Concrete is the most utilized construction material globally. 10-15% of the components in concrete are cement. This means that a lot of cement is needed in concrete construction. In Kenya, Ordinary Portland Cement (OPC) and Portland Pozzolana Cement (PPC) are the most utilized cement. The cost of this cement is considered unaffordable due to the high clinker fraction, its cost, and the energy needed in the manufacturing process. The high cost of cement in Kenya is partly attributed to high tariff charges during the importation of clinker. Besides the high cost of clinker, its production involves emissions of CO2 accounting for about 6-8% of the global anthropogenic CO2. The solution to reduce the cost of cement and CO2 emissions lies within the chemistry of cement. Utilization of pozzolanic material such as limestone and calcined clays has been proposed as a good substitute for a substantial portion of clinker to produce LC3 blended type of cement. One of the ways to lower the cost of cement is by utilizing calcined clays and low-grade limestone which are locally available in the production of cement. LC^3 is an eco-friendly cement technology that has the potential to reduce the CO_2 emitted to the atmosphere by several hundred millions of tones. It also saves on the cost of production due to lower energy required. In the present study, calcined clays and Kunkur fines the by-products of Kunkur rock used in the clinker production were used to replace limestone in LC^3. Its effect on the performance of LC^3 was investigated. X-Ray Fluorescence (XRF) technique was used to determine the chemical composition of clay, Kunkur fines and limestone and their suitability in LC^3. Cement paste and mortar prisms with a mix proportion range of clinker 40-55%, calcined clay 25-40% and kunkur fine 15-25% were cast and cured in water and their compressive strength determined after 2, 7 and 28 days. Mineralogical characteristics of the hydration products were determined using X-ray Diffraction (XRD). Microstructural characteristics of hydration products were studied using Scanning Electron Microscopy coupled with energy-dispersive X-ray(SEM-EDX). The hydration kinetics were studied using a semi-adiabatic calorimeter. Gibb's Energy Minimization Software (GEMS) was also used to predict the hydration phases. Clays and Kunkur fines were found to contain kaolinite content. The major content in kunkur fines was determined to be calcite at 68% of the total content. XRD and SEM results showed the presence of hydration products, C_3S, C_2S C_3A, and C4AF up to 28 days. The semi-adiabatic calorimeter results indicated reduced hydration phases for cement blends containing kunkur fines when compared to OPC. On the other hand, GEMS results indicated that the kunkur fines were reactive because of a pozzolanic reaction between the calcite content and alumina present in calcined clay. Cement blends with the composition of clinker and kunkur fines at 41 and 16%, 42 and 26%, and 45 and 18% respectively were observed to have compressive strength in descending order with 41 and 16% having the highest strength. However, a 30% decrease in strength for LC^3 blend containing kunkur fines compared to OPC. In conclusion, incorporation of kunkur fines at 15% and calcined clays at 45% in the LC^3 system was observed to show highest compressive strength performance comparable to commercial OPC. Durability properties is recommended to be undertaken to determine the suitability of these material in construction.