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Wind Tunnel Experimental Investigation of the Effect of Using Non-Erodible Coatings on Sand Transport Rate of Talle-Hamid Desert Area

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Extended Abstract

Introduction: Due to the detrimental consequences of the application of stabilizers such as mulch and other protectives on the soil surface, including the wafting of bad smell, blackening of the ground, increasing thermal coefficient, warming of the whole area, and even destruction of plants and their unsustainability in nature, wide use of such stabilizers could not be considered as a useful solution to control wind erosion. Therefore, to solve the problem of sandstorms in Iran and get the deserts' soil stabilized, this study proposes that deserts be coated with non-erodible materials (e.g., gravel, sandblasting, etc.)

Materials & Methods: Based on the purpose of this study, the effect of gravel cover with 30%, 50%, and 75% coverage on the sandblasting rate of MontazerQaem -TaleHamid desert was investigated using the wind tunnel. To investigate the effect of different gravel coatings on the sand particle transport rate, first, a sand sample was gathered from the Talle-Hamid area in Tabas, located 209 km off the Bafgh Railway, at 55/89 latitude and 32/93 longitude degrees, respectively, and the particle density of sand particles size was measured using standard ASTM D854-02. Its amount was found to be 2724 kg/m3. In the next stages, dry aggregation of sand particle size was first extracted from different parts of the MontazerQaem-Talle-Hamid track. According to the ASHTO T27 standard, at least 500 gr random fine sample particles should be collected from

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each site to sieve. Four samples were collected from sites that were 209, 213, 217, 222, and 222.7 km off Tabas. Having enumerated Standard-sized sieved particles, we used a vibrating machine to shake different particle diameters for at least 15 minutes. Furthermore, scales with a minimum accuracy of 0.01gr were used to weigh particles of different diameters. According to the standard of reconstitution for fine particles such as sand, the minimum sample size for sieving is 300gr, and the sample should be dried at 110 ° C in a three-stage oven. Then, these particles' transportation rate was measured at different wind speeds for uncovered gravel samples.

Results & Discussion: Initially, by increasing the wind speed from 1 m/s to 8 m/s, it was found that the particle's creeping movement started at 6.9 m/s and its creeping speed was 6.9 m/s. The index sample was then placed in the wind tunnel for 5 minutes at different speeds of 9.9, 12.4, 17.2, and 22 m/s, and sand particle transportation was determined. It was also found that wind erosion increased by increasing wind speed polynomials. Subsequently, sands with 30-50% and 75% gravel cover were inserted into the wind tunnel for 5 minutes at wind speeds of 10.5, 15.7, and 22.9 m/s. Having determined the rate of wind erosion, we observed that the wind erosion rate decreased with an increasing percentage of gravel cover at a certain speed. We also found that the greatest effect on decreasing wind erosion rate occurred at wind speed 22.9 m/s, with the reduction percentage of erosion being 67.5%. The study results showed that the wind erosion rate decreased with an increasing rate of gravel cover at a certain speed, and the highest effect of graved on reducing wind erosion was reported for gravel cover of 75%. Therefore, covering the surface of a sandy desert with non-corrosive materials such as sand or gravel could be a practical solution for preventing wind erosion.

Conclusion: The effects of non-erodible coating or gravel on the rate of sand particle erosion were investigated via the wind tunnel, the results of which showed that the samples with gravel cover were effective in reducing wind erosion of sand particles. The greatest reduction in wind erosion rate was reported for the sites covered by 75% gravel. According to research conducted in the Chinese deserts, gravel cover with eroding sand particles and reducing wind velocity at the sand surface could well improve erosive sand levels. The present study also showed that at 22.9 m/s wind speed and 75% gravel cover, the erosion rate decreased by 67.5%. Therefore, to reduce the effects of sandstorms in Iran and stabilize the sandy desert area, non-erodible coating such as gravel would be recommended instead of mulch.

Keywords: non-erodible materials, stabilization, dust, wind tunnel.