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IIT (ISM), Dhanbad Research on “Development of Cement Free Concrete using GGBS and Fly Ash for Civil Infrastructures”

Intended at minimizing the usage of natural resources and also for decreasing the usage of huge energy required in production of Ordinary Portland Cement (OPC) or common cement, researchers of IIT (ISM), Dhanbad led by Dr. Satadru Das Adhikary, Assistant Professor of Civil Engineering Department and assisted by Mr. Debjit Mitra Roy, a research scholar developed a cement-free concrete (CFC) using industrial wastes such as Fly Ash and Ground Granulated Blast Furnace Slag (GGBS).

OPC of common cement is generally utilized as a primary binder material for developing concrete around the world and it is well known that the generation of OPC not only adversely affects the environment but also depletes the natural resources. Thus, researchers and scientists are continuously exploring alternative binder materials by using industrial by-products to develop sustainable concrete. These by-products include GGBS obtained from the iron and steel plants and Fly Ash that is obtained from coal-based thermal power plants which were effectively used in the presence of liquid alkali activator solution (AAS) to develop cement-free-concrete (CFC).

Describing the process of development of binder material as part of three year research worth Rs 23.6 lakh which is still continuing from September 2019, Adhikary said "A mixture containing 50% of GGBS, 50% of Fly Ash, AAS to binder ratio of 0.45-0.55, 7 M (Molar) solution of Sodium Hydroxide (SH), ratio of sodium silicate (SS) to (Sodium Hydroxide) SH of 1.5-2.0 along with 3-6 hours of time interval between AAS preparation and concrete casting were proposed as an optimum design mix. The optimum mix design would satisfy the desired compressive strength, workability and setting time criteria.

To characterize the material properties, various fresh and hardened mechanical properties (e.g., workability, compressive strength, split-tensile strength and flexural strength) of CFC were exhaustively explored and compared with national and international codes/standards. Furthermore, XRF (XRay Fluorescence-a non destructive analytical technique used to determine the elemental composition of materials), XRD (X Ray Diffraction that allows to ascertain the molecular structure) and FESEM (Field Emission Scanning Electron Microscope -Utilized for Characterisation of Micro Structures) were conducted to investigate the microstructural properties and the reaction mechanism of the developed CFC. It is envisaged that the developed CFC will be very useful for construction of large-scale sustainable civil infrastructures in near future, keeping in mind the latest climate change scenario.

Finally, Dr. Adhikary mentioned that this work is supported by research funding worth Rs 23.6 lakh by the Phase IIT of (Technical Education Quality Improvement Programme) TEQIP-III and TATA STEEL LIMITED which is gratefully acknowledged. This research is already published in Q1 journal (Web of Science) from Science Direct publisher. For details about this research work, please refer to the following link:

<https://www.sciencedirect.com/science/article/pii/S0272884222019411>

Photo Caption

1. Typical manufacturing process of the developed CFC shown in Fig. below
2. Dr Satadru Das Adhikary- Assistant Professor-Department of Civil Engineering, IIT (ISM) Dhanbad