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On behalf of the organizing committee, we are pleased to announce that the 3th International Conference on Environmental Science and Technology (ICOEST-2018) is held from September 19 to 23, 2018 in Kiev. ICOEST 2018 provides an ideal academic platform for researchers to present the latest research findings and describe emerging technologies, and directions in Environmental Science and Technology. The conference seeks to contribute to presenting novel research results in all aspects of Environmental Science and Technology. The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Environmental Science and Technology. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in al lareas of Environmental Science and Technology. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world. ICOEST 2018 is the oncoming event of the successful conference series focusing on Environmental Science and Technology. The scientific program focuses on current advances in th eresearch, production and use of Environmental Engineering and Sciences with particular focus on their role in maintaining academic level in Science and Technology and elevating the science level such as: Water and waste water treatment, sludge handling and management, Solid waste and management, Surface water quality monitoring, Noise pollution and control, Air pollution and control, Ecology and ecosystem management, Environmental data analysis and modeling, Environmental education, Environmental planning, management and policies for cities and regions, Green energy and sustainability, Water resources and river basin management. The conference's goals are to provide a scientific forum for all international prestige scholars around the world and enable the interactive exchange of state-of-the-art knowledge. The conference will focus on evidence-based benefits proven in environmental science and engineering experiments.

Best regards,

Prof. Dr.Özer ÇINAR

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Improvement of Engineering Properties of Sandy Soils by *Bacillus simplex*

Baki Bagriacik[1], Esra Sunduz Yigittekin[2], Fatima Masume Uslu [2], Sadik Dincer [3*]

Abstract

In this study, serious tests have been applied in the laboratory to investigate the availability of sandy soils with Bacillus simplex for increasing the bearing capacity and decreasing consolidation settlement. In the examinations, sand samples which were taken from river bed were used. Experiments were performed at Cukurova University Central Laboratory and soil mechanics laboratory of Civil Engineering Department on oven-dried sand samples. The sand was classified as uniform clean sand (SP). At experiments, B.simplex have been injected into the sandy soil with low bearing capacity. B.simplex is a bacterium that produces calcium carbonate. The B.simplex has been fed for adherence to the sandy soil. Then they have been dried in an oven fed and engineering experiments have been carried out. As a result of study, it was observed that the engineering properties of the sandy soils could be improved by injecting B.simplex into the soil.

Keywords**:** *Soil Improvement, Bacillus Simplex, Sandy Soils*

1. INTRODUCTION

As many of construction is concentrated in populated urban areas, there is increasing need to construct on soft subsoils, which were considered unsuitable for construction just a couple of decades ago. Soft soils have been made in recent years in advanced constitutive modeling of such materials. For high subgrade constructions, selection of appropriate materials for embankment construction is the more important issue not only in terms of cost but also expected engineering performance. Loadings, excavations and transportation of these materials are the most important component of the total cost during embankment building process. At conventional approach, the soft soils at geotechnical engineering are removed and replaced by gravel or squashed rock layer. The embankment, subbase and base materials are provided that receive sites resulting in important cost increases. Using onsite soils is the most economical touch particularly in comparison to bringing choose borrow materials from faraway locations. It is reasonable that stabilization of borderline on-site soils and improvement of their engineering properties can be a well-balanced alternative to take on loan plant. Soil stabilization methods are important in dealing with for geotechnical engineering and transportation engineering departments. In addition to that, soil stabilization is becoming an alternative for increasing the strength properties of cohesionless soils. There are a lot of stabilization methods and one of the most important stabilization methods is the soil stabilization with *B.simplex* There are a lot of studies about different soil stabilization methods [2, 17] but there is restrict study [18,19] about stabilization with *B.simplex* in the literature for geotechnical engineering and transportation engineering departments.

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2. MATERIAL AND METHODS

In the experiments, sand samples which were taken from Cakit River bed in Cukurova District were used. Experiments were performed at soil mechanics laboratory of Cukurova University on oven-dried sand samples. The sand was classified as uniform clean sand (SP) according to TS 1500 [20]. Test results of the sieve analysis are given in Table 1 [21]. Experimental studies were performed at the soil mechanics laboratory of Cukurova University using a direct shear test. At experiments, B.simplex have been used for soil improvement. B.simplex is a bacterium that produces calcium carbonate. Soil samples were collected from Thuja and Pinus pinea trees and 2 gr from each samples have weighed and homogenized in 10 ml sterilized serum physiologic by vortexing then, soil suspension have incubated for 15 min at 85 ° C to eliminate non-spore forming bacteria. At the end of the incubation, 100 µl from each samples were seeded onto urea agar plate by spread method and incubated for 24 hours at 37 ° C. Identifying has been conducted with molecular sequence-based identification, for this purpose isolated microorganisms' 16S ribosomal DNA sequence has been submitted to an online database (NCBI DNA sequence database) for comparison with known sequences. For the experimental study urea medium has been used [22]. Components of urea medium have been described below. All component of urea medium have been mixed in 900 mL of distilled water until dissolved, and the pH of the resulting urea medium solution has been adjusted to 6.0 and distilled water has been added to reach the final required volume (1 L) then, medium was autoclaved (at 120 for 15 minute). At the end of the autoclave process a 20-ml volume of calcium chloride solution has been added to the urea medium. After these procedure, the B.simplex has been injected into the sandy soil and fed for 15 days for adherence to the sandy soil. Then they have been dried in an oven fed and engineering experiments have been carried out. After preparation of both sandy soil and B.simplex treated sand mixtures. Direct shear tests were performed using only sandy soil and sandy soil with B.simplex The direct shear test is the main engineering property of soil which controls the stability of a soil mass under vertical loads. It is a major interest in the design of different geotechnical and transportation structures to determination of the soil shear strength parameters. Figure 1 shows the direct shear test machine which was used to run the shear test. The shear box has a 60 × 60 mm horizontal cross section area, and the specimen height is 25 mm. The tests were conducted according to ASTM D-3080 [23] at constant displacement rate of 1.00 mm/min. The shear stress was recorded as a function of horizontal displacement up to an average shear strain of 12.50%. Tests were performed at three different vertical normal stresses of σN = 28 kPa, 56 kPa and 112 kPa in order to completely define the shear strength parameters such as the friction angle (φ)) for both sandy soil and B.simplex treated sand mixtures. In addition to these, microscopic examination (SEM) and chemical analyzes were performed for both sandy soil and B.simplex treated sand mixtures at Cukurova University Central Laboratory.

Table 1. *Soil properties [21]*

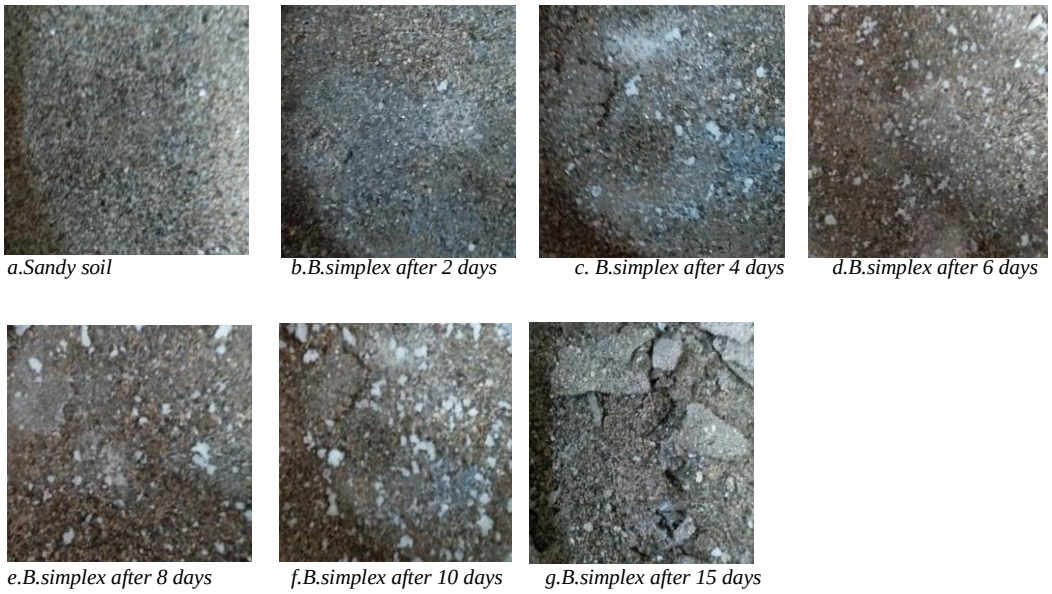
Granulometric Parameters	Unit	Value
Percentage of Medium Grained Sand	%	46.40
Percentage of Fine Grained Sand	%	53.60
Effective Grain Size, D_{10}	M	0.0018
D_{30}	M	0.0030
D_{60}	M	0.0050
Coefficient of Uniformity, C_u	-	2.78
Coefficient of Curvature, C_c	-	1.00
Soil Class	-	SP
Maximum Dry Specific Gravity	kN/m^3	17.06
Minimum Dry Specific Gravity	kN/m^3	15.03
Specific Gravity	kN/m^3	26.80



Figure 9. Direct shear test machine

3. FINDINGS AND DISCUSSION

Serious tests have been applied in the laboratory to investigate the availability of both only sandy soils and sandy soils with *B.simplex* for soil improvement in this study. The images of B.simplex injected into the sandy soils after 2 days, 4 days, 6 days, 8 days, 10 days and 15 days are shown in Figure 2 and the images of microscopic examination (SEM) for 50 µm, 5 µm, 4 µm and 2 µm are shown in Figure 3. The chemical analyzes results are shown in Table 2. The direct shear test results are shown at Figure 4.



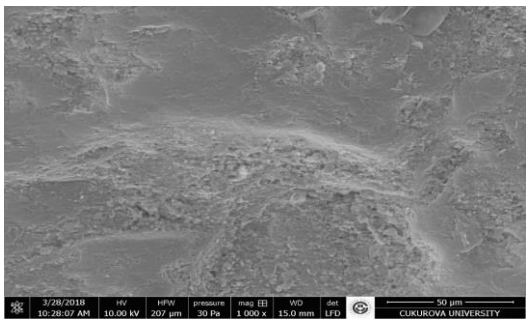
a.Sandy soil *b.B.simplex after 2 days* *c. B.simplex after 4 days* *d.B.simplex after 6 days*

e.B.simplex after 8 days *f.B.simplex after 10 days* *g.B.simplex after 15 days*

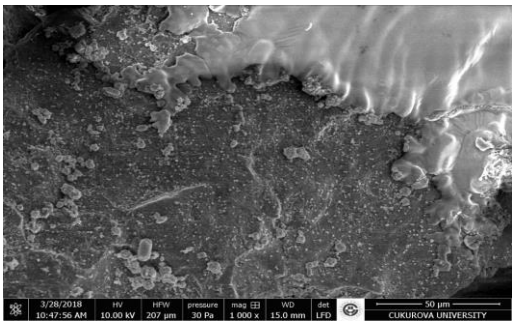
Figure 2. The images of both sandy soil and sandy soil with B.simplex

It was determined that white particles in the sand ground were formed as the number of days increased in the sand-blasted *B.simplex*. The side of the white particles produced in this *B.simplex* is believed that calcium

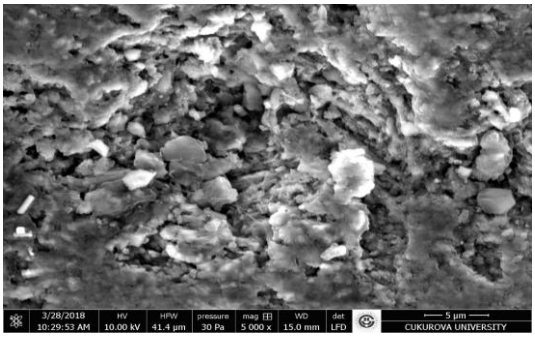
carbonates. Finally, it was seen that the amount of calcium carbonate increases as the number of days increases on bacterial injected sandy soil from Figure 2.



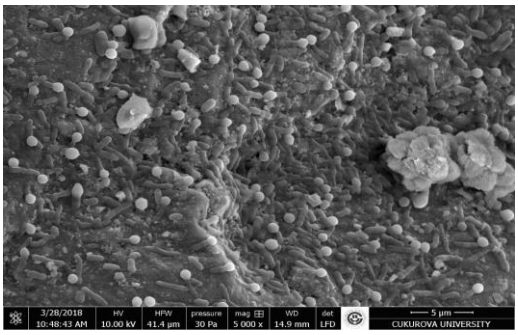
a. Sandy soil for 50 µm



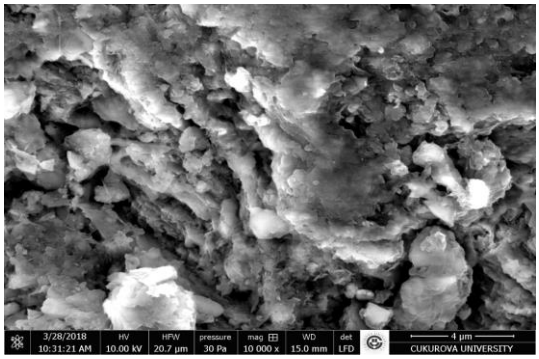
b. Sandy soil with Bacillus sp. for 50 µm



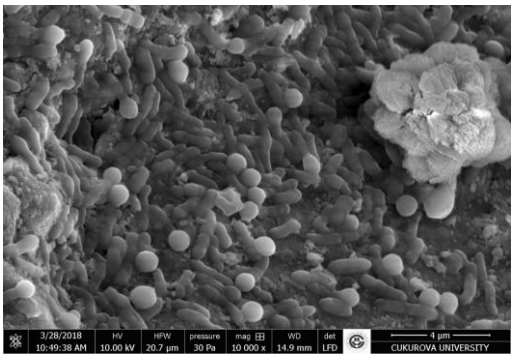
c. Sandy soil for 5 µm



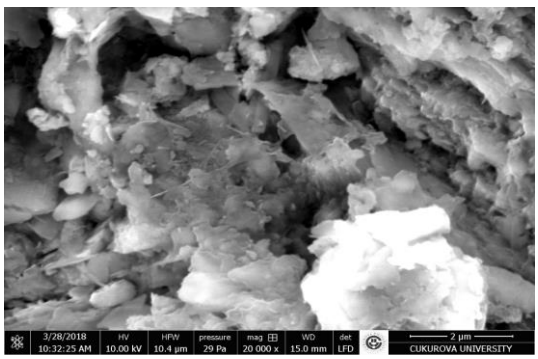
d. Sandy soil with B.simplex for 5 µm



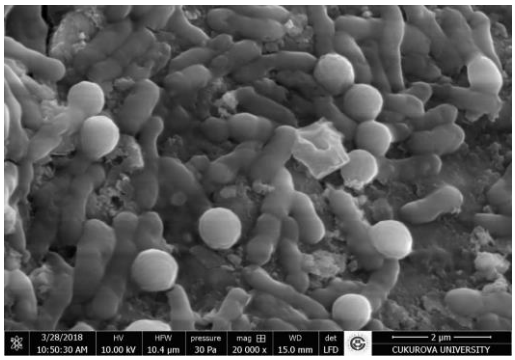
e. Sandy soil for 4 µm



f. Sandy soil with B.simplex for 4 µm



g. Sandy soil for 2 µm



h. Sandy soil with B.simplex for 2 µm

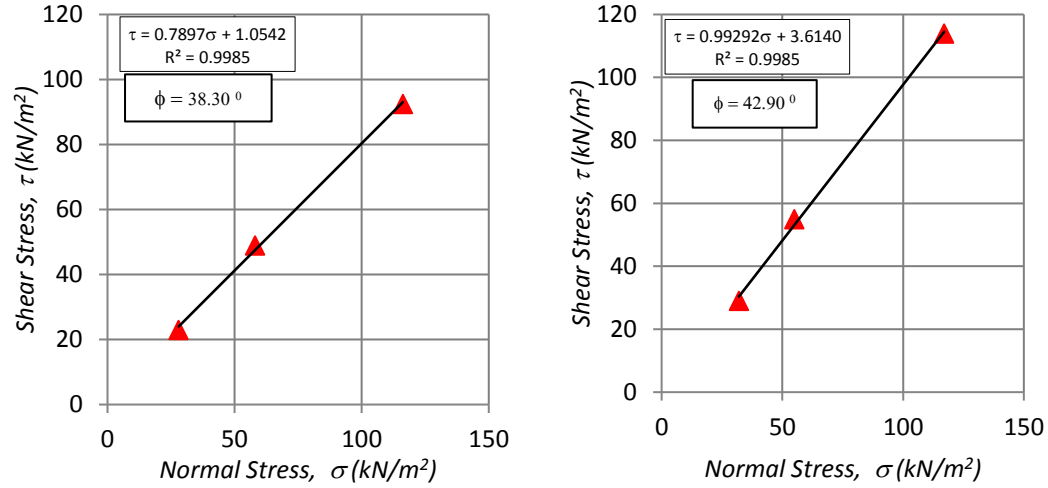
Figure 3. The images of microscopic examination (SEM) both sandy soil and sandy soil with B.simplex

As a result of microscopic investigations (Figure 3), it was determined that no calcium carbonate material was found on the sand that was not injected with *B.simplex* However, a significant amount of calcium carbonate material was observed at the end of the 15 days after *B.simplex* injected sand. When microscopic examination of the *B.simplex* on the injected ground was carried out, it was determined that these calcium carbonate formations were spread to the ground at considerable rates.

Table 2. *The chemical analyzes results*

Element	Weight (%)	
	Only Sandy Soils	Sandy Soils with *B.simplex*
Ca K	***1.44***	***33.72***
O K	45.54	35.56
Mg K	20.55	0.84
Al K	1.22	0.55
Si K	19.21	1.51
CK	6.36	-

According to the results of chemical analysis at table 2, 1.44% calcium carbonate amount was found on sandy soil. When the *B.simplex* injected to sandy soil, it was seen that this rate increased to 33.72%.



a. Sandy soil *b. Sandy soil with B.simplex after 15 days*

Figure 4. The direct shear test results

The frictional angle was found to be 38.30 degrees for only sandy soil. It was determined that the frictional angle increased to 42.9 degrees, when the *B.simplex* injected to sandy soils (Figure 4). It was also observed that the amount of cohesion (from 1.0542 kN/m^2 to 3.6140 kN/m^2) to on the sandy soil increased with the injection of *B.simplex* As a result, it was observed that the properties of the sandy soils could be improved by injecting *B.simplex* into the soil.

4. CONCLUSIONS

This paper has presented to investigate the availability of both only sandy soils and sandy soils with *B.simplex* for soil improvement. Microscopic examination (SEM), chemical analyzes and direct shear test were performed for both sandy soil and *B.simplex* treated sand mixtures at Cukurova University Central Laboratory and at soil mechanics laboratory of Civil Engineering Department. The general results obtained at the conclusion of this study are presented below:

- It was determined that no calcium carbonate material was found on the sand that was not injected with *B.simplex*.
- A significant amount of calcium carbonate material was observed at the end of the 15 days after *B.simplex* injected sand.
- When microscopic examination of the *B.simplex* on the injected ground was carried out, it was determined that these calcium carbonate formations were spread to the ground at considerable rates.
- 1.44% calcium carbonate amount was found on sandy soil. When the *B.simplex* injected to sandy soil, it was seen that this rate increased to 33.72%.
- It was observed that the frictional angle increased from 38.30 to 42.9 degrees, when the *B.simplex* injected to sandy soils and the amount of cohesion (from 1.0542 kN/m^2 to 3.6140 kN/m^2) to on the sandy soil increased with the injection of *B.simplex*.
- As a result of this study, it was observed that the engineering properties of the sandy soils could be improved by injecting *B.simplex* into the soil.

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