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EXTENDED ABSTRACT

Investigation of the Effects of Freeze-Thaw Cycles on the Deformation Parameters of Biologically Stabilized Sand

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1. Introduction

In designing a geotechnical structure, two factors of resistance and deformation should be considered, so in this study, the effects of melting and freezing cycles on the deformation parameters of biologically stabilized sand are evaluated and various factors such as all-round pressure, number Melting and freezing cycles Temperature changes in each cycle and the duration of each cycle are evaluated. For this purpose, non-drained reinforced static triaxial tests are performed and the deviation-axis-strain stress curves, chord stiffness (Esec), tangential stiffness (Etan), stiffness equal to 50% of maximum resistance (E_{50}) and absorbed energy (EA) are performed). Is evaluated. The Taguchi method is used to design experiments and provide a relationship to predict some deformation parameters. The results of this study show that the application of melting and freezing cycles reduces the deformation parameters of stabilized samples. The destructive effect of melting and freezing cycles on hardness is greater than the absorbed energy.

2. Methodology

2.1. Experimental study

To investigate the effects of the mentioned factors on the specimen stabilized by the MICP method. For this purpose, consolidated-undrained triaxial tests were performed. According to the number of factors considered in this research, the Taguchi method and Minitab software were used to design experiments. In this research, four variables at three levels are incorporated. Considering the conducted research works, the following values are selected for the mentioned factors:

- Confining pressure: 25, 50, and 100kPa
- Temperature variation in the freeze-thaw cycles: -7°C to 7°C, -10°C to 10°C (2018) and -18°C to 23°C, -23°C to 23°C (2016).
- Duration of the freeze-thaw cycle: 3, 6, 12, and 24 hours (2018)
- Number of the freeze-thaw cycles: 5 (2018), 3, 7, 10 (2016) and 15 (2018)

3. Results and discussion

As can be seen at Fig. (1-a), an increase in CP leads to an increase in the strength of MCPI specimens subjected to FT cycles. An increase in CP increases the effective stress, increasing the specimens' shear strength.

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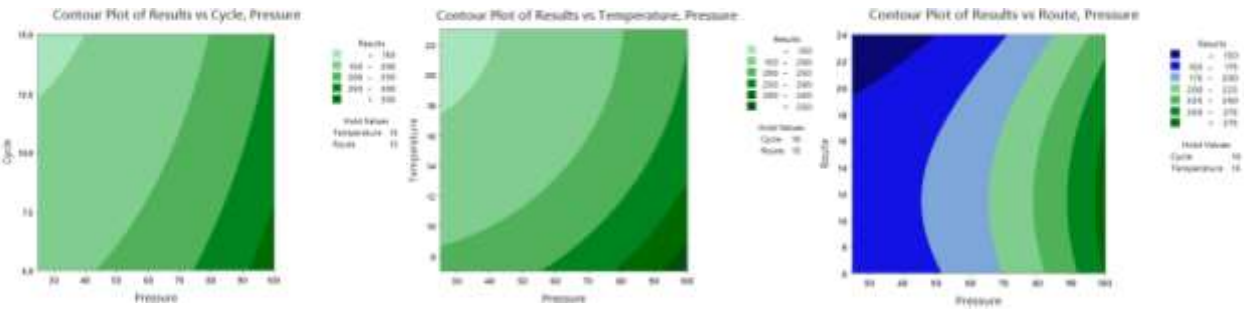
(1-b) shows that a decrease in the FT cycles' temperature causes reduced strength of the specimens. There is a surface tension force between the soil and water particles. (1-C) shows the effect of changes in maximum deviatoric strength in terms of confining pressure and the duration of freeze-thaw cycles in the form of two-dimensional contours.This figure shows that increasing the time of FT cycles decreases the deviatoric strength.



(a) (b) (c)

Fig. 1. (a) Changes in the maximum deviatoric strength according to the confining pressure and the number of freeze-thaw cycles, (b) Changes in deviatoric strength in terms of confining pressure and temperature of freeze-thaw cycles, (c) Maximum changes in deviatoric strength according to confining pressure and temperature of freeze-thaw cycles

3.2. Prediction of the strength

Equation (1) is presented for prediction of the strength. In this Equation, CP (confining pressure) is in kPa, NC denotes the FT cycle number, HT denotes the high temperature in centigrade, LT denotes the low temperature in centigrade, D denotes the time of each cycle in hours, and q denotes the deviatoric strength in kPa.

$$q=308.111+1.73714CP-3.9666NC+21.555LT+9.777HT-1.5476D \tag{1}$$

4. Conclusions

The summarized results of these studies show that A decrease in the FT cycle temperature reduces the strength of stabilized specimens, as predicted by the Taguchi method, the ideal temperature range (-7.7) for MICP method is suitable, and at a lower temperature than this range, the deviatoric strength drop abruptly increases. As predicted by Taguchi, the confinement pressure is 100kPa, the freeze-thaw cycles are 5 and the temperature (-7.7) are present in these cycles for an average of 12 hours. To test the deviatoric strength, a sample with these conditions yielded 393kPa, and the maximum value was determined to be approximately 386 kPa.

5. References

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