Abstract

Expansive soil covers a big portion of the world's land area. It is one of the main contributors to cracks in structures such as buildings, roads, and pavements among others. Soil stabilization is aimed at reducing plasticity, shrinkage/swelling potential, and increasing their overall strength and durability. The most common method of soil, results in chemical stabilization, which involves the addition of chemical additives to the soil, resulting in a chemical reaction. Ordinary Portland Cement (OPC) has been the most widely used additive in the stabilization of expensive soils. However, it is expensive for low-income earners, especially in developing countries. In addition, its production contributes 5-8% of the global man–made CO2 emission. Limestone Calcined Clay Cement (LC3) is a blended cement made by substituting 45% of the clinker in OPC with calcined clay and limestone. It has been successfully used in concretes but its use in expensive soil stabilization has not been studied. LC3 works in a similar reaction mechanism as OPC, making it a suitable replacement for OPC. The expected potential benefit of using LC3 is that it would lower the overall cost of construction and an overall reduction in CO2 emissions. The present study was, therefore, aimed at investigating the effect of using LC3 in the stabilization of expensive clay soil. Expansive clay soil samples were obtained from Nchiru, in Meru County. To make the clay soil suitable for cement stabilization, it was mixed with quarry dust obtained from Kaguma quarry, in Meru County. The clay–quarry dust mixture was separately mixed with OPC and LC3 in proportions of % to 5%. The effect of these dosages on the performance of the expansive soil was determined by changes in Atterberg limits, Maximum Dry Density (MDD), Optimum Moisture Content (OMC), and California Bearing Ration (CBR). From XRD analysis, there was the formation of CSH which is responsible for the stabilization in both LC3 and OPC. In LC3 stabilized soil, there was also the formation of hemi-carbo aluminate which enhances strength development in the stabilized soil. Results indicate that clay soil mixed with 40% quarry dust and treated with 5% LC3 dosage gave the best outcome. The Plasticity Index (PI) and Linear Shrinkage (LS) decreased by 48.9% and 50% respectively when treated with 5% of LC3 , while the CBR increased from 8% to 155% for the same LC3 dosage. When the soil was treated with 5% OPC, the PI and LS decreased by 51.1% and 56.1% while CBR increased from 8% to 164%. It can be concluded that the use of LC3 in the stabilization of expensive soils has huge potential to bring down the cost of construction and increase CO2 savings as its performance is comparable to OPC in terms of reduction in plasticity and strength improvement.