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STUDY OF GLASS POWDER AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT-Concrete is a construction material composed of cement, aggregates (fine and coarse aggregates) water and admixtures. Today many researches are ongoing into the use of Portland cement replacements, using many waste materials like pulverized fly ash (PFA) and ground granulated blast furnace slag (GGBS). Like PFA and GGBS a waste glass powder (GLP) is also used as a binder with partial replacement of cement which take some part of reaction at the time of hydration, also it is act as a filler material. In this study, waste glass powders have been used as replacements to the concrete ingredient i.e. cement and the mechanical properties like compressive strength are measured. Also we were studied the size effect of glass powder on strength of concrete. For checking strength effect of replacement of cement by glass powder, the cement is replaced at 10%, 20% and 30%. For study of size effect of glass powder the powder is divided in to two grades one is glass powder having size less than 90 micron and another is glass powder having particle size ranges from 90 micron to 150 micron. It is found from study, Initial strength gain is very less due to addition of GLP on 7th day but it increases on the 28th day. It is found that 20% addition of GLP gives higher strength. And also GLP size less than 90 micron is very effective in enhancement of strength.

Keywords- waste glass powder; concrete; strength; replacement

1. NTRODUCTION

The environmental impact of concrete, its manufacture and applications, is critical. Some effects are harmful; others good. Rest all depend on use circumstances of concrete. A main ingredient of concrete is cement, which has its own environmental impacts and contributes largely to those of concrete. The cement industry is one of the primary industrial producers of carbon dioxide (CO2), creating up to 6% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% from burning fuel. Glass is an amorphous solid that has been found in various forms for thousands of years and has been manufactured for human use since 12,000 BC. Glass is one the most versatile substances, used in many applications and in a wide variety of forms. The interest of the construction community in using waste or recycled materials in concrete is increasing because of the emphasis placed on sustainable construction. Glass is an inert material which could be recycled and used many times without changing its chemical property (Aimin Xu and Ahmad shayam, 2004). Efforts have been made in the concrete industry to use waste glass powder as partial replacement of cement. Waste glass when ground to a very fine powder shows pozzolanicproperties as it contains SiO2 and therefore to some extent can replace cement in concrete and contribute in strength development. Glass is amorphous material with high silica content, thus making it potentially pozzolanic when particle size is less than 75 micron. This paper reports the results of an experimental investigation on the use of glass powder in partially replacement cement in fibre reinforced concrete and summarized the behavior of concrete involving partial replacement of cement by waste glass powder 0% to 40% at interval of 5% each.

Table No. 1: Chemical composition of cement and glass

Sr. No.	Composition (% by mass) / Property	Cement	Waste glass powder
1.	Silica(Sio2)	20.1	72.4
2.	Alumina(Al2O3)	4.6	0.4
3.	Iron Oxide(Fe2O3)	3.0	0.2
4.	Lime(CaO)	60.9	9.6
5.	Magnesia(MgO)	2.5	3.4
6.	Sodium oxide(Na2O)	0.18	13.8
7.	Potassium oxide(K2O)	0.83	0.1
8.	Sulphur trioxide(SO3)	3.9	-
9.	Loss of ignition	1.9	0.35
10.	Fineness % passing by sieve	97.5	80
11.	Unit Weight kg/m3	3155	2597
12.	Specific Gravity	3.15	2.57

II. Materials Used For Mix

For preparation of mix of grade M20, materials used and their specification details are given below: 1. Cement: The cement used in this study was 43 grade ordinary Portland cement (OPC) confirming to IS: 8112-1989.
2. Fine aggregate: Locally available sand confirming to zone II with specific gravity 2.62 was used. The testing of sand was done as per Indian specification IS: 2386 (Part III)-1963.
3. Coarse aggregate: Coarse aggregate used was 20mm and down size and specific gravity 2.76. Testing was done as per Indian standard specification IS: 2386 (Part III)-1963.
4. Glass powder: Waste glass available locally was collected and made into glass powder. Glass waste is very hard material. Before adding glass powder in the concrete it has to be powdered to desired size. In this experiment glass powder having partials size less than 90 micron was used.
5. Water: the water used was portable, fresh, colorless, odourless, and tasteless water that is free from organic matter of any type.
6. Polypropylene fibers: polypropylene fibers are specially engineered for use in concrete and mortar as a micro reinforcement system. They possess very high tensile strength, but their low modulus of elasticity and higher elongation do not contribute to the flexural strength. Polypropylene (PP) is a versatile thermoplastic material, which is produced by polymerizing monomer units of polypropylene molecules into very long polymer molecules or chains in the presence of a catalyst under carefully, controlled heat and pressure. Propylene is an unsaturated hydrocarbon, containing only carbon and hydrogen atoms:

CH2=CH
CH3
(Propylene)

III. Test Conducted

Experimentation was done on prepared mix of grade M20 with w/c ratio 0.45. 3 sets of mix were prepared for testing, normal mix, mix inn which cement is replaced with glass powder and mix in which glass powder and 0.03% of glass fibres were used. For investigation of results following tests were conducted: Compression Test Flexural Test Split tensile Test Workability(Slump Cone Test)

IV. Conclusions

As the percentage of replacement of cement with glass powder increases strength increases up to 20% and beyond that it decreases. The highest percentage increases in the compressive strength was about 23% and flexural strength was about 17% and split tensile strength was about 18% at 20% replacement level. The increases in strength up to 20% replacement of cement by glass powder may be due to the pozzolonic reaction of glass powder due to high silica content. Also it effectively fills the voids and gives a dense concrete microstructure. However, beyond 20% the dilution effect takes over and the strength starts to drop. Thus it can be concluded that 20% was the optimum level for replacement of cement with glass powder. As the glass content increases workability decreases. As there is a reduction in fineness modulus of cementations material, quantity of cement paste available is less for providing lubricating effect per unit surface area of aggregate. Therefore, there is restrain on the mobility.