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EXPERIMENTAL STUDY ON STRENGTH AND WOKABILITY PROPERTIES OF CONCRETE USING RICE HUSK ASH AND EGG SHELL POWDER CONCRETE

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Abstract - This research has been done to find out the maximum percentage of RHA and eggshell powder as partial cement Replacement. The construction industries are in the search to find alternative products that can reduce the cost of construction. Demand for cement has been growing every day. In this Research, different RHA and ESP concretes were developed by replacing with cement. Concrete plays an important role and a large quantity of concrete is being utilized in every construction. The eggshell which usually disposes of is used as an alternate for the cement because the shell of an egg is made up of calcium. An eggshell is used in different combinations to find the practicability of using the eggshells as an alternative to cement. RHA is produced after the burning of Rice husk When we burn rice husk in open field for the production of rice husk in open field for the production of rice husk as that contain high carbon content which adversely affects the properties of concrete and also caused highly crystalline form in structures. The aim of this project is to halt the pollution of the environment by the improper disposal of the Eggshell waste, a remain from eggshells domestic waste such as schools, restaurant, bakeries, homes, and fast food hotels, by using it as an additive material in form of ash & powder in conventional concrete with grade M25, as it is normally used in construction sites. Eggshell is one of the waste materials which can be a promising future in the construction industry as a partial or full substitute of either cement just because of its physical similarity to the fine Cement.. The RHA6% and ESP6% is replaced with Cement show positive results. workability reduces with increasing % age of Rice-Husk-Ash and Egg shell powder The maximum proportion of replacement has been found by conducting the following strength tests: Compressive strength test, Flexural strength test and Split Tensile Strength Test.

***Key Words*: RHA (RICE HUSK ASH),ESP (EGG SHELL POWDER, Concrete.**

1.INTRODUCTION

The versatility, durability, sustainability, and economy of concrete have made it the world's mostly used construction material. Concrete is a nuclear family or we can say household of this dissimilar material like binding material (cement, fly Sash, Rice husk ash) fine aggregate, coarse aggregate and water. Often, the reinforcement and flavour enhancer or additives involved in the mixture to attain the desired physical properties of the end material. When these constituents or elements are fuse together, they shape a fluid mass that is easily casted into shape. Over time, the cement forms a hard matrix which girds the rest of the constituents together into a durable stone-like material with many uses. The object and purpose is to mix these materials in measured amounts to make concrete that is easy to: Transport, place, compact, finish and which will set, and harden, to give a strong and durable product. The amount of each material (i.e.; cement as binding material, water for mixing and aggregates like a fine aggregate that is sand used as void filler and coarse material that is gravel used as inert material) affects the properties of hardened concrete.

1.1 RICE HUSK ASH

The RHA is generally by-product of agricultural residue that we can obtain under the controlled temperature of below 800 °C. Through this process contain 25% ash that will gives us 85% to 90% Amorphous silica that imparts strength and about 5% Alumina that act as a flux and also imparts quick setting property. Due to this RHA is highly Pozzolanic in nature. A pozzolanic material is an essential siliceous compound that does not possess its own cementing properties but finally divided in the presence of water reacts with calcium hydroxide released during hydration process to make cementing material.

1.2 EGG SHELL POWDER

Eggshells are the organically decomposable waste obtained from chick hatcheries, bakeries, and fast-food restaurants. Among other biodegradable wastes, this can affect the surroundings and thus can lead to ecological issues/contamination which would need appropriate solutions. Scientists have been investigating the beneficial use of Egg shells in construction purposes or other related purposes and it is known that the eggshell is mainly has the composition of compounds of calcium. Okonkwo et al (2012) presented eggshells are composed of 93.70% calcium carbonate (in calcium), 4.20% of it is organic matter, 1.30% is magnesium carbonate, and 0.8% of it is calcium phosphate.

2. LITERATURE REVIEW

Syed Saad Ali, et.al 2019: In this study, test was done on concrete with partial replacement of cement with ESP in the proportion of (0-20%) and fine aggregate with Copper scum (0-20%). Slump cone value for the copper slag and ESP increases with increasing in the percentage of ESP and copper slag so the concrete was not workable. The value of the Compaction factor test about copper slag and egg shell powder decreases with increase in the percentage of both copper slag and ESP in the concrete. The compressive strength of concrete is find out to be optimum at 10% replacement of copper slag and egg shell powder and is the optimum value after 7 days curing and 28 days curing. The split tensile strength of concrete is find out to be optimum at 15% replacement of copper slag and egg shell powder for 28 days curing in M30 grade concrete and maximum at 10% replacement of copper slag and egg shell powder for 28 days curing. So, the replacement of 10% to 20% of copper slag and egg shell powder is useful for better strength values in M30 grade of concrete.

Maurice E. Ephraim et.al (2012). This research is done to investigate the effects after replacing partially ordinary Portland cement with RHA that is super pozzolanic the percentage level up to 25% and its result shows the strength properties are improved.

Godwin A. Akeke et.al (2013) This research is done to investigate the effects after partially replacing the RHA with OPC and also study its flexural properties to determine their modules of structures as well as its tensile strength of concrete. The percentage level was up to 25% in the production of concrete with no loss of workability or strength. After that result shows us tensile strength increases due to addition of RHA and flexural strength shows marginal improvement with 10% to 25% RHA replacement level.

Amarnath Yerramala Et.Al., (2014) studied the Properties of concrete with eggshell powder as cement replacement, and showed the Compressive strength was higher than control concrete for 5 % ESP replacement at 7 and 28 days of curing ages. Split tensile strength concrete up to 10 % with ESP replacement unavoidable.

Vashisht Patil, Prof. M. C. Paliwal(2020) This research is done to investigate This huge amount of production prompts utilization of natural resources and it is very unsafe for environment. Enormous amount of waste by-products are delivered from the manufacturing enterprises, for example, mineral slag, fly ash, silica fumes, rice husk ash and so on. the rice husk ash is an agricultural byproduct which is obtained from the rice mills ,the husk which is obtained from mill is of no use i.e it is not even be used for animals to eat. Hence it is used as a fuel in various big industries the burning temperature is very high hence they are obtained from that .the RHA is very lightweight. The research work here deals with the partial replacement of cement with RHA in concrete at various percentage such as 0%,5%,10%,15%,20% and 25% by mass of cement. Various experimental investigations are carried out to find out the compressive strength, split tensile strength and of concrete samples cured for period of 7 and 28 days . the results obtained from the experiments with satisfactory replacement of cement with rice husk ash are presented in this research paper.

Harsha Bhaskaran et.al 2016 This paper presents the partial replacement of cement by egg shell powder. In present world, increased accumulation of carbon dioxide content in atmosphere is creating environmental pollution and global warming. In every tons of cement manufacturing produces equal amount of carbon dioxide. In order to reduce the impact of carbon dioxide emission and to protect the environment, cement is been replaced by egg shell powder. This study represents the influence in properties of concrete when cement is replaced by 5%, 10% and 15% of egg shell powder. Properties are experimentally investigated based on compressive strength, split tensile strength and flexural strength of concrete. Compressive, tensile and flexural strength up to 7 days of age were compared with conventional concrete; from the results obtained, it is found that egg shell powder can be used as cement replacement material.

3. MATERIALS

CEMENT In this project, one of the binding materials is used that is cement and also one of the important materials for building in today's construction world. The Ultra tech 43 grade of ordinary Portland cement by IS: 8112-1989 is used in this project.

3.1 FINE AGGREGATES Aggregate is the granular material used to produce the concrete or mortar and when the particles of the granular material are so fine those they pass through a 4.75mm sieve that is fine aggregate. It is an essential constituent in concrete that is consists of natural sand or crushed stone. Density and the quality of fine aggregate that is sand is strongly influence the strength and hardened properties of concrete.

3.2 COARSE AGGREGATES Out of total aggregates, the aggregates that are retained on 4.75mm sieve are termed as coarse aggregates. The local available coarse aggregates (natural stone Aggregates) are used in the present work. The coarse aggregates with size of 20mm will be used in this present work.

3.3 RICE HUSK ASH

Ingredients	% Content
CaO(lime)	60
SiO2(Silica)	28
Al2O3(Alumina)	5
Fe2O3(Iron oxide)	4
MgO(Magnesia)	2
Alkalies	0.8
Sulphur	0.2

Table -1: **Chemical composition of Rice Husk Ash**

3.4 EGG SHELL POWDER

S.No	Composition	Percentage(%)
1.	CaO	53%
2.	MgO	1%
3.	SiO_2	1.5%
4.	Al_2O_3	0.28%
5.	Fe_2O_3	0.36%
6.	Cl	0.011%

Table -1: Chemical composition of EGG SHELL POWDER

4. METHODOLOGY

CASTING In order to test compressive strength of concrete, concrete specimens of standard cubical mould of size 150*150*150mm were casted in eleven different batches having different replacement percentage of Rice Husk Ash and ESP. The specimen used for this test is cylindrical and its dimension is 150mm in diameter and 300mm in length. The test is made on the beam of size 700 mm× 150mm × 150mm.

4.1 CURING All the materials when mixed adequately to achieve homogeneous mixture. After mixing the concrete was checked for required slump and then filled into moulds of required tests. The mould filled with concrete was compacted by table vibrator to achieve proper compaction. Mould surface was finished with trowel and date of casting with mix designation number is marked on it. The concrete specimens were then removed from moulds after 24 hours and then placed in curing tanks for curing process for 28 days at normal room temperature.

4.2 SLUMP CONE TEST It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside

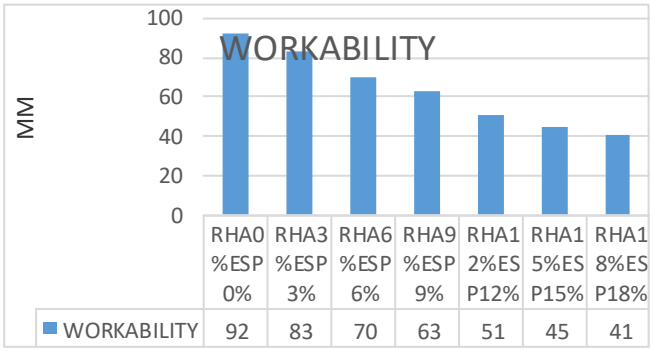

Fig -1: SLUMP CONE TEST

4.3 COMPRESSIVE STRENGTH TEST

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 7 days and 28 days in this research.

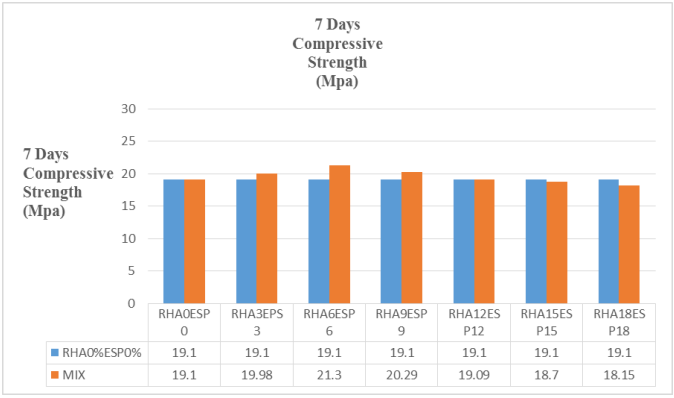

Fig -2: COMPRESSIVE STRENGTH TEST 7 days

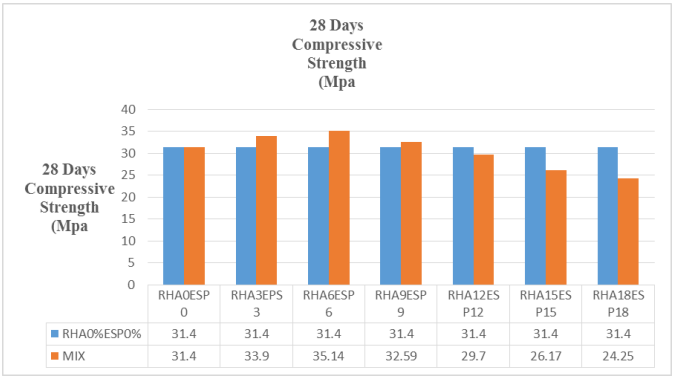

Fig -2: COMPRESSIVE STRENGTH TEST 28 days

4.4 SPLIT TENSILE STRENGTH

The specimen used for this test is cylindrical and its dimension is 150mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 7 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen

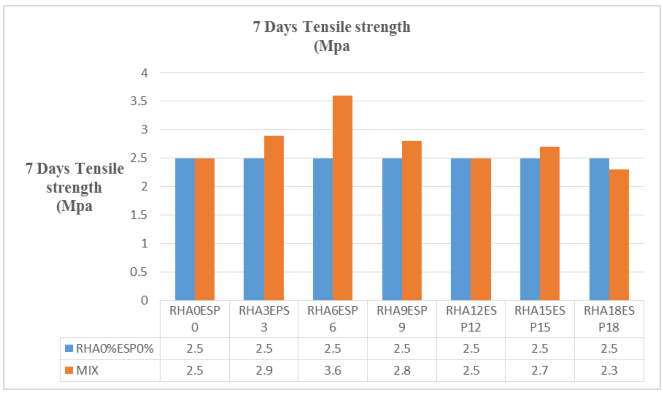

Fig -2: 4 SPLIT TENSILE STRENGTH 7 days

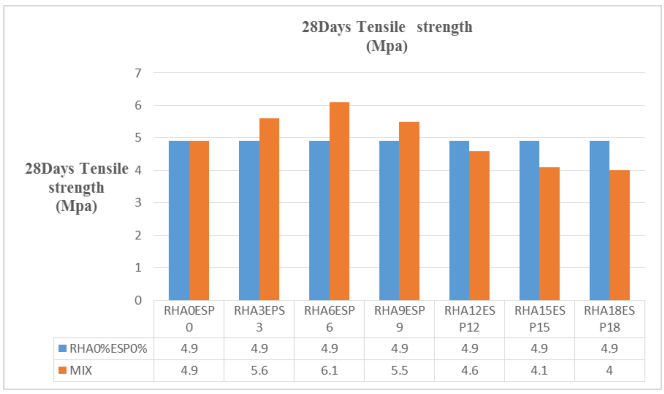

Fig -2: 4 SPLIT TENSILE STRENGTH 28 days

4.5 FLEXURAL STRENGTH TEST

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 7 and 28 days for testing.

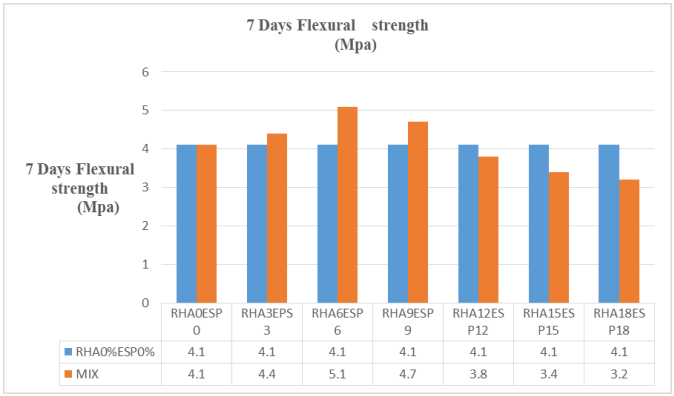

Fig -2: 4 FLEXURAL STRENGTH 7 days

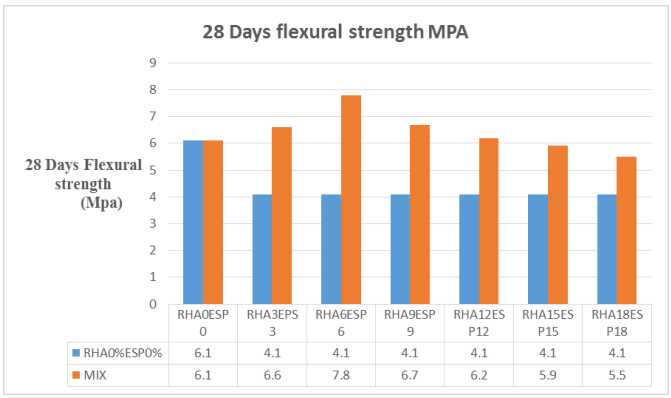

Fig -2: 4 FLEXURAL STRENGTH 28 days

5. CONCLUSIONS

1. The outcome of workability by Slump test method concluded that workability reduces with increasing % age of Rice-Husk-Ash and Egg shell powder. This may be due to water demand raises with raising % age of RHA.

2. The Compressive strength results show that by replacing cement with Rice-Husk-Ash and Egg shell powder, there is increase in compressive strength but aggregates in higher volume decreases strength. After Rice-Husk-Ash and Egg shell powder volume addition and replacing Cement, there is decrement of compressive strength.

3. The excellent substitution % age of RHA and ESP in terms of strength and economy is RHA6ESP6. The value of compaction strength obtained at optimum percentage substitution is 35.14 which is 11.9% higher than normal Mix.

4. The split tensile strength and flexural strength or modulus of rupture shown same nature as that of compressive strength or toughness strength.

5. The use of RHA and ESP in civil engineering works will reduce environmental pollution, upgrade quality of concrete, and reduce its cost of production.

6. The replacing of Cement with ESP has shown +ve impact on split tensile strength up to 6% substitution.

7. The highest value of tensile strength was obtained at RHA6ESP6 replacement which is 6.1Mpa.

8. The flexure strength also showed maximum strength when 6% of Cement is being replaced by RHA and 6% ESP, increased the strength up to 7.8% at 28th day. Both help in increasing strength at low volume replacement.

9. The excellent of favorable substitution % age of RHA and ESP in terms of strength at 28 days and economy is RHA6ESP6.

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