on the rate of erosion of samples exposed to wind and this method can be used in fine-grained soils of Meighan area and soils with similar conditions to prevent surface erosion. This method increases the surface resistance of the soil against melting and freezing, scouring, and penetration of the cone. Soil bacterial stabilization in the study area is more suitable than cement and lime stabilizers in terms of reducing erosion and reducing pollution.

5. References

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