



Laboratory modeling of the free swelling and swelling pressure curves for high plasticity clays stabilized with chemical additives

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Abstract

This paper presents the results of an experimental program developed to assess the effect of an ionic stabilizer branded as CBRPlus/CON-AID on the swelling potential of an expansive soil collected from a forest road in the northern region of Iran. A series of swelling tests consisting of free swelling and swelling pressure were conducted on natural and stabilized soil specimens in an Oedometer apparatus. Results indicated that the use of various concentrations of the ionic stabilizer (0.0096%, 0.03%, 0.05%, 0.07% and 0.09%) caused a considerable reduction in the swelling properties consisting of final free swell (S_f) and swelling pressure (P_s). Furthermore free swelling (FSC) and swelling pressure (SPC) curves for natural and stabilized soil were modeled as a function of the ionic stabilizer concentration and its corresponding maximum dry unit weight using multivariable regression models. In addition a simplified sensitivity analysis was adopted to investigate the effect of the ionic stabilizer concentration and its corresponding maximum dry unit weight on the final free swell and swelling pressure values of natural and stabilized soil specimens.

Keywords: Free swelling, swelling pressure, ionic stabilizer, multivariable regression, sensitivity analysis

1. INTRODUCTION

Swelling of expansive soils is caused by wetting and water content change. The large volume change upon wetting causes severe damage to overlying structures, particularly light buildings and pavements (Estabragh *et al.* [1]). Soil stabilization is the process by which a stabilizer agent is added to natural soil to improve engineering properties such as swelling. Many techniques have been proposed by several researchers to eliminate or reduce the effect of swelling. These techniques are generally divided into chemical and mechanical techniques. Chemical stabilization methods can be divided into two categories based on the use traditional or non-traditional agents. Traditional agents such as cement, lime and fly ash are commonly used in construction practices; however non-traditional agents such as polymers, resins and Enzymes have been mainly used in scientific and research work.

Many researchers such as Al-Rawas *et al.* [2], Sezer *et al.* [3], Dash and Hussain [4] and Estabragh *et al.* [1] have stated that the use of traditional agents (cement, lime and fly ash) can effectively reduce the swelling potential of expansive soils. Other researchers such as Savage [5], Aydin *et al.* [6], Shrisavkar and Koranne [7] and Estabragh *et al.* [8] concluded that the use of chemical additive such as ionic stabilizers, polymers and resins have a significant effect in reducing the swelling potential of expansive clays.

The literature review shows that there has been limited research in regard to the use of non-traditional stabilizers such as CBRPlus (an ionic stabilizer) in reducing swelling potential of expansive soils. Therefore the aim of this research was to investigate the effect of CBRPlus with various concentrations on the swelling behavior of an expansive clay. In addition a simplified regression analysis was adopted to model and investigate the effect of various concentrations of CBRPlus and its corresponding maximum dry unit weight on the free swelling and swelling pressure curves.