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Investigations on Utilization of Chrome Sludge, Chemical Industry Waste, in Cement Manufacturing and Its Effect on Clinker Mineralogy

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Abstract : The utilization of industrial waste materials and by-products in the cement industry helps in the conservation of natural resources besides avoiding the problems arising due to waste dumping. The use of non-carbonated materials as raw mix components in clinker manufacturing is identified as one of the key areas to reduce Green House Gas (GHG) emissions. Chrome sludge is a waste material generated from the manufacturing process of sodium dichromate. This paper aims to present studies on the use of chrome sludge in clinker manufacturing, its impact on the development of clinker mineral phases and on the cement properties. Chrome sludge was found to contain substantial amounts of CaO, Fe2O3 and Al2O3 and therefore was used to replace some conventional sources of alumina and iron in the raw mix. Different mixes were prepared by varying the chrome sludge content from 0 to 5 % and the mixes were evaluated for burnability. Laboratory prepared clinker samples were evaluated for qualitative and quantitative mineralogy using X-ray Diffraction Studies (XRD). Optical microscopy was employed to study the distribution of clinker phases, their granulometry and mineralogy. Since chrome sludge also contains considerable amounts of chromium, studies were conducted on the leachability of heavy elements in the chrome sludge as well as in the resultant cement samples. Estimation of heavy elements, including chromium was carried out using ICP-OES. Further, the state of chromium valence, Cr (III) & Cr (VI), was studied using conventional chemical analysis methods coupled with UV-VIS spectroscopy. Assimilation of chromium in the clinker phases was investigated using SEM-EDXA studies. Bulk cement was prepared from the clinker to study the effect of chromium sludge on the cement properties such as setting time, soundness, strength development against the control cement. Studies indicated that chrome sludge can be successfully utilized and its content needs to be optimized based on raw material characteristics.

Keywords : chrome sludge, leaching, mineralogy, non-carbonate materials
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