

Abstract

In this research report, special High Density-Shielding Concrete (HDSC) was developed. The objective of this research was to investigate, design and test HDSC to be used to construct the newly upgraded South African Neutron Radiography (SANRAD) facility situated at the South African Nuclear Energy Corporation (NECSA).

To understand the concept of radiation shielding in detail, a literature review on several aspects surrounding radiation shielding and interaction of radioactive energies and matter was conducted. This involved aspects such as the types of radiation, theory of radiation shielding, different materials used for radiation shielding and several other topics. Based on the compiled literature and the availability of materials that could be used, concrete was selected as the best shielding material and further undertakings were carried out to develop a specific mixture that would shield the radioactive energies. The main contributing factors in the decision making with regard to the use of concrete were the already existing knowledge and technology, the local availability of most high density concrete aggregates needed, the versatility and composite nature of the material, the economic benefits of using the material, low maintenance and ease of manufacture, and the structural integrity of the material.

The final mixture produced in this research was workable and cohesive with average 28- day compressive cube strength of 29.9 MPa, water to cement ratio of 0.51 and density of 4231 kg/m³. The concrete was made to be of high slump with a height and spread of 230 mm and 510 mm respectively. The final mixture was composed of CEM I 52.5 N, silica fume, water, hematite sand, hematite stone, steel shot, colemanite and chemical admixtures.