Experimental Study on Concrete for Partial Replacement of Cement With Eggshell Powder (Esp) & Ggbs

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Abstract- *The main problem facing the world today is environmental pollution. In the construction industry, pollution is generated mainly by the production of portland cement and environmental pollution occurs. Carbon dioxide which is produced by the cement industry causes environmental pollution and global warming. Approximately 900 Kg of carbon dioxide is emitted from 1000 kg of cement manufacturing process. To reduce the impact of cement production on the atmosphere, waste byproducts were used as a blend in this study to reduce environmental pollution and resource consumption. In this study, egg shell powder is 30% (5, 10, 15, 20, 25 and 30) and GGBS is fixed at 25%. These two wastes are used in M25 grade concrete as a partial substitute for cement and determine various properties such as workability, compressive strength and tensile strength.*

Keywords- Eggshell powder, GGBS, compressive strength, Split tensile strength.

I. INTRODUCTION

India is the world's second largest producer of eggs every year. Treating garbage eggshells is a big deal. If you send it to the landfill, it will harm the human body and cause problems related to human health and environment. Egg shells are generally rich in calcium and have almost the same limestone composition. The use of egg shell waste rather than regular lime as a cementitious material can have the same benefits as preserving natural lime and using waste. The objective of the current review is to determine the potential availability of these reckless materials as a building material for cement. GGBS is also a waste of the steel industry. GGBFS cement has been reasonably utilized because its performance properties under strong conditions have been improved and extended during the generation due to the general economy. In addition, the use of pozzolanas as additives in cement and the use of cement in the latter days are highly recognized every day. GGBS is one of those pozzolanic materials that can be used as a cement-based fixture in cement or concrete composites. By inquiring about work up to date, we suggest that these supplemental cement materials can improve the performance properties of concrete, such as work capacity, strength, permeability, durability and resistance to corrosion. The advantages of using these byproducts construction are (1) it reduces the amount of construction and demolition waste entering landfill sites; and (2) it reduces the use of natural resources.

EGGSHELL POWDER

The chemical composition of Eggshell powder and cement was found to be similar. The main ingredient of egg shell was calcium carbonate (about 51%). Eggshell waste has evolved from poultry farms, restaurants and hotels. These wastes are used in animal feed and are disposed of in many countries. These wastes are collected and implemented in this projects.

Processing of egg shell powder is performed in the following order: (1) material collection, (2) crushing and powdering of egg shells, (3) egg shell powder sieving, and (4) mixing of cement and shell powder. The constitution of Eggshell powder is made on a 75 micron sieve. The retained residues were supplied to the fertilizer and animal feed industries.

GGBS (GGBFS)

The pulverized blast furnace slag consists essentially of a silicate of calcium and an alumina silicate. Portland cement is a good catalyst for slag activation because it contains three main chemical components that activate slag, such as lime, calcium sulphate and alkali. The material has a glass structure. And the ground is less than 45 microns. The surface area is about 350 - 450 m2 / kg Blaine. Crushed slag, usually sulphate and alkaline water, supplied with common port land cement and with active agent, react chemically with GGBS and hydrates and chemicals in a similar way to Portland cement.

II. DESIGN AND TESTS

A. Mix Proportion

Our project is proposed of M25 grade of concrete and the mix design was based on IS 10262-1982 and IS 383 -1970 codal provisions. The mix proportion arrived was 1:1.2:2.25 (cement : fine aggregate : coarse aggregate).

B. Casting

The compressive strength of the mixture was determined using a cube of internal dimensions 150X150X150mm. A cylinder with a diameter of 150 mm and a height of 300 mm was cast to evaluate the split tensile strength. The ratios for the various mixtures were evaluated against a 100 mm slump. The mix is designed for M25 grade concrete according to the IS code. All materials are weighed. Separately as in the mix design. Cement, sand, natural-coarse aggregate and recycled coarse aggregates were thoroughly dry blended with a pan mixer until uniform mixing was achieved. The required quantity of water is added to the dry mix. Put fresh concrete into the mold and use compression as a mechanical vibrator. The specimens were removed from the mold after 24 hours and placed in a water pound to cure for 28 days. After 28 days, remove the specimen, allow it to dry in the shade, and then test the specimen.

C. Water Absorption Test

Water absorption test was carried out for 7 th day saturated cube specimen and oven dried specimen .The water absorption of the specimen was 7 % to 9% (for several specimens)

D. Slump Test

The mold for the slump test is a truncated cone with a height of 300 mm. The bottom is 200mm and the top is 100mm in diameter. The bottom is placed on a smooth surface and the container is filled with concrete with three layers tested for workability. Each layer was turned a standard 1 mm diameter steel bar 23 times. When the mold is filled with concrete. The cone will slowly and carefully drop the unreinforced concrete vertically. Slump When the height of the concrete center decreases, it is called slump. The decrease in concrete height against mold is measured on a scale.

E. Compressive Strength Test

We are preparing M25 mix designs using the characteristics of materials. Then we have up to 30% egg shells. At each rate we are building a cube. After testing the cube on the 7th, 14th, and 28th, all weights are applied before testing the cube. Compressive strengths were calculated for all ratios of cube using the compressive strength formula using,

Volume of cube = a3

=150x150x150 = 3.375x106 mm3

For all concrete mixes, the compressive strength is determined in 150 × 150 × 150 mm cubes at 7 days, 14 days and 28 days of hardening. The following table shows the results of compressive strength tests applied to concrete at constant intervals of 5, 10, 15, 20, 25 and 30% of egg shell powder and 25% of GGBS at each interval. The test results of the cube compressive strength are shown in the figure below.

Proportion	CUBE		
	7 day	14 day	28 day
OPC(M25)	16.29	18.88	31.33
ESP 5% + GGBS 25%	19.00	24.66	35.92
ESP 10% + GGBS 25%	20.32	27.47	38.81
ESP 15% + GGBS 25%	21.77	29.40	41.85
ESP 20% + GGBS 25%	20.87	27.36	42.08
ESP 25% + GGBS 25%	19.36	25.77	38.29
ESP 30% + GGBS 25%	18.43	23.77	37.10

Fig.1 (Compressive strength results)

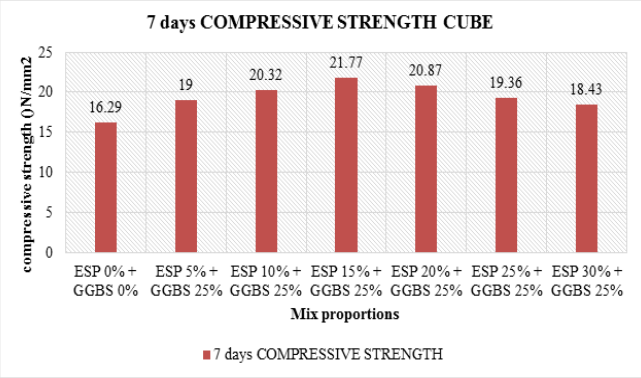

Fig.2 (7 days compressive strength)

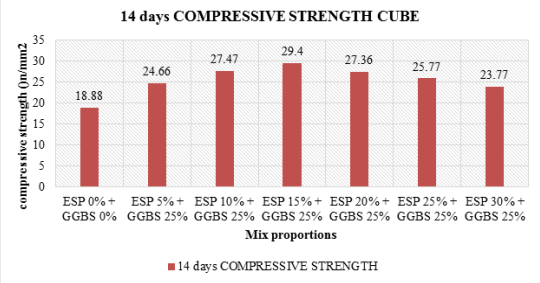

Fig.3 (14 days compressive strength)

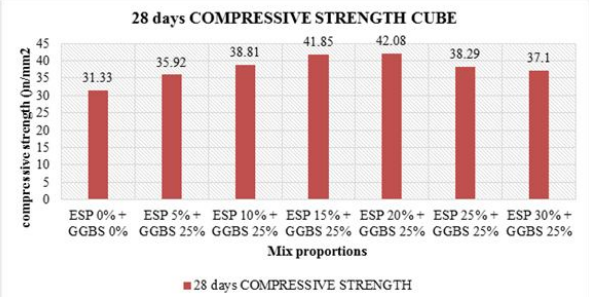

Fig.4 (28 days compressive strength)

F. Split Tensile Test

This test is performed using a 3000 kN Compression Tester (CTM). The cylinder is placed on the lower compression plate and aligned in the same way as the center line shown at the end. Portrait of a specimen. The top plate of the CTM then contacts the top of the cylinder. Loads and breaking loads applied at a constant speed of 140 kg / cm2 are recorded. The strength is calculated as the split tensile, which is a formula of 2P / πdl.

The test was administered 28 days after treatment. Split tensile is performed for cylinders 150 mm in diameter and 300 mm in length according to IS 5816-1999. Tables 9-11 and Figures 4-6 show the results of the split tensile strength of concrete made with constants 5, 10, 15 and 20, 25% and 30% of the eggshell powder and 25% of GGBS are fixed at each interval. In this study, inorganic mixtures are used to improve the tensile strength of concrete made of Egg Shell Powder and GGBS. 25% of the compressive strength and GGBS of the partial cement substitute concrete made of 5, 10, 15, 20, 25 and 30% egg shell powder range from 2.20 to 3.20 at 28 days. From the experimental results, the crack tensile strength of concrete made with 30% ESP and 25% GGBS shows a higher compressive strength value than the natural aggregate concrete mixture. From the results, it was concluded that ESP & GGBS could slightly improve the compressive strength of concrete. Therefore, ESP can be replaced up to 30% and GGBS can be replaced up to 25% without affecting the required strength.

Proportion	CUBE
	28 day
OPC(M25)	2.20
ESP 5% + GGBS 25%	2.36
ESP 10% + GGBS 25%	2.50
ESP 15% + GGBS 25%	2.71
ESP 20% + GGBS 25%	2.80
ESP 25% + GGBS 25%	3.01
ESP 30% + GGBS 25%	3.20

Fig.5 (Split Tensile strength)

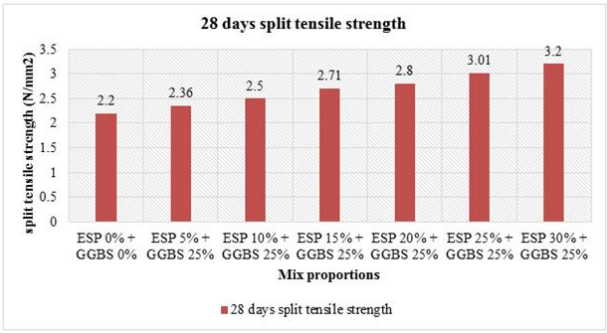

Fig.6 (28 days Split Tensile strength)

III. CONCLUSION

The compressive strength of conventional concrete is 16.29 Mpa at 7 days, whereas compressive strength 0f partially replaced cement by an amount of 15% ESP and 25% of GGBS at 7 days found to be 29.40 Mpa. Also it is found that the compressive strength of partially replaced concrete have 33 % higher strength than the conventional concrete respectively

The Compressive strength of conventional concrete is 31.33Mpa at 28 days, whereas compressive strength of partially replaced cement by an amount of 15% ESP and 25% of GGBS at 28 days found to be 42.08 Mpa. Also it, is found that the compressive strength of partially replaced concrete have 35% higher strength than the conventional concrete respectively

The Split Tensile strength of conventional concretes is 2.20 Mpa at 28days, whereas Split Tensile strength of partially replaced cement by an amount of 30% ESP and 25% of GGBS at 28 days found to be 3.20 Mpa. Also it is founds that the Split Tensile strength of partially replaced concrete has 5.93 % higher strength than the conventional concrete respectively

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