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Civil Engineering 2016 : General overview of the effect of FA-CD composite on concrete behavior - Ikotun B D - University of South Africa

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This study looked into the possibility of increasing the utilisation of fly ash (FA) in concrete technology. FA, being an industrial waste that is in abundance in South Africa and a source of environmental pollution, is presently being used minimally in the construction industry. The study on its interaction with cyclodextrin (an enzymatic modification of starch) for possible increased usage in concrete operations was done. Different South African fly ashes were characterised and their compatibility with cyclodextrin to form a useful composite was studied by XRD, SEM and FT-IR. Composite samples were synthesized following 2 different procedures. Since, these are novel composites, indicative tests were performed on strength (compressive and split tensile) and durability (oxygen permeability, sorptivity and porosity) on mortar/concrete made with FA (30% of cement by mass) and fly ash-β-cyclodextrin (FA- β-CD) composite, that further guided the research. Based on the indicative test results, a possible optimum composite synthesis method and percentages of β-cyclodextrin (β-CD) in the mixtures were identified. These optimal parameters were used to study the effect of FA, β-CD and (FA-β-CD) composite on cement paste hydration (XRD, SEM and FT-IR), rheology (viscosity and setting time), concrete strength (compressive and split tensile) and concrete durability (oxygen permeability, sorptivity, porosity and chloride conductivity). In general, concrete's hydration products were modified with FA–cyclodextrin composite, which boosted the performance of FA in concrete. The composite improved FA concrete's early compressive strength, permeability, sorptivity, porosity and chloride conductivity.

Recently, colossal amounts of FA were found on the world. Manz (1980) announced that the assessed creation of coal debris was 278.443 Mt (million tons) in 1977, of which around 14% was utilized. Manz (1993) revealed that the evaluated creation of coal debris in 1989 was roughly 562 Mt, of which around 16.1% was utilized, while the rest was arranged in landfills. As indicated by the yearly overview results distributed by American Coal Ash Association, for the year 2009, around 63 million tons of FA was delivered, roughly 25 million tons from them were utilized in different applications, while around 10 million tons of them were utilized in concrete and concrete items, and roughly 2.5 million tons were utilized in mixed concretes and crude feed for clinker. Ahmaruzzaman (2010) revealed that the yearly creation of coal debris overall was evaluated around 600 million tons, with FA establishing roughly 500 million tons at 75–80% of all out debris delivered. Bakharev (2005) revealed that around one billion tons of FA was delivered yearly worldwide in coal-terminated steam power plants. Just a little piece of this debris is utilized (20–30%); the rest is land filled-and surface-seized, with likely dangers of air contamination and defilement of water because of draining (Femández-Jiménez and Palomo, 2005). Because of the fast financial turn of events and the development on the planet creation utilization of vitality over the world, FA has essentially expanded. In this manner, FA ought not exclusively be discarded securely to forestall natural contamination, yet ought to be treated as an important asset. Rather than dumping it as a waste material, FA can be utilized in concrete (Mehta, 1993, Erdoğan, 1997) to diminish the ecological issues of intensity plants, to diminish electric costs other than lessening the measure of strong waste, ozone depleting substance outflow related with Portland clinker creation and to monitor existing common assets, monetary grounds as pozzolan for a halfway substitution of concrete due to its useful impacts of lower water request (Ravina and Mehta, 1986) for comparable usefulness, enhancements in quality (Dunstan, 1986, Bijen and venSelst, 1993, Lam et al., 1998, Rashad et al., 2009 drying shrinkage (Haque et al., 1984, Hansen and Reinhardt, 1991, Nanni et al., 1996, Delagrave et al., 1997, Pittman and Ragan, 1998), imperviousness to fire (Seleem et al., 2011) and lower development of warmth. In spite of the fact that FA is an important mineral admixture for mixed PC and concrete, just about 6% of the all out accessible FA is utilized for this reason (Malhotra and Mehta, 2002). Thus, the strategy to supplant concrete with a high volume of FA has produced significant intrigue.

HVFA is a way to deal with augment the FA contribution to concrete. Notwithstanding, HVFA concrete has been not a bound together definition but at

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this point. Sivasundaram et al., 1990 accepted that supplanting concrete proportion above 30% with FA in concrete is characterized as HVFA concrete. Be that as it may, 40% is characterized as far as possible in many state principles or guidelines, the amount of FA in concrete doesn't surpass 40% specified by and large. In this way, Dunstan et al., 1992 accepted that above 40% FA in concrete characterized as HVFA concrete is appropriate. A few analysts proposed that the concrete might be characterized as HVFA concrete when the amount of FA surpasses that of concrete in cementitious material (for example the amount of FA is over half). Bilodeau and Malhotra (1992) proposed that the amount of FA in HVFA concrete must be 50–70%, in particular the volume of FA is bigger than concrete in concrete. LEED (PCA, 2005) pointed that HVFA concrete included up to 40% of FA in concrete or in concrete. HVFA concrete for structure applications was created by the Canadian Center for Mineral and Energy Technology (CANMET) in 1985 (Carett et al., 1993, Mok, 1996). This kind of concrete has ordinarily over half (Langley et al., 1989, Mehta and Monteiro, 2006) FA in the all outcementitious material. The U.S. Maritime Facilities Engineering Command (NAVFAC) has as of late created HVFA concrete plan, of which half of PC is supplanted with FA, by mass (Burke, 2012).The incorporation of HVFA in the framework positively affects a few properties and a negative impact on different properties. To be sure, there is no article which sums up the past investigations completed on the new properties, solidified properties and toughness of glue/mortar/concrete containing high volume Class F FA (⩾45%) as concrete substitution by weight or by volume which can serve the market. Hence, this article was composed to introduce the past discoveries identified with this theme, to gather these discoveries in a single paper which can be treated as a source of perspective base for future investigates.

Biography :

Ikotun B D is working as a Researcher and Senior Lecturer in Civil Engineering Department at University of South Africa. She completed her DIng (waiting graduation), MSc (Eng) and BEng degrees in Civil Engineering from the University of Johannesburg, University of the Witwatersrand, South Africa and The Federal University of Technology Akure, Nigeria respectively. Her research interests are in concrete mix design, concrete structural and durability properties testing, chemical deterioration of concrete, mechanical testing of concrete, concrete quality optimization techniques and investigation of extenders as they affect mortar and concrete properties. She has authored and co-authored articles in peer-reviewed conference proceedings and reputable journals. She has served as a reviewer for reputable journals and presently supervising Post-graduate students.

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