AN EXPERIMENTAL STUDY ON THE USE OF WASTE CERAMIC MATERIAL, EGG SHELL POWDER AND IRON SLAG IN SELF COMPACTED CONCRETE

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Abstract: Throughout the world, concrete is being widely used for the construction of most of the buildings, bridges etc. Hence, it has been properly labeled as the backbone to the infrastructure development of a nation. Development of a nation not only depends upon the technology but also depends upon the infrastructure. Without concrete infrastructure is not possible. Thus concrete is indispensible material in every construction. The major element of concrete is cement. Since cement price is volatile and demand is so high, an alternate material can be used for replacement of cement. Since several replacement experiments were done for coarse and fine aggregate. Hence we go for replacement for cement. The alternate material in our project used was powdered Eggshell, Ceramic waste and Iron slag. In the present study, these Eggshell, Ceramic waste and Iron slag is used as a partial replacement of cement and various properties like workability, compressive strength, split tensile strength and flexural strength were determined.

Keywords: Concrete, characterization, eggshell power (ESP), Workability, Egg Shell Powder

1.0 INTRODUCTION

To meet out this rapid infrastructure development a huge quantity of concrete is required. Concrete is a composite material which has relatively high compressive strength, but significantly lower tensile strength. At present, for a variety of reasons, the concrete construction industry is not sustainable. Firstly, it consumes huge quantities of virgin materials which can remain for next generations. Secondly, the principal binder in concrete is Portland cement, the production of which is a major contributor to greenhouse gas emissions that are implicated in global warming and climate change. Thirdly, many concrete structures suffer from lack of durability which may waste the natural resources. A major component of concrete is cement and it is one of the three primary producers of carbon dioxide, a major greenhouse gas. 900kg of CO_2 are emitted for every ton of concrete. As of 2001, the production of Portland cement contributed 7% to global CO_2 emission, largely due to the sintering of limestone and clay at 1500°C. The CO_2 emission of concrete is directly proportional to the cement content used in the concrete mix. Cement manufacture contributes greenhouse gases both directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide and also through the use of energy, particularly from the combustion of fossil fuels. There is a growing interest in reducing carbon emission related to cement production from both academic and industrial sectors. Recycling of waste components contributes to energy savings in cement production, to conservation of natural resources and to protection of the environment. Hence, currently, the entire construction industry is in search of a suitable and effective waste product that would considerably minimize the use of cement and ultimately reduce the construction cost. On the other hand The price of building materials now a days is very high in different parts of the nation; particularly developing areas like Punjab, Delhi, etc. This high and uncontrolled rising cost can be reduced to minimize by use of different building materials that are cheap, locally available and bring about a reduction in the overall self-weight of the building. Some industrial and other products that would otherwise dump the environment as waste or at best be put into only limited use could gainfully be employed as building material. This paper analyses the material namely; Egg Shell Powder which can be utilized as alternative materials to substitute cement in the building industries, in order to evaluate and affirm the suitability of replacing cement with egg shell powder in concrete Structures.

1.2 HISTORY OF STUDY

The use of admixtures to increase the structural properties of construction material is not a new process. It ranges more than 5000 years from the season of Egyptian pyramids to show day brightening concrete improvements. Around 3000 BC, Egyptians utilized mud blended with straw to give more quality. Later in 300 BC, the antiquated Romans utilized a material that is amazingly near present day bond to manufacture huge numbers of their compositional wonders. The Romans additionally utilized creature items in their concrete as an early type of admixtures. Later in 1939, the prologue to steel substituting asbestos was set aside a few minutes yet at that period it was not fruitful. In 1890, the expansion of gypsum when granulating clinker to go about as a retardant to the setting of the solid was presented in the USA. In 1985, the silica seethe and different superplasticizers were acquainted as an admixture with enhance the quality. After that different admixtures, for example, fly slag, Egg shell powder, metakaolin and rice husk fiery debris, steel or optical filaments are acquainted with enhance the mechanical properties of cement.

1.3 ROLE OF EGG SHELL POWDER IN CONCRETE

Concrete in hardened state have some limitations due to which admixtures should be added to improve its property such as durability of the concrete and Egg shell powder concrete has shown better behaviour because of their good ability to stop or delay cracks. In concrete there is a risk of drying shrinkage likely due to rich powder content. Concrete has a heterogeneous structure and due to complex structure of concrete, internal stresses produced. Due to this internal stresses it results in micro cracks developed in fresh or hardened state of concrete Egg shell powder enhanced the various strength properties such as durability, compressive strength and ductility etc.

Figure 1.1: Egg Shell Powder

1.4 CERAMIC TILES

Broken tiles were collected from the solid waste of ceramic manufacturing unit. From Village Dhanas near to Chandigarh and Crushed them into small pieces by manually (and by using crusher. And separated the coarse material to use them as partial replacement to the natural coarse aggregate. Specific gravity of the crushed waste tiles is 2.39. Impact value of these crushed tiles is 25.81%.

Figure 1.2: Ceramic Tiles

1.5 IRON SLAG

Iron slag is a residual waste of steel, left in the steel , left in the steel manufacturing industries, but now it is used in four several products. Due to its easy obtain ability and low cost it is used in various resolutions.

Figure 1.3: Iron Slag

1.6 LITERATURE REVIEW ON WASTE CERAMIC MATERIAL, EGG SHELL POWDER AND IRON SLAG

Amarnath Yerramala studied the Properties of concrete with eggshell powder as cement replacement. This paper portrays investigation into utilization of poultry waste in concrete through the advancement of concrete fusing eggshell powder (ESP). Diverse ESP concretes were created by supplanting 5-15% of ESP for cement. The outcomes showed that ESP can effectively be utilized as incomplete substitution of concrete in concrete creation. The information introduced cover quality improvement and transport properties. Regarding the outcomes, at 5% ESP substitution the strength were higher than control concrete and show that 5% ESP is an ideal substance for greatest strength. Also, the execution of ESP cements was practically identical up to 10% ESP substitution as far as transport properties with control concrete. The outcomes additionally demonstrate that option of fly ash remains alongside ESP is helpful for moved forward execution of concretes. (1)

Meenakshi Dixit et al studied the Effect of Using Egg Shell Powder and Micro silica partially in Place of Cement in M25 Concrete. This study consider intends to examine the suitability of egg shell powder as fractional substitution for cement (OPC 43) in the generation of minimal effort and light weight concrete .This examination explores the execution of concrete mix regarding Compressive strength for 7 days and 28 days, Flexural strength of beam 28 days and Splitting tensile strength of cylinder for 28 days individually of M-25 review concrete at different substitution levels of OPC by Egg shell powder and a specific level of micro silica as by weight of cement. Water-binder proportion was kept consistent for all cases. These Concrete examples were cured in water under ordinary barometrical temperature. On the premise of result that halfway substitution of bond in M- 25 concrete from Egg shell powder and Micro silica was found to increment in all strength (Compressive, Flexural and Splitting Tensile strength) and durability of variety mix of concrete on all age when contrasted with normal concrete. (2)

Jayasankar.R et al did the experimental study on Concrete using Fly Ash, Rice Husk Ash and Egg Shell Powder. In this study, Ordinary Portland cement on forming to IS: 8112, 43 grade, Dalmia brand was used. Screened river sand with fineness modulus equal to 2.6 conforming to grading zone III of IS: 3831970 was used. Well graded blue granite stone aggregate passing through 12mm and retained in 4.75mm sieve with fineness modulus of 7.48 was used. Fly ash procured from Neyveli Lignite Corporation, Neyveli, Tamil nadu India was sieved before used. Egg shells procured from local centers was grinded, sieved before used. Rice Husk Ash procured from local agricultural lands and flower mills was incinerated, cleaned and sieved before used. Based on the results of these works it can be concluded that RHA, Fly ash and ESP mixed cubes has equal strength with that of conventional concrete cubes in certain categories. M20 and M25 cubes takes equal load compared to conventional concrete and M30 grade concrete's load carrying capacity is slightly decreased. (3)

Er. Varinder Singh et al did the Physical & Analytical Investigation of Concrete with Replacement of Cement with Egg Shell Powder & Coal Powder Ash. The mix of Coal Powder Ash and Egg Shell Powder were utilized as fractional substitution of cement in concrete structures. In this examine, egg shell powder from 0% to 10% in products of 2.5% and coal powder ash from 0% to 5% in products of 1.25%. The results demonstrated that there was increment in the Compressive strength, flexural and tensile strength of the examples containing 11.25% egg shell powder and coal powder ash remains when contrasted with the control mix. Workability of concrete mix diminishes with increment in the egg shell and coal powder slag content. The diagnostic outcome from ANSYS was acquired by the results got from the exploratory work and results were confirmed. (4)

Ashif M. Qureshi et al studied the Innovative use of Rice Husk Ash Fly Ash and Egg Shell Powder in Concrete. In this investigation, Tests were done according to following codes of Bureau of Indian Standards. The test for compressive quality on shapes were estimated at 7, 14 and 28 days of restoring according to IS : 516 1959, test for flexural quality on pillar was estimated at 28 days of relieving according to May be: 516 1959 and test for split rigidity on chamber was estimated at 28 days of restoring according to IS : 5816 1999. Solid block of 150 x 150 x 150 mm measurements were projected for testing compressive quality. Vibration was given to the molds utilizing table vibrator. Following 24 hours the 3D squares put in restoring tank for 7, 14 and 28 days relieving. In the wake of restoring these solid shapes were tried on advanced pressure testing machine according to I.S. 516-1959. (5)

1.7 COMPRESSIVE STRENGTH TEST

The concrete strength depends on various aspects like the cement type, quality or proportion of copper slag, recycled aggregates and curing temperature. The compressive strength results are given in figure 1.4. Compressive strength test was performed confirming to IS 516-1959 to achieve the test results for concrete at the age of 7 and 28 days.

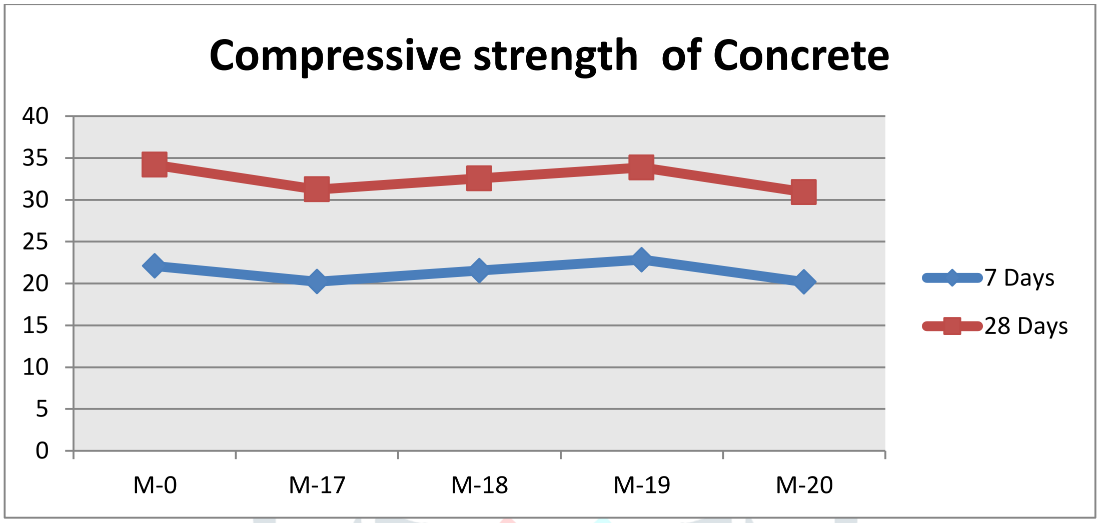

Figure 1.4: Compressive strength of Concrete by using Egg Shell Powder, Iron Slag and Ceramic Tiles

1.8 SPLIT TENSILE STRENGTH TEST

The split tensile strength examination was performed to confirm to IS 516-1959 so as to achieve the value of concrete aged 7 days and 28 days. A Compression Testing Machine (CTM), of 1000Kn capacity was used to test the cylinders. The outcomes are displayed in in figure 1.5.

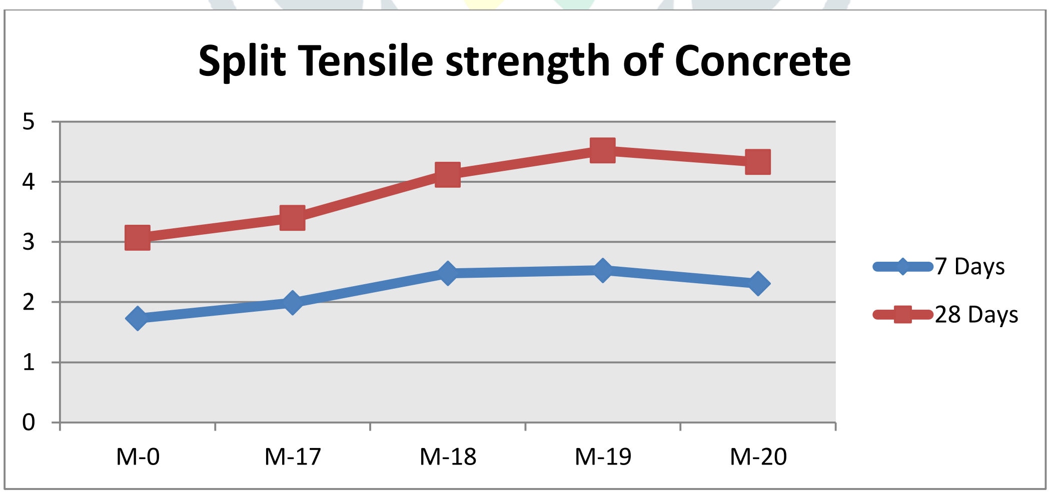

Figure 1.5: Split tensile strength of Concrete by using Egg Shell Powder, Iron Slag and Ceramic Tiles

1.9 FLEXURAL STRENGTH TEST

The Flexural examination was performed to confirm to IS 516-1959 so as to achieve the value of concrete aged 7 days and 28 days. The results are shown in Figure in figure 1.6

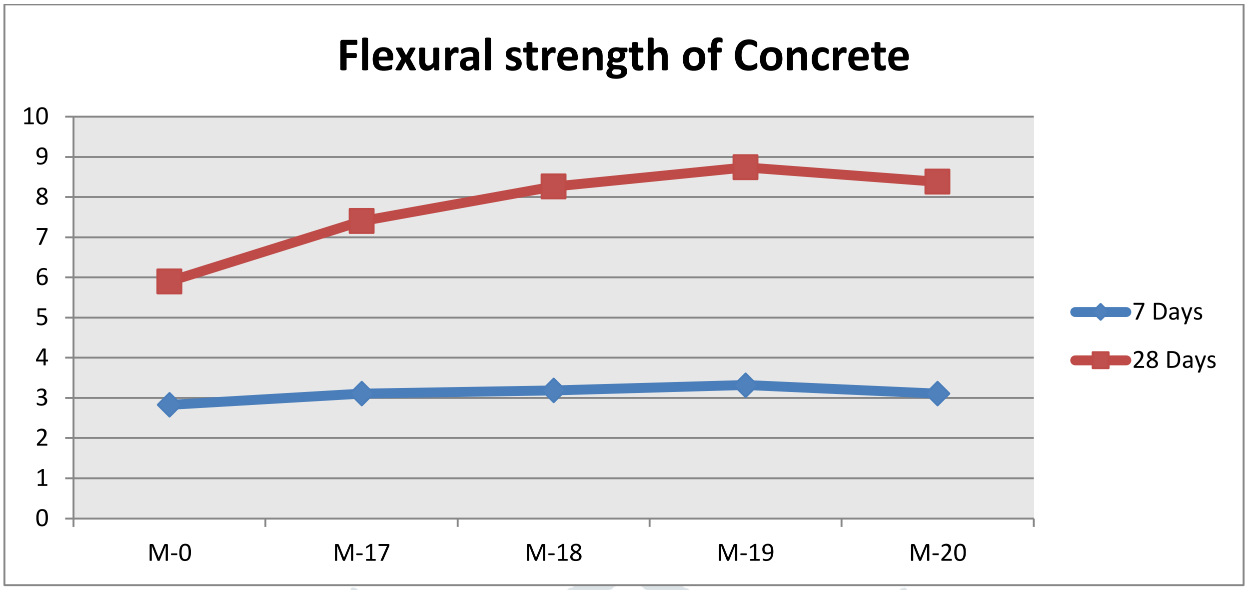

Figure 1.6: Flexural strength of Concrete by using Egg Shell Powder, Iron Slag and Ceramic Tiles

CONCLUSION

Following are the various conclusions drawn after the test performance on cube samples of concrete by using waste ceramic material, egg shell powder and iron slag:

1. The compressive strength of concrete increases by the addition of waste ceramic material, egg shell powder and iron slag in concrete.
2. The optimum percentage of Egg shell powder, Iron slag and waste ceramic material is 18 %, 24 % and 24 % in the Compressive strength of the concrete.
3. The maximum Compressive strength test is achieved 39.53 in the mix of 18 % ESP+ 12 % IS+ 12 % CT.
4. The split tensile strength of concrete increases by the addition of waste ceramic material, egg shell powder and iron slag.
5. The optimum percentage of Egg shell powder, Iron slag and waste ceramic material is 18 %, 24 % and 24 % in the Split tensile strength of the concrete.
6. The maximum Split tensile strength test is achieved 4.52 in the mix of 18 % ESP+ 12 % IS+ 12 % CT.
7. The Flexural strength of concrete increases by the addition of waste ceramic material, egg shell powder and iron slag.
8. The optimum percentage of Egg shell powder, Iron slag and waste ceramic material is 18 %, 24 % and 24 %in the Flexural strength of the concrete.
9. The maximum Flexural strength test is achieved 8.74 in the mix of 18 % ESP+ 12 % IS+ 12 % CT Steel Slag.
10. The overall optimum mix of all the test is M-19 having 18 % Egg shell Powder+ 12 % Iron slag + 12 % Ceramic tiles.

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