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EXTENDED ABSTRACT

The Effect of Lime and Nanosilica Stabilization Process on Compressive Strength and Slake of Marly Soils in Saturated State

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1. Introduction

Marly soils have a relatively good resistance in the dry state, but these characteristics tend to significant degradation in contact with water (Ouhadi & Yong, 2003, Hosseini et al. 2012). The Failure to identify the behavior of clayey fine-grained soils, and especially marls, can challenge the structures constructed on such soils. Because of the extent and distribution of this type of soil in many regions of Iran, especially in southern Iran, and the high potential for the construction of hydraulic structures in these areas, it is necessary to study the behavior of these soils. Accordingly, the purpose of this study is to investigate the geotechnical characteristics of marl soils and provide a solution for improving the engineering properties of these soils.

2. Methodology

In order to achieve the objectives of this research, the effect of adding lime and adding lime and nanosilica on soil geotechnical properties (such as Atterberg limits, compressive strength) with regard to the time of curing of the marl has been investigated.

In order to determine the percentage of lime and nano-SiO_2 required for soil stabilization, physical and mechanical experiments were conducted in various amounts of lime and nano-SiO_2. First, the pH of soil and lime were measured separately using pH meter (Istek-Ecomet) in 1:4 soil-to-water ratio (4 gr soil and 40 ml distilled water) and then different percentages of lime (2, 4, 6, 8 and 10 % of dry soil weight) and various percentages of nano-SiO2 (0.5, 0.7, 1 and 2 % of dry soil weight) were added to the soil.

Also, in order to further evaluate the effects of additives on soil properties, sediment and slake tests have been carried out

X-Ray Diffractometer (D8-ADVANCE) with Cu-Kα radiation was applied to achieve the x-ray diffraction pattern of the Marl sample. Fig. 1. shows the x-ray diffraction diagram for the studied marl sample. Results of XRD analysis conducted on natural soil indicated palygorskite, kaolinite and sepiolite as main clayey minerals and quartz, feldspath and calcite as non-clayey minerals in the marl soil.

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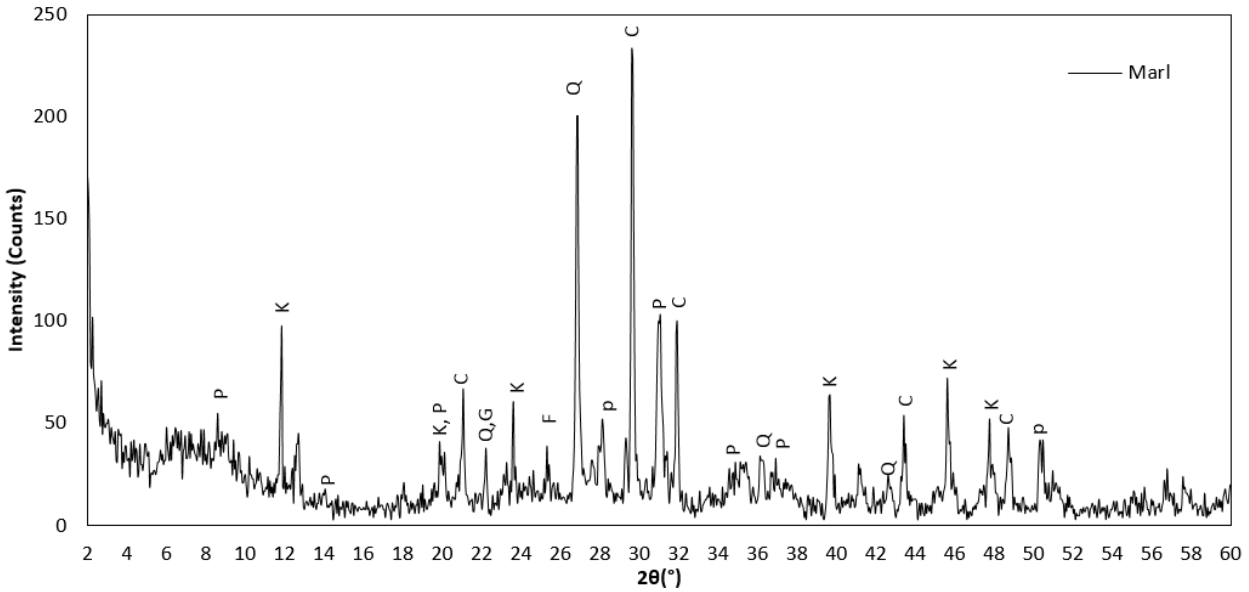

Fig. 1. XRD pattern of Marl soil sample: P) Palygorskite, K) Kaolinite, C) Calcite, Q) Quartz, G) Gypse, F) Feldspath

3. Results and discussion

pH is one of the common criteria for evaluating lime content as a stabilizer agent. In fact, the minimum amount of lime that causes cationic exchange in the soil can be identified based on changes in the pH of the reaction medium. This amount of the stabilizer agent (lime) changes soil properties significantly (Ouhadi et. al. 2014; Al-Mukhtar et. al. 2010) Based on the results obtained from LL, PL, PI tests, unconfined compressive strength, sediment and slake tests, the process of soil specifications changing can be investigated in the presence of different percentages of stabilizer materials (lime and nano-SiO_2).

stabilization of the studied marl soil with lime and nano-SiO_2 increases soil resistance. The results for the unconfined compressive strength of the samples modified with lime and nano-SiO_2 after 28 days of treatment are represented in Fig. 2. The compressive strength had an increasing trend with an increasing amount of lime-nano-SiO_2 which can be due to the chemical interaction of lime and nano-SiO_2 particles. Then, the complete consumption of lime by nano-SiO_2 improved the bond between particles and eventually enhanced the unconfined compressive strength of samples.

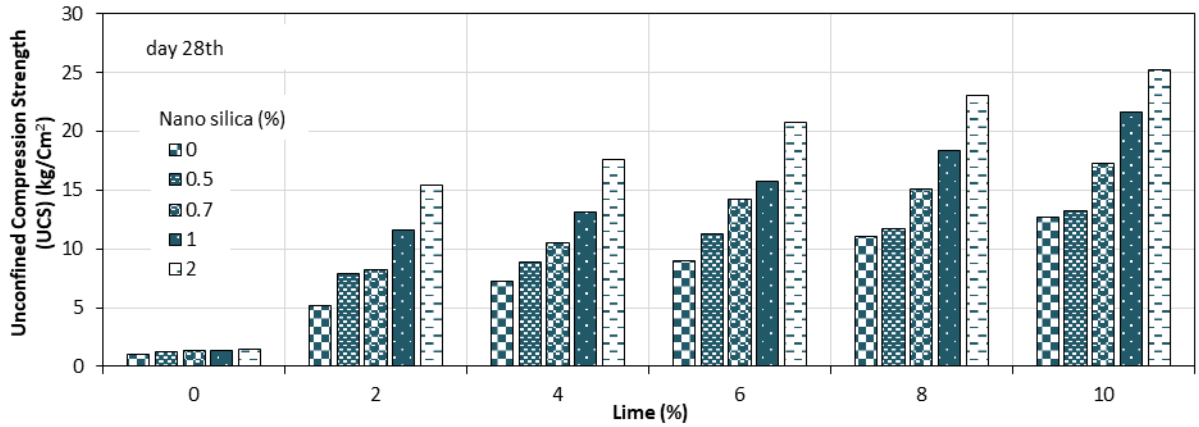

Fig. 2. Trend of changes of the unconfined compressive strength (UCS) for samples stabilized with lime and nano-SiO_2 (28-days treatment)

4. Conclusions

The results show that the Sedimentation rate of Stabilized marl with 6% lime and 0.7% nanosilica is about 60% compared to non-additive soil. The results obtained from the Atterberg Limit test showed a decrease in

the plastic index of the marl with an increase in lime and nanosilica values; also, the results of unconfined compressive strength tests showed that 6% lime with 0.7% nanosilica in the 28-day curing increased the compressive strength of soil by 92.67%. Based on the results, with increasing the treatment time, lime participation in pozzolanic reactions was increased, also, the results obtained from the Atterberg limits test showed a diminution in the paste limit of the marl sample with increasing lime and nano-SiO2 values.

5. References

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