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Effect of Thermal Stabilization of Soil, Bentonite, Calcium Carbonate and Fibers on Behavior Properties of Clay Soil

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ABSTRACT

Various factors, including the thermal stabilization and the presence of chemicals such as bentonite for the protection of nuclear waste lead to the exposure of clay soil to the heat. Besides, the presence of large amounts of carbonate as one of the main components of clay soils, especially in the arid and semi-arid regions, and its effect on the soil engineering properties emphasize the necessity to study the combined effect of heat and carbonate on the engineering behavior of clay soils. Accordingly, the present paper studies the interaction of clay-bentonite, clay-lime, and clay-fiber at high temperatures and its effect on the properties of clay soils. In this regard, a series of macro-structural experiments are conducted. The different thermal levels considered in the present study, according to the previous research, are 0 to 900. The soil behavior is investigated using numerical and laboratory methods. The experiments conducted in this area include the weight changes and the unconfined compressive strength of the soil. The effect of using the bentonite and fiber on the strength indicates that at a given temperature, increasing the percentage of bentonite leads to increased strength. In addition, the rate of increase is different at different temperatures, so that the highest increase occurs for the addition of 30% bentonite to the soil, reaching the unconfined compressive strength to 1.88 times the control sample. However, adding 0.5% fiber and 4% lime shows the maximum strength.

Keywords: Thermal stabilization, Clay soil, Bentonite, Behavior properties, calcium carbonate.

1. INTRODUCTION

Soil stabilization is considered part of the road construction process, which is usually performed by two physical and chemical methods. In the chemical stabilization, the chemicals are added to the soil. The successful implementation of the soil chemical stabilization requires finding the appropriate chemical with the optimal dosage, studying the proper mixing method, proper treatment, and studying the chemical conditions of the soil [1]. However, the thermal methods (heating, cooling) used for the absorption of soil contaminants including industrial materials such as nuclear waste, oil and industrial materials have long been studied to improve the soil strength properties [2]. The presence of industrial materials in the nature as the environmental pollutants and the added nuclear waste poses a serious threat to human health, and removing such materials from the environment has been studied in different research [3]. O'Brien (2018) studied the restoration behavior and the physical properties of soil using the thermal stabilization. It was noted in this research that the environmental pollutants can be reduced by the soil thermal stabilization to help improve the soil strength [4]. Tzovolou (2011) suggested cleaning the contaminated environment in Nepal using the chemical injection method, which reduced the environmental pollution. It was noted that the application of steam injection method in the low-permeability saturated soils has been rarely investigated, and it was used for the