

Influence of Pine Wood Ash as Pozzolanic Material on Compressive Strength of a Concrete

Authors : M. I. Nicolas, J. C. Cruz, Ysmael Verde, A.Yeladaqui-Tello

Abstract : The manufacture of Portland cement has revolutionized the construction industry since the nineteenth century; however, the high cost and large amount of energy required on its manufacturing encouraged, from the seventies, the search of alternative materials to replace it partially or completely. Among the materials studied to replace the cement are the ashes. In the city of Chetumal, south of the Yucatan Peninsula in Mexico, there are no natural sources of pozzolanic ash. In the present study, the cementitious properties of artificial ash resulting from the combustion of waste pine wood were analyzed. The ash obtained was sieved through the screen and No.200 a fraction was analyzed using the technique of X-ray diffraction; with the aim of identifying the crystalline phases and particle sizes of pozzolanic material by the Debye-Scherrer equation. From the characterization of materials, mixtures for a concrete of $f'c = 250 \text{ kg / cm}^2$ were designed with the method ACI 211.1; for the pattern mixture and for partial replacements of Portland cement by 5%, 10% and 12% pine wood ash mixture. Simple resistance to axial compression of specimens prepared with each concrete mixture, at 3, 14 and 28 days of curing was evaluated. Pozzolanic activity was observed in the ash obtained, checking the presence of crystalline silica (SiO_2 of 40.24 nm) and alumina (Al_2O_3 of 35.08 nm). At 28 days of curing, the specimens prepared with a 5% ash, reached a compression resistance 63% higher than design; for specimens with 10% ash, was 45%; and for specimens with 12% ash, only 36%. Compared to Pattern mixture, which after 28 days showed a $f'c = 423.13 \text{ kg/cm}^2$, the specimens reached only 97%, 86% and 82% of the compression resistance, for mixtures containing 5%, 10% ash and 12% respectively. The pozzolanic activity of pine wood ash influences the compression resistance, which indicates that it can replace up to 12% of Portland cement by ash without compromising its design strength, however, there is a decrease in strength compared to the pattern concrete.

Keywords : concrete, pine wood ash, pozzolanic activity, X-ray

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