ABSTRACT

Fly ash based Geopolymer is considered as the third generation cement after lime and Portland cement. Geopolymer cements are acid resistant cementitious materials with zeolite properties, developed for the long term containment of hazardous and toxic wastes. The term geopolymer is generally used to describe an amorphous alkali aluminosilicate which was also commonly used for inorganic polymer, alkali- activated cements, geocements, alkali-bonded ceramics, hydro ceramics etc.

This research is carried to investigate the fresh, hardened, durability and structural behaviour of Fibre Reinforced Geopolymer (FRGP) concrete members. The casting and testing of FRGP concrete specimens were done according to the specifications followed for ordinary Portland cement mortar and concrete. The test specimens were heat-cured in an oven/heat curing chamber. The tests were carried out for the fresh concrete initially. The slump value and percentage of flow for fresh geopolymer concrete with and without polypropylene fibre were tested in accordance with ASTM-C143 and ASTM C1362-09 respectively. The compressive strength of 150 mm x 150 mm x 150 mm concrete cubes were ascertained by testing as per the procedures stipulated in IS: 516:1959. Split tensile strength test was conducted on 150 mm diameter and 300 mm height cylinders cast and tested in accordance to IS: 5816-1999. FRGP concrete beams of standard size 750 mm x 150 mm x 150 mm confirming to IS: 516-1959 was used for evaluating flexural strength of plain concrete. Durability tests on Geopolymer concrete with and without polypropylene fibre cubes were conducted according to ASTM C642 and the results were compared. Tests on water permeability and water absorption were also carried out and compared. Drying shrinkage was tested according to ASTM C596-07. Hydrogen ion concentration of concrete was also studied and respective pH values were evaluated. The Ultrasonic pulse velocity test was conducted as per the procedure given in IS: 13311:1992. The Geopolymer concrete with and without polypropylene fibre cubes were also tested for its structural and strength loss
under elevated temperature at three different levels (300 °C, 500 °C and 900 °C). Geopolymer concrete with and without polypropylene fibre discs of size 90 mm diameter and 35 mm thickness had been developed to measure the rate of transport of chloride ions into the concrete by Rapid Chloride Penetration (RCPT) Test as per ASTM C 1202-94. Further the microstructure of FRGP concrete was studied using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray analysis (EDAX) and X-ray diffraction analysis.

Reinforced Geopolymer Concrete (RGC) with and without polypropylene fibre beams of 150 mm x 150 mm cross section and 1500 mm length were manufactured and subjected to two point loading test to investigate the deflection crack patterns and ultimate moment. Also the RGC slabs were casted with and without polypropylene fibre on geopolymer concrete and a basic study was conducted on structural behaviour.

From the entire test data it was concluded that the addition of fibre increases the flexural toughness of the beams. The volumetric fractional addition of Polypropylene Fibre gives the maximum load carrying capacity at 0.4%, but the toughness was high, attributed to the reduction in deflection. Until 0.6% addition of Polypropylene Fibre addition, the load carrying capacity of beams was maintained not lesser than the control specimen. The addition of Polypropylene Fibre gives more resistance toward bending by increasing its flexural resistance. The addition of Polypropylene Fibre also reduces the strain localization of the fly ash based RC beams. Hence the addition of Polypropylene Fibre should be maintained at 0.4% or lesser. From the test results it is observed that Geopolymer Slabs exhibited brittle failure. With the incorporation of Polypropylene Fibre in Geopolymer, the brittle behaviour of Geopolymer Concrete can be brought to ductile.