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PERFORMANCE OF CONCRETE WITH PARTIAL REPLACEMENTS OF CEMENT WITH EGG SHELL POWDER AND FA WITH COPPER SLAG

Veenam Mounica[1] T.Mahesh Kumar [2]
(Department of Civil Engineering)
NRI Institute Of Technology , Vijayawada ,India

Abstract: Concrete is being widely used for the construction of most of the buildings, bridges and it is also known as backbone to the infrastructure development of a nation. At present, for a variety of reasons, the concrete industry is not sustainable. Firstly, it consumes huge amount of natural resource due to which no virgin material will be left for future generation. Secondly, the major component of concrete is cement. Lot amount of greenhouse gas will be emitted in the manufacturing processes of cement. Thirdly, concrete structure suffers from durability problem due to which natural resources are wasted. Therefore, there is a need to find an alternative method so that concrete industry becomes sustainable. The cement produces about 5% of CO2 emissions of the world. 900kg of CO2 for every 1000kg of cement produced. In this project an experimental investigations will be conducted to study the properties of concrete containing copper slag as the partial replacement to fine aggregate and cement with egg shell powder. Different toughness test will be conducted on such concrete of M30 grade of concrete to know the compressive strength , split tensile strength and flexural strength by varying proportions of copper slag with fine totals by 0%,10%,20%,30% and cement with egg shell powder by 0%, 10%, 20%,30% by weight .The result obtained will be compared with the conventional concrete there by knowing the adjustments in the properties of cement containing copper slag as partial replacement to fine totals. The percentages of replacements is taken reference from after careful study literature review.

Index Terms **–** Copper slag, Egg shell powder, Sustainable concrete**.**

I. INTRODUCTION

The utilization of commercial waste or secondary materials has inspired the assembly of cement and concrete in construction field. New by-products and waste materials are being generated by numerous industries. Dumping or disposal of waste materials causes environmental and health problems. Therefore, recycling(reuse) of waste materials could also be an excellent potential in concrete trade. for several years, outgrowth(side product) like ash , silica fume and scum were considered as residue materials. With such materials concrete showed improvement in workability and sturdiness compared to old- fashioned concrete and has been used at intervals the event of power, chemical plants and under-water structures. Over recent decades, intensive research studies are administered to explore all possible reuse methods. Construction furnace, waste, steel scum, coal ash and bottom ash are accepted in many places as numerous aggregates in hill, roads, pavements, foundation and building construction. for each ton of copper production, about 2.2 plenty of copper scoria is generated. it's been calculable that approximately 24.6 million plenty of scum are generated from the planet copper industry. Although copper scum is widely utilized in the sand blasting industry and within the manufacturing of abrasive tools, the rest is disposed of with none further reuse or reclamation. Copper scum(slag) possesses chemical and mechanical properties that qualify the fabric to be utilized in concrete as a partial replacement for Portland cement or as a substitute for aggregates. for instance , copper scum features a number of favourable impersonal properties for aggregate use like excellent soundness, abrasion resistance and stability. Copper scum(slag) also conjointly exhibits pozzolanic properties since it contains low CaO. Under activation with NaOH, it'll exhibit artifact property and could be used as partial or full replacement for cement. the use of copper scum for hydraulic cement replacement in concrete, or as staple has the twin advantage of eliminating the value of disposal and lowering the value of the concrete. the utilization of copper scum/scoria within the concrete business as a replacement for cement will have the great thing about reducing the costs of disposal and facilitate in protecting the environment . Despite the actual fact that a lot of studies are according on the results of copper scum replacement on the properties of Concrete, further investigations are necessary so as to get a comprehensive understanding that might provide an engineering base to allow the use of copper slag(scum) in concrete.

Sustainable concrete:

In the pioneering report of the World Commission on Environment and Development (WCED), sustainable development is defined as: “Meeting the needs of the present generation without compromising the ability of future generations to meet their needs.” concept of sustainability is abalance of social, economic, and environmental principles as illustrated in Fig 1

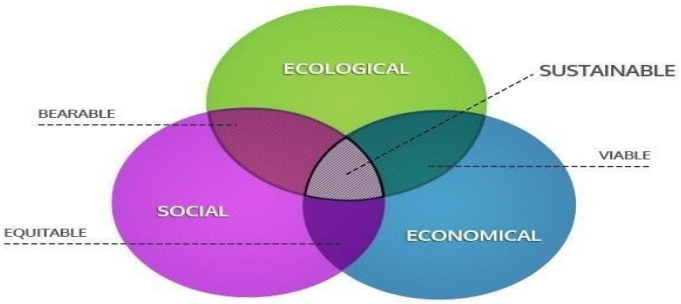

Fig-1: The concept of sustainability is supported by a balance of social, economic, and environmental principles.

Sustainability of Construction Materials:

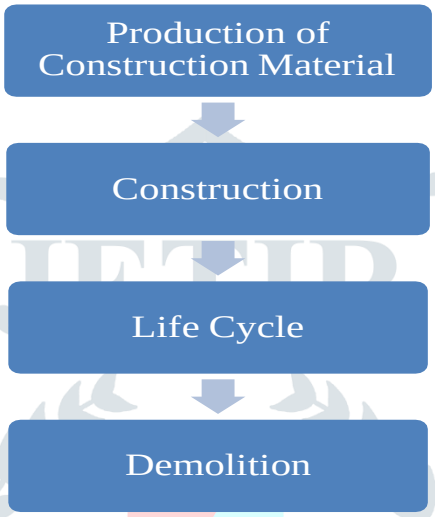

Fig -2: Various stages of construction Materials

Concrete sustainability:

For over 200 years, concrete has nearly become undisputed building material to human beings for its long lasting and dependable nature. Due to versatile and flexible nature of concrete, it is used in every type of structure and in every field, for example buildings, pavements, tunnels,sea shore structures etc. Concrete is durable in almost all types of weathering conditions and this makes concrete as extensively used building material. The principles (environmental, social, and economical) of sustainable development are easily incorporated in the design and proportioning of concrete mixtures and exhibited readily through applications in service. Particularly becauseof its long life, concrete is an economical, cost-effective solution. The use of concrete consumes minimal materials, energy, and other resources for construction, maintenance, and rehabilitation over its lifetime, while providing essential infrastructure to society.

Climate change and global warming are current and major concerns for humanity. The global warming is attributed to greenhouse effect because of gases termed as green house gases. The world's energy production is largely dependent on fossil fuel burning that produces CO_2. Thus major contributor to CO_2 emission that is CO_2 produced and emitted because of human activity, is energy production. Hence, higher the energy used in making of a material, the moreits contribution to CO_2. Embodied energy is defined as the available energy that was used in the work of making a product. Higher embodied energy thus balance. A sustainable material therefore shall have low embodied energy. Embodied energy is the sum of energy consumed in the production and transport.

Table-1: Embodied production energy of some construction materials

Type of Material	Energy (MJ/g)
Ordinary Portland Cement (OPC)	5.85
Lime	5.63
Lime Pozzolona	2.33
Steel	42.00
Aluminum	236.80
Glass	25.8

The following are the replacement materials to produce sustainable concrete.

1) Copper Slag
2) Egg Shell Powder

Copper Slag:

In this project fine aggregate is replaced with copper slag. The copper scum which we used had collected from a dealer of 'Hindustan copper limited' atVishakhapatnam. The wholesale price of the copper slag is about ₹650/ton and is also economical to use copper slag at the places where it is available. Copper scum is a outgrowth of copper extraction(methods used to obtaining copper from its ores) by smelting(applying heat to ore). During smelting, impurities become scum which floats on the molten metal. Slag that is quenched (the rapid cooling of a work piece) in water produces angular granules to obtain certain material properties which are disposed of as waste or utilized as discussed below.

- Copper Scum is mainly used in surface blast- cleaning and in construction.
- Copper Scum can be used in concrete production as a partial replacement for sand.
- It is used as a building material, formed into blocks. Such use was common in areas where smelting was done. The granulated slag (<3 mm size fraction) has both insulating and drainage properties which are usable to avoid ground frost in winter which in turn prevents pavement cracks. The usage of this scum reduces the usage of primary materials as well as reduces the construction depth which in turn reduces energy demand in building. Due to the same reasons the granulated scum is usable as a filler and insulating material in house foundations in a cold climate. Numerous houses in the same region are built with a scum insulatedfoundation.

Fig-3: Copper Slag

Table -2: Physical Properties of copper slag

S. No	Property	Values
1	Specific gravity	3.35
2	Fineness modulus	3.18
3	Bulk density	3.0
4	Water absorption	0.3 %

Table-3:Chemical properties of Copper Slag

Component	Copper slag (CS %)
SiO_2	33.05
Al_2O_3	2.79
Fe_2O_3	53.45
CaO	6.06
MgO	1.56
SO_3	1.89
K_2O	0.61
Na_2O_3	0.28
TiO_2	0
Mn_2O_3	0.06
CI	0.01
Loss of ignition	0
IR	0
CuO	0.46

Egg Shell Powder: The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another methods for processingand using egg shells waste in an ecological friendly way. There is a need to find a low cost solution. Removal of egg shell waste are usually not income centers but cost centers.

Fig-4: Egg Shell sample before and after crushing

Table -4: Physical Properties of Egg shell powder

NAME	PHYSICAL PROPERTIES
Specific gravity	0.85
Moisture content	1.18
Bulk density	0.8
Partial density	1.012
Porosity	22.4 BET
Surface area	21.2

Table-5: Chemical Properties of Egg shell Powder

Oxide contents	Percentage (%)
CaO	50.7
SiO2	0.09
Al2O3	0.03
MgO	0.01
Fe2O3	0.02
Na2O	0.19
P2O5	0.24
SrO	0.13
NiO	0.001
SO3	0.57
Cl	0.219

Objective of the project :

- This thesis mainly focuses on trying to create Sustainable concrete. With partial replacements in fine aggregate and binding material with copper slag and egg shell powder respectively.

- Aggregates was replaced at different percentages and different tests are conducted on specimens.
- The above results are comparing with conventional concretes. From the comparison of the results we will decide whether the replacement is advisable or not.

Scope of the study:

In this project an experimental investigations will be conducted to study the properties of concrete containing copper slag as the partial replacement to fine aggregate and cement with egg shell powder. Different toughness test will be conducted on such concrete of M20 grade of concrete to know the compressive strength , split tensile strength and flexural strength by varying proportions of copper slag with fine totals by 0%, 5%, 10%, 15%, 20%,25%,30% and cement with egg shell powder by 0%, 5%, 10%, 15%, 20%,25%,30% by weight .The result obtained will be compared with the conventional concrete there by knowing the adjustments in the properties of cement containing copper slag as partial replacement to fine totals. The percentages of replacements is taken reference from after careful study literature review.

Materials Used And Basic Tests:

The following materials are used for the execution of this thesis

Cement: Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most crucial style of cement are used as a component in the production of mortar in masonry, associate degree of concrete- that could be a combination of cement and associate degree combination to make a robust building material. The ordinary Portland cement of 53 grade is used in accordance with IS: 12269-1987.

Coarse Aggregates: Crushed stone aggregate of 20mm size is brought from nearby quarry. Aggregates of size more than20mm size are separated by sieving.

Fine Aggregates: Regionally available natural sand, free fromorganic matter is used. The result of sieve analysisconfirms it to Zone-II (according to IS: 383- 1970).

Copper Slag: The copper scum which we used had collected from a dealer of 'Hindustan copper limited' atVishakhapatnam. The wholesale price of the copper slag is about ₹650/ton and is also economical to use copper slag at the places where it is available.

Egg shell powder: In the present work, egg shells which was a residue material will be collected from bakeries, fast food restaurants and are sun dried. Stored eggshell will be powdered in flour mill. The grinded egg shells were sieved through the 90 micronsieve size and then packed to use it in the cement replacement.

Water: Generally potable water should be used. This is to ensure that the water is reasonable free from such impurities as suspended solids, organic matter and dissolved salts, which may adversely affect the properties of the concrete, especially the setting, hardening, strength, durability, pit value, etc.

Basic Tests:

The following basic tests are conducted on different types of materials

1. Consistency
2. Initial and final setting time
3. Specific Gravity
4. Sieve Analysis

Mix design:

With the given materials,the four variable factors need to be considered inconnection with specifying a concrete mix are:

1.Water –cement ratio.

2.Cement – aggregate ratio.

3.Gradation of the aggregates.

4.Consistency

Mix Proportion	Cement Kg/m^3	Fine Aggregate Kg/m^3	Coarse Aggregate Kg/m^3	Water Kg/m^3	Copper slag Kg/m^3	Egg Shell Powder Kg/m^3	Super Plasticizer Kg/m^3
Mix 1(0%)	360	798	882	197	0	0	1.44
Mix 2(10%)	324	718.2	882	197	79.8	36	1.44
Mix 3 (20%)	288	638.4	882	197	159.6	72	1.44
Mix 4 (30%)	252	558.6	882	197	239.4	108	1.44
Mix 5(40%)	216	478.8	882	197	319.2	144	1.44

Experimental Investigation:

It was proposed to investigate the properties of concrete, cast with partial replacement of cement with Egg shell powder and fine aggregate with copper slag slag by 0%, 10%, 20%, and 30 % ,40% and cured in potable water.

The following mixing sequence was arrived at after several trails optimizing the workability.

- All the ingredients were first mixed in dry condition in the concrete drum mixer for one minute.
- Then 70% of calculated amount of water was added to the dry mix and mixed thoroughly for one minute.
- The remaining 30% of water was mixed with the super plasticizer and poured into the mixer at the final stage and mixed thoroughly for another one minute before the concrete is taken from the mixer.
- The concrete was filled in the cube moulds of 150mm×150mm×150mm. Because strengths of concrete were cast in each mix.
- A minimum of 3 cubes were tested to ascertain any particular value and the mean thereof was taken as the result.

Results and discussions:

The experimental investigation has been carried out on the test specimens to study the fresh and mechanical properties of concrete by replacing the cement by Egg shell powder and fine aggregate is replaced with of copper slag for arriving optimum percentage of Glass powder and Steel Slag that gives maximum strength. The test Specimens are cast in steel moulds. The inside of the mould is applied with oil to facilitate the easy removal of specimens. The raw materials are weighed accurately. The concrete is mixed thoroughly in dry condition. The mixing is continued until a uniform colour is obtained. Fresh concrete is placed in the mould. The concrete specimen cast is a 150 × 150 ×150-mm cubes, After 24 h from casting, the test specimens are taken out and

placed in a curing tank, for 7 days age of the specimens. The specimens are tested for compression under UTM for arriving optimum % of Copper powder and Egg shell powder that gives maximum strength.

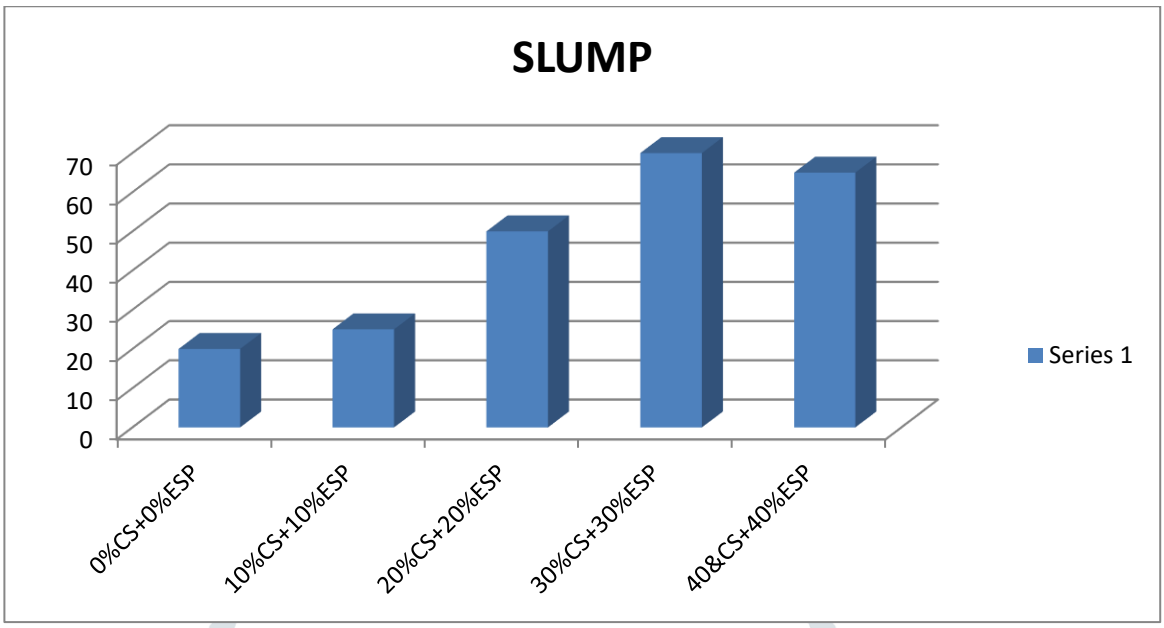

Fig-5: Slump For M30 grade concrete

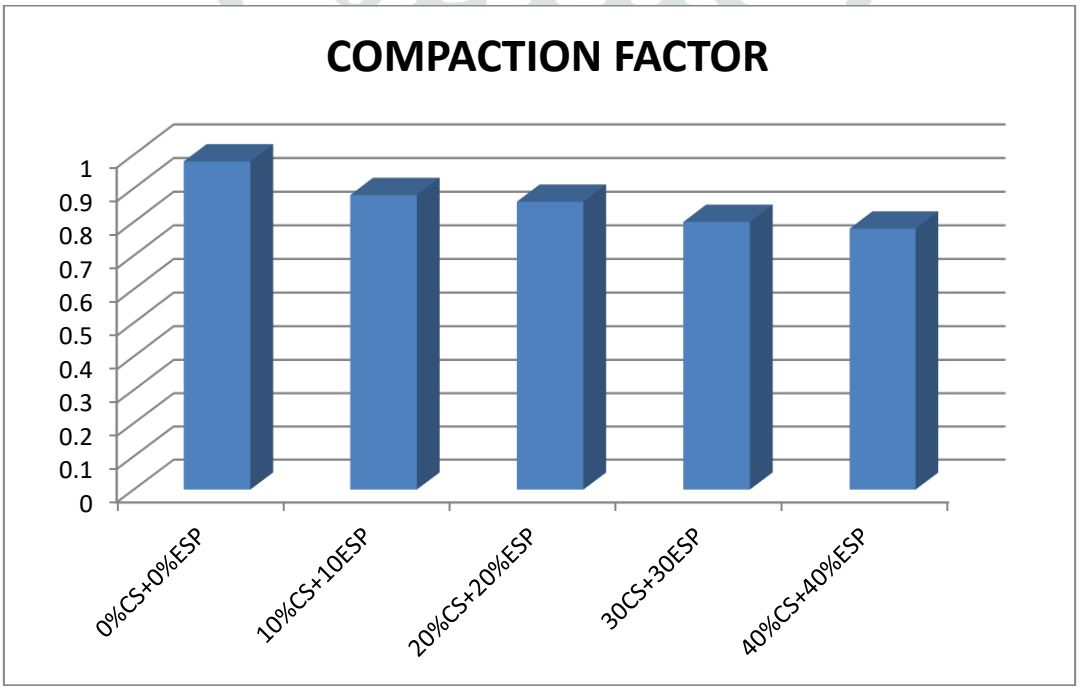

Fig-6: Compaction factor For M30 grade concrete

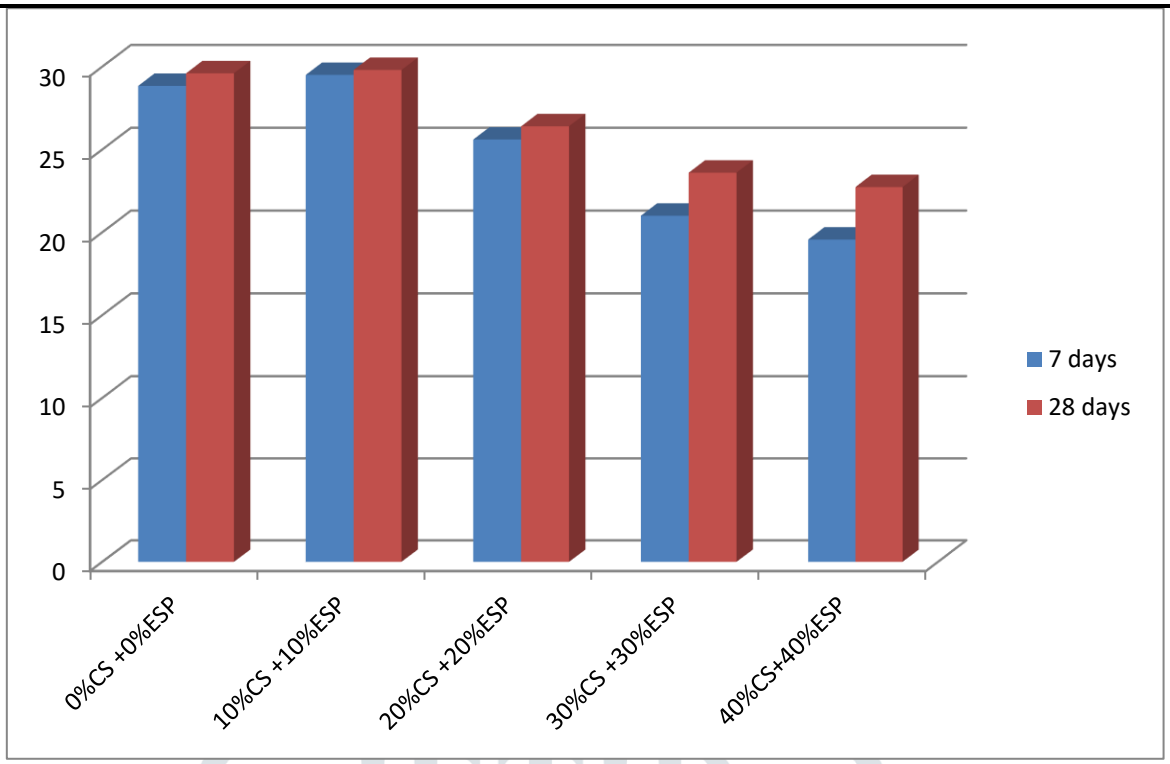

Fig-7: Compressive strength For M30 grade concrete

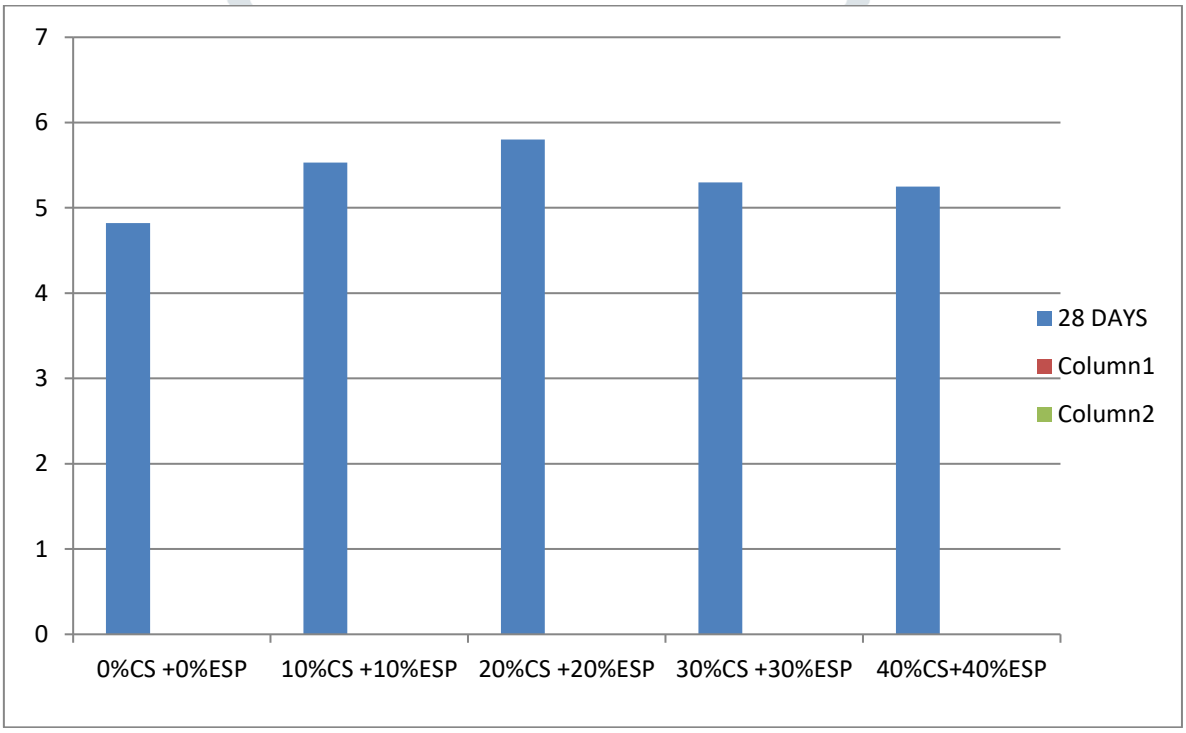

Fig-7:Split Tensile Strength For M30 grade concrete

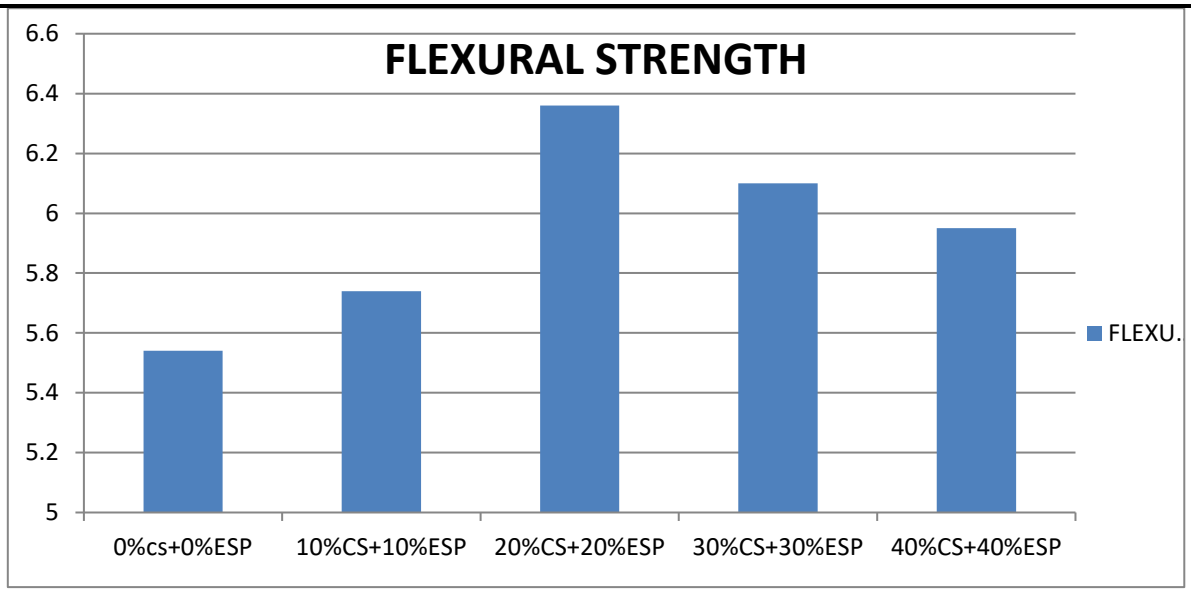

Fig-8: Graph: Flexural strength For M30 grade concrete

Conclusions:

Based on the above results the following conclusions had been drawn

- The material properties of the cement , fine aggregates and coarse aggregates are within the acceptable limits as per IS code recommendations so we will use material for research.
- Slump cone value for the copper slag and egg shell powder increases with increasing in the percentage of copper slag and egg shell powder so the concrete was not workable.
- Compaction factor value of copper slag and egg shell powder decreases with increase in the percentage of both copper slag and egg shell powder.
- The compressive strength of concrete is maximum at 10% replacement of copper slag and egg shell powder and is the optimum value for 7 days curing and 28 days curing.
- The split tensile strength of concrete is maximum at 20% replacement of copper slag and egg shell powder for 28 days curing in M30 grade concrete
- So, the replacement of 10% to 20% of copper slag and egg shell powder is generally useful for better strength values in M30 grade of concrete.

References:

- M. Sivakumar, Dr.N. Mahendran Strength And Permeability Properties Of Concrete Using Fly Ash (Fa), Rise Husk Ash (Rha)And Egg Shell Powder (Esp).
- Anand Parkash, Ar. Pardeep Kumar Yadav A Review Study Of Egg Shell Powder As A Cement ReplacingMaterial In Concrete.
- Vinay Kumar V A, Dr.H.Eramma An Experimental Investigation On Partial Replacement Of Cement With Egg Shell Powder And Lathe Waste In Concrete.
- Deepika K P Dr.Asha.K Utilization Of Copper Slag As A PartialReplacement Of Fine Aggregate In Concrete.
- N. Parthasarathi, M. Prakash , K. S. Satyanarayanan Experimental Study On Partial Replacement OfCement With Egg Shell Powder And Silica Fume.
- Nitish Kumar Sharma A Review On Partial Replacement Of Cement By Egg Shell Powder.
- M. N. Freire, J. N. F. Holanda Characterization Of Avian Eggshell Waste Aiming Its Use In A Ceramic Wall Tile Paste.
- M.O.A. Mtallib And A. Rabiu Effects Of Eggshells Ash (Esa)On The Setting Time Of Cement.
- Praveen Kumar R Vijaya Sarathy.R Jose Ravindraraj.B Experimental Study On Partial Replacement OfCement With Egg Shell Powder.
- D.Gowsika, S.Sarankokila, K.Sargunan Experimental Investigation Of Egg Shell Powder As Partial Replacement WithCement In Concrete.
- S.A. Raji, A. T. Samuel Egg Shell As A Fine Aggregate In Concrete For Sustainable Construction.
- Ch. Sai Bhavagna G. Lalitha Experimental Study On Concrete (M30) By Partial Replacement Of Fine Aggregate With Copper Slag.
- Jyoti Kamal, Prof. J.P. Singh Experimental Study On Strength Characteristics Of M25 Concrete With Partial Replacement Of Coarse Aggregate By Coconut Shell.
- Balimidi Harinath, Paladin Durga Varaprasad, Utti Lakshmi Kanth Experimental Study On Compressive Strength Of Cement Concrete Cubes By Partial Replacement OfCement With Egg Shell Powder.
- Gupta Ritesh S, Kheshwala Cherag B, Mom Samir R, Varaliya Mohammad A, Amin Kamani.
- Vijayvenkatesh.C Partial Replacement Of Cement With Glass Powder And Egg Shell(Powder)Ash In Concrete.