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Improve Collapsible soil by polymer material

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Abstract

Collapsible soils are among the problematic soils in nature that due to wetting, make many settlements so that according to research, the amount of settling can reach 1 to 2% of the thickness of the soil layer. If this type of soil is not identified, if structures are built on them, the constructed structure will be damaged if the soil saturates and changes in soil moisture. The existence of such soils in many parts of the world including Kerman province of Iran, necessitates the attention to study the behavior and characteristics of the collapsible soils. The aim of this contribution is to investigate the effect of butadiene rubber on the stabilization of collapsible soils. The tested fine-grained soils that have been sampled from two different sites were stabilized through injecting different percentages of butadiene (the number of experiments was 84). The ASTM D5333 Double-Consolidation Method, was applied in order to examine the stabilized soils on intact soil samples. The results show that the penetrations of butadiene rubber as well as the formation of butadiene rubber columns have led to reduction in soil collapse. Considering development of intelligent systems using prediction behavior of stabilized collapsible soils, the ANFIS model was used to predict degree of collapsibility of soil samples stabilized by injection Styrene Butadiene Rubber.

Keywords: *Collapsible soil stabilization, Styrene-Butadiene rubber, Fuzzy inference system*

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Extended Abstract:

1. Introduction

Constructions are done either inside or on the ground. But not all soils are suitable for construction for example the collapsible soils that are sensitive to moisture. The important thing about these soils is the changes made in their properties because after wetting, their structure tend to unstable conditions. Collapsing soils are included in this group. By using a special polymer in rammed sand, Zimbardo (Zimbardo et al,2020) reduced the rammed sand. Silveria (Silveria et al, 2020) Compacted collapsible soil; their results show a little decrease in the degree of collapsing. Abbeche (Abbeche et al 2010) investigated the soil compaction behaviour by injecting grout (water, cement, sand) and the results of the investigation show that the injected grout has improved the properties of the compacted soil. The investigations have been done by Fattah (Fattah et al 2013) show an improve in the properties of collapsing soil by injecting the grout.

2. Materials and methods:

The soil used was obtained from two different sites in Kerman city. The samples were taken intact from the depths of 4 to 6 meters.The investigated soils are classified as ML and CH. In this study, Sterile Butadiene Rubber is used as a soil improver. The previous researches show that using this chemical has increased the shear strength and reduced the liquid limit of the soil. These factors are the main reasons for selecting this polymer material. The soil properties have been investigated after injecting this substance into the soil in 2, 3, 4, 5, 6, and 7 percents, during 4, 7, 14, and 28 days. The RCP coefficient has been used for measuring the amount of reduction in collapse. In addition, after taking the SEM photos, it was percieved that the presence of SBR has reduced the porosity in the soil.

With the increase of the additive, the collapsibility property decreases. Also, with the increase in the duration, a further decrease in collapsible soil has been observed. The use of ANFIS shows that there is a good agreement between the experimental data and the predicted data.

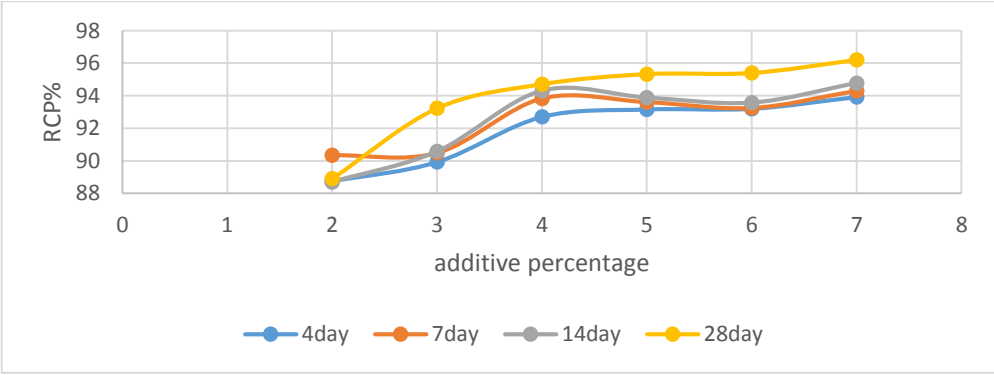

Figure.1 Reduction of Collapsible index by changing the duration and percentage of soil additive type 1 (two-dimensional).

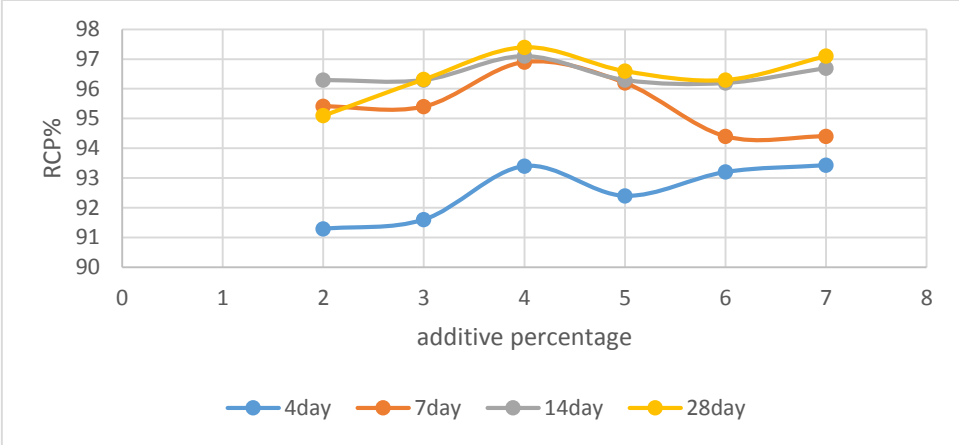

Figure.2 Reduction of Collapsible index by changing the duration and percentage of soil additive type 2 (two-dimensional).

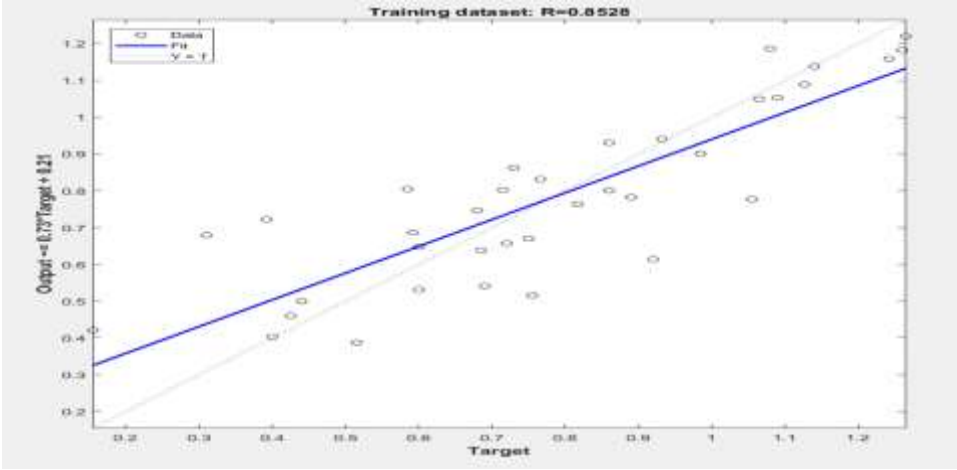

Figure.3 ANFIS results versus laboratory values corresponding to experimental data

Conclusion

A study was carried out on collapsible soil samples to investigate the effects of changes in the percentage of additives during different periods of time on soil compaction characteristics. Based on the results, the following conclusions can be drawn:

After examining the soil stabilized by butadiene in the central region of Iran, Kerman, it was found that after injecting at least 2% of the substance,there is a decrease of 88% in the amount of creep during at least 4 days. In the period of 28 days, it has shown the greatest amount of reduction in the yield. The ANFIS program also shows a good match between the training data and the prediction

data ($R=0.85$,$R^2=0.99$). By increasing the additive and increasing the processing time, the properties of the soil experience more serious changes, which leads to a decrease in collapsible soil.

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