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Performance Evaluation Of Plastic Granules And M-Sand As Fine Aggregate In Fiber Reinforced Concrete

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***Abstract*—** Concrete is used as most indispensable material in the infrastructure development throughout the world. About 35% volume of concrete is comprised of natural sand as a prime material, which has become expensive and also a scarce material. In view of this, there is a need to identify suitable alternative material in place of river sand. This nearly inert material concrete is suitable as a medium of recycling waste or industrial by products. The use of these waste products is not only a partial solution to environmental and ecological problems but also improves the microstructure and consequently the durability properties of concrete. In this context an experimental study is done based on Manufacture Sand and polypropylene plastic granules (PPG) for replacement of fine aggregate in concrete. The strength properties of M_{15} grade concrete is studied with different proportions of plastic granules and M-Sand. The various plastic and M-Sand proportions are 25% and 30% by volumeof river sand used in the concrete. Strength tests are carried out with different proportions of replacements of river sand with MS and PPG. Cube specimens, cylinder specimens and prism specimens of 9 numbers each were cast for different proportions of M_{15} concrete , cured and tested for 7 ,14 and 28 days. Compression test, split tensile test and flexural strength tests are done and the results are compared with control specimens. It was observed that on 70% substitution of Fine aggregate with plastic granules and M-Sand, the compression and tensile strength of concrete was within permissible limit for use in construction industry. Thus these materials in lieu can be used in cost reduction and also managing material waste in production of concrete.

Keywords: Cement , Sand , Fibres.

I. INTRODUCTION

1) GENERAL

Concrete plays the rightful roleto meet the requirements of globalization, in the construction of buildings and other structures. A large quantum of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce.The mining of aggregates in rivers has led to deterioration of river basins, also increase in pollution and changes in pH level. The process of extraction of sediments causes the river to cut its channel through the bottom of the valley floor in both upstream and downstream of the removal site. The sand mining in rivers had gone up to such an extent that in many countries, there is a legal prohibition on sand mining. This process has in turn led questions to mankind to solve the problems generated by this growth. The problems defined are acute shortage of constructional materials, increased dumping of waste products. Hence in order to overcome the above said problems waste products should be employed as construction material.

Concrete is suitable as a medium of recycling wastes or industrial by products. In the era of increased attention to the environmental impact of construction and sustainable development, waste materials usage in concrete plays a major role. Using waste materials as replacement of conventional natural materials minimizes the depletion of natural resources. This project is an investigation on the attempt to evaluate the characteristics of concrete using Plastic granules and M-sand as fine aggregate,for the purpose of exploring the characteristics comparison of these materials with natural sand.

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2) MATERIALS USED

The materials used in this project includes

- Cement OPC 53 grade
- River sand
- Polypropylene plastic granules
- M-Sand
- Super plasticizer
- Coarse aggregate
- Hooked steel fibres

3) CEMENT

Cement is the bonding material used in between coarse aggregates and fine aggregates. It is the mostly widely used important ingredient in construction works .Ordinary Portland cement (Dalmia OPC 53 grade) confirming to requirements of IS 12269-1987 is used.

4) FIBERS

In this study Galvanized steel fibers of aspect ratio 30 was used to improve the ductility and strength properties of concrete mix. The cross sectional dimensions of this typical Galvanized steel fiber of diameter of 0.1 cm wire was used, which are created in various form of geometry.

5) NATURAL RIVER SAND

Generally river sand is used as a fine aggregate. Due to increase in the utilization of concrete in construction sector, the need for river sand has been increased enormously. Limitations have been laid on the large scale mining of river sand from river beds.The fine aggregate used in this study was clean river sand purchased from traders at Chennai.

6) POLYPROPYLENE PLASTIC GRANULES

Polypropylene (PPG), also known as polypropene, is a thermoplasticpolymer used in a wide variety of applications including packaging and labeling, textiles (e.g., ropes, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes. . Maintenance free (such as painting is minimized) .Hygienic and clean, Ease of processing / installation and also Light weight . the plastics used in this study in polypropylene plastic granules collected from CIPET, chennai.

7) M-SAND

As the ability to use natural sand in cement mixtures declines, there has been an increased interest in the potential of M-Sand to replace it. M-Sand is a waste product produced during the crushing process which is used to extract stone, and there is a great deal of it around, making it plentiful and cheap. The dust produced byquarrying has already been used in the construction industry for projects such as road building, and making materials such as bricks and tiles.

II. OBJECTIVE AND SCOPE

1) OBJECTIVES:

- Preparation of mix Design for M_{15} grade concrete
- Study the effect of 100% replacement of natural sand by M-Sand and plastic granules on strength characteristics of M_{15} grade concrete.
- To carry out strength tests on concrete replaced with various proportions of Plastic granules and M-Sand for various curing periods of 7,14 and 28 days
- To evaluate the management of waste materials without compensating the strength properties of concrete.

2) SCOPE

- Reduce the utilization of fine aggregate in concrete thereby saving natural river sand
- Environmental protection by reducing the waste disposal problem of plastics.
- Substantially reducing the cost of concrete by reusing the waste dumps

III. METHODOLOGY

The chapter briefly explains the methodology adopted in this experimental work.In the first phase,the physical properties of ingredients of concrete and fresh concrete properties have been found and a mix design for M_{15} concrete was calculated

- Preliminary tests on cement, fine aggregate, coarse aggregate, PG and MS.
- Mix design for M_{15} concrete.
- Determination of compressive strength of design mixes.
- Casting of prism with unconventional concrete and normal concrete.
- Conducting split tensile and tensile test on specimens.
- Casting of beams with unconventional concrete and normal concrete.
- Conducting compressive test on specimens.

IV. TESTS ON HARDENED CONCRETE

Laboratory tests were carried out to determine characteristic compressive strength, load deflection characteristics, stress strain behavior and shrinkage measurement.

1) COMPRESSION TEST OF CONCRETE

- Remove the specimen from water after specified curing time and wipe out excess water from the surface.
- Take the dimension of the specimen to the nearest 0.2m
- Clean the bearing surface of the testing machine
- Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
- Align the specimen centrally on the base plate of the machine.
- Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
- Apply the load gradually without shock and continuously at the rate of 140kg/cm^2/minute till the specimen fails
- Record the maximum load and note any unusual features in the type of failure.

Compressive strength is given by

$$Fc = \frac{Pm}{A}$$

F_c = Compressive strength
P_{max}= Maximum load that cube sustains
A= Cross sectional area of the cube

2) SPLITTING TENSILE TEST OF CONCRETE

- Take the wet specimen from water after the required days of curing
- Wipe out water from the surface of specimen
- Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.
- Note the weight and dimension of the specimen.
- Set the compression testing machine for the required range.
- Keep are plywood strip on the lower plate and place the specimen.
- Align the specimen so that the lines marked on the ends are vertical and centered over the bottom plate.
- Place the other plywood strip above the specimen.
- Bring down the upper plate to touch the plywood strip.
- Apply the load continuously without shock at a rate of approximately 14-21kg/cm2/minute
- Note down the breaking load(P)

$$Fsp = \frac{2P}{\pi dl}$$

F_{sp}= indirect tensile strength
P= maximum load sustained by the specimen
d= diameter of the specimen
l= length of the specimen

Fig 4.1 Prism Mould

Fig 4.2 Prism Specimens

3) FLEXURE TEST OF CONCRETE

- The thickness and width of the beam are measured.
- The loading block is gripped and test jig in the upper and lower gripping head respectively.
- The specimen is located so that the upper surface is to the side and centered in loadingassembly.
- The machine is operated until the loading block was bought into contact with the upper surfaces of the specimen. Full contact between the load (and supporting) surfaces and thespecimen is ensured to secure.
- The required parameters are set on the control panel.
- The load recorder is adjusted on the front panel controller to zero, to read load applied.
- Start button is pressed to start the flexural test.
- The specimen is observed, as the load was gradually applied.
- The maximum load is recorded and loading is continued until complete failure.

$$Ff = \frac{Pl}{bd}2$$

F_f= flexure strength
P= maximum load sustained by the specimen
d= diameter of the specimen
l= length of the specimen
b= breadth of the specimen

V. CONCLUSION

1. All the mixes of concrete formed byreplacement of natural sand bymanufactured sand when compared to reference mix i.e., 0% replacement, reveal higher compressive strengths.
2. In 50% replacement of natural sand, the compressive strengthincreases by 7.03%, which is maximum.
3. Concrete mix becomes harsh with increasein proportion of manufactured sand.
4. Results show that the river sand can be partially replaced by manufactured sand.
5. After determining the value of the results of the forgoing findings, the following conclusion were drawn:
6. The use of plastic granules as an alternative fine aggregate for concrete mix decreases the water-cement ratio depending on the amount present in the mixture.
7. The use of recycled plastics as fine aggregate decreases the unit weight of concrete.
8. The use of plastic as an alternative for fine aggregate is not recommended for structural members such as columns, beams and suspended slabs.
9. The modulus of elasticity is dependent with the compressive strength, and unit weight of concrete, hence, the recycled glass bottles as fine aggregate decreases the value for modulus of elasticity.
10. The use of plastic granules as an alternative fine aggregate increases the amount of material cost for concrete due to aggregate.

Ductility index, stiffness and energy absorption capacities of internal curing specimens are more than that of water curing specimens.

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