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Experimental Study Of Self-Compacting Ferrocement With Partial Replacement Of Cement By Eggshell Powder

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Abstract During the world, concrete is presence broadly used for the structure of greatest of the buildings, bridges etc. Presently, the complete construction industry is in exploration of an appropriate and operative the unused product that would greatly minimalize the use of cement and eventually decrease the creation cost. The carbon dioxide produced by cement industries causes environmental pollution and global warming. Such a substitute material are egg shell powder and silica fume. Therefore the suitable solution is the various waste material is partially replace with the cement. Since several replacement experiments are done for coarse and fine aggregates. It may lightly minimise the construction cost.So, in our concept of the project is partial replacing the cement with eggshell powder .our project describes the effect of replacement of eggshell powder for cement in proportion such as 5%,10% and 15%of ESP. The results outcome were found to be successful.

After curing period of 28 days, it is checked for its compressive strength, flexural strength test are taken. These are in comparison with a normal mixture which is 0% of ESP and determine the best combination of replacing the material.

Index term: Egg Shell Powder, Silica Fume, Plastisizer,cement

Introduction

In presence, concrete is broadly used for the shape of greatest of the buildings, bridges and so forth. Presently, the entire construction industry is in exploration of the precise and operative the wasted product that could significantly minimized the use of cement and in the end decrease the manufacture cost of concrete.

The huge amount of the carbon dioxide released during the manufacture of OPC due to the combustion of fossil fuel is in the order of one ton for every ton of OPC produced. In addition, the extent of energy required to produce OPC is only next to steel and aluminium. On other hand the abundant availability of Egg-shell waste worldwide creates opportunity to utilize this as a substitute for OPC to manufacture mortar or concrete.Within a span of 25 years, in India the egg production has gone up to 190 billion from few millions. Weight of Egg-shell of one Egg is near about 8 gms, It means every year 152000 metric tonnes of egg shells are produced.

Ferrocement: According to the ACI committee on ferrocement defined it is “Ferrocement is a type of thin walled reinforced concrete construction, where usually a hydraulic cement mortar is reinforced with layers of continuous and relatively small diameter wire meshes”. The mesh may be made of metallic or other suitable material.
According to the American Bureau of Shipping, ferrocement is defined as, “A thin and highly reinforced shell of concrete in which the steel reinforcement is distributed widely throughout the concrete, so material under stress acts approximately as a homogenous material”.

Objective of project

1) To develop Eggshell powder based self-compacting ferrocement.
2) To finalized the proportion of egg-shell powder with silica-fume.
3) To study the workability properties of fresh self-compacting ferrocement with partial replacement of cementby Eggshell powder
4) To study the effect of Eggshell powder on properties of self-compacting ferrocement with partial replacement of cement by Eggshell powder.

Literature review

P. Pliya, D. Cree, have studied limestone derived eggshell powder as a replacement in Portland cement mortar. In this study they concluded that the CaCO3 percentage contained in white and brown eggs were for the most part identical and slightly higher than conventional limestone. In this study, they also reported that the addition of white and brown eggshell limestone powder in mortar reduced the compression and flexural strength at all levels of limestone Portland cement replacement.

Khaleel, O. R., Razak, A., have developed mix design methods for self-compacting metakaolin concrete with different properties of coarse aggregate.(2014). This study was conducted in three phases, i.e. paste, mortar, and concrete. In this study, initial investigation on cement paste is carried out to basis for water-cement ratio and dosage of SPs. In this study metakaolin (MK) were used in mortar with replacement level 5%, 10%, 15%, 20% by weight of cement. Self-compacting concrete was achieved by adding suitable materials such as mineral admixture and superplasticizers. From results it can be concluded that, the optimum ML replacement level for cement was 10% from the view point of workability and strength. Results also indicate that, mixes which contain course aggregate with lower volume, small size, and continuous grading affected positively the fresh properties of SCC.

Gaikwad M. J., Shah, S. N., Patil. S. V., Dhonde. H. B., have developed a self-compacting mortar for prefab ferrocement. (2015). According to this work, certain limitations in traditional ferrocement construction would be overcome by using mass scale prefabrication of ferrocement product with the help of stronger, durable, better quality self-compacting mortar. This article reported SCM with relatively low w/c ratio provide improve bond characteristics between cement mortar and reinforcement, thus enhancing the mechanical and durability characteristics. According to this article, marsh cone test is not adequate to ascertain the powder- HRWR compatibility. Fly ash replacement provide significant improvement in slump flow, stability and strength of SCM.

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Nikbin, I., have reported effect of specimen shape and size on the compressive strength of self-consolidating concrete (SCC), (2014). In this study three mixes were proportionate to investigate the mechanical properties of self-compacted concrete cylinders and cubes. In this investigation natural sand and 12.5mm maximum size of course aggregates were used. Characterization tests were conducted are slump flow, T500, V-funnel, and L-box. Results indicate that, effect of specimen size plays an important role in slenderness ratio of specimen of 0.5 and 1.0, whereas for higher slenderness ratio, size effect is minimally affected by the concrete mix design.

Material and Methodology

Introduction From review of literatures it is observed that, only a limited number of studies have been evaluated the properties of concrete with partial replacement of cement by Egg-shell powder. Not even one literature is available in the published works regarding the use of Egg-shells powder in self-compacting ferrocement. For development of green ferrocement and quality control in methods of fabrication and construction of ferrocement it is necessary to characterized self-compacting cement mortar So that, mortar can be pumpable.

Fundamental Concept: Eggshells are agricultural throw away objects produced from chick hatcheries, bakeries, fast food restaurants among others which can damage the surroundings and as a result comprising ecological issues/ contamination which would need appropriate treatment. India ranked second in the world with annual Egg production. Production in India is about 185 billion to about 190 billion in year 2016. These many egg shells will be a waste annually. Disposal of these egg shells is a big problem because if they are send to landfills then it attracts vermin and causes problems related to human health and environment. Egg shells are rich in calcium and has nearly same composition that of limestone.From this review we can conclude that Egg shell concrete is best option to overcome the problems of solid waste management.

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3.3 Materials:In present experimental work, white coloured eggshells collected from restaurants and small Omelette stalls at mahatma nagar, Nashikis to be used as source material. Godavari River Sand is used as filler material. The sand is sieved and size fractions are combined in equal proportion to maintain grading complying with standard sand as per IS 650:1991.

1}Mortar:
For the Eggshell powder based self-compacting mortar, following parameters were selected on the basis of literature review.
2)Water:
The demand of water increases with increase in fineness of source material for same degree of workability. So, the minimum quantity of water required to achieve desired workability is selected on the basis of degree of workability, fineness of Egg shell powder and grading of fine aggregate.
3Cement:
Ordinary Portland cement of 53 grade is used. Table 1 shows the test results of basic properties of cement.
4) Eggshell Powder:
200 grams of egg-shells are produced every day at one station, it means total 10 kilograms of eggshells are produced every day in mahatma nagar. Egg-shells were grinded in small mixer to get fine size as same as size of cement. Egg-shell powder was sieved by using 90 micron sieve and powder passing through 90 micron sieve was taken for testing.

Experimental investigation:

Trial mix proportions for initial investigation

In present study, trial mix proportions were adopted from literature review for initial investigation and then required changes were done with help of results of workability and compressive strength tests. The trial proportions were adopted from literature review to finalise the proportions of various materials in self –compacting mortar. The quantity of plasticizers was selected on the basis of actual results of initial trials. The required quantity of plasticizer was found out on the basis of workability results of initial trials of self-compacting mortar.W/C ratio was selected on the basis of results of workability of initial trials. Minimum water content for each proportion was selected on the basis of results. If more water were added in mix then segregation was occurs and if more plasticizer were added in mix then specimen was not fully hardened after 24 hours therefore the minimum quantity of water and plasticizer was select on the basis of actual results of workability.

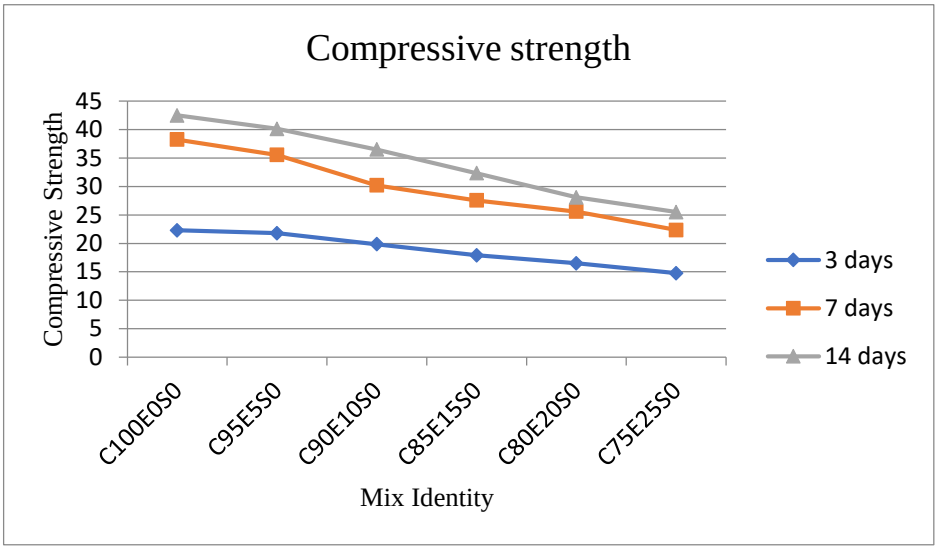
Sr. No	Mix Identity	Cement	Eggshell Powder	% of Eggshell Powder	Sand	Water in %	Plasticizer in %
01	C100E0S0	700	-	-	1400	0.28	1.7
02	C95E5S0	665	35	5	1400	0.30	1.6
03	C90E10S0	630	70	10	1400	0.30	1.5
04	C85E15S0	595	105	15	1400	0.30	1.5
05	C80E20S0	560	140	20	1400	0.35	1.5
06	C75E25S0	525	175	25	1400	0.35	1.5

Mix Proportion

Testing of trial mix: Results of workability and compressive strength test are shown in table

Sr. No.	Mix Identity	Mini slump (mm)	Compressive strength (mPA)		
			3 days	14 days	28 days
01	C100E0S0	200	22.29	38.25	42.50
02	C95E5S0	215	21.80	35.55	40.15
03	C90E10S0	218	19.85	30.20	36.50
04	C85E15S0	220	17.90	27.55	32.35
05	C80E20S0	223	16.50	25.60	28.10
06	C75E25S0	225	14.75	22.35	25.50

Compressive strength results of trial mixes

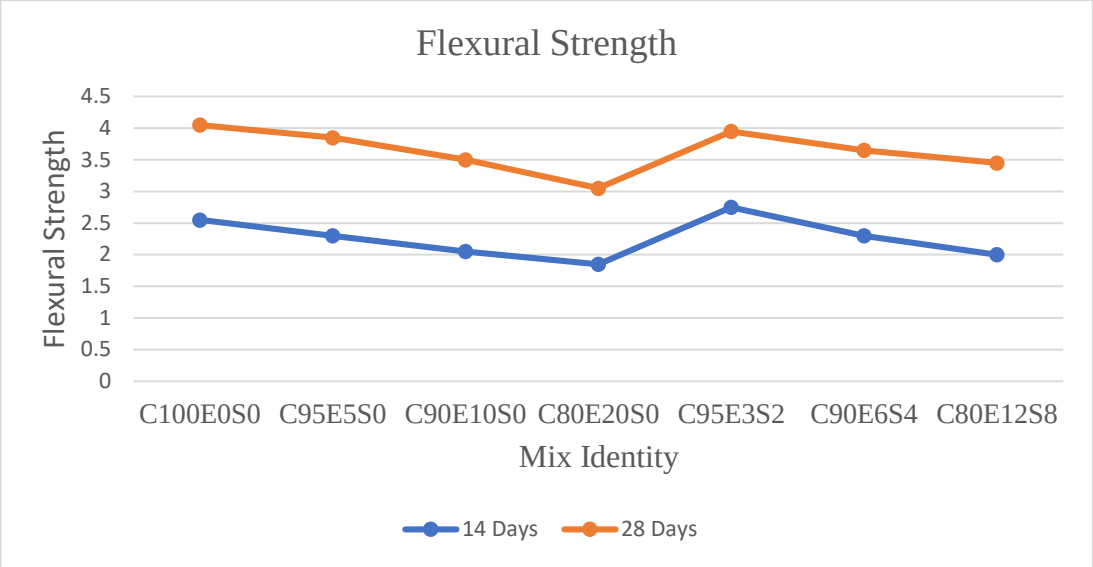


From the literature review it was observed that f proportion of 1:1 gives maximum strength but considering the economy point of view, the proportion of 1:1.5 was selected for further work.

Method of cast and testing of specimens:

Test for Flexural strength of self-compacting ferrocement: The system of loading used to find out the flexural strength is central point loading or third point loading. In centre point loading, maximum fibre stresses are come below the point of loading where the bending moment is maximum. The standard size of beam specimen was selected as per past investigation of flexural strength of self-compacting mortar and the size of beam specimen was (150 X 150 X 300) mm. Water curing of 14 days and 28 days was done and after water curing, the beam specimens were tested in Universal Testing Machine under centre point loading to find out flexural strength

Sr. No.	Mix Identity	Flexural Strength (Mpa)	
		14 Days	28 Days
01	C100E0S0	2.55	4.05
02	C95E5S0	2.30	3.85
03	C90E10S0	2.05	3.50
04	C80E20S0	1.85	3.05
05	C95E3S2	2.75	3.95
06	C90E6S4	2.30	3.65
07	C80E12S8	2.00	3.45



CONCLUSIONS:

- Compressive strength of Egg-shell based self- compacting ferrocement is very less as compare to controlled self-compacting ferrocement because Egg- shell powder is rich in calcium content but silica content in eggshell powder is very less. If silica fume is added into egg-shell based self-compacting ferrocement then compressive strength as well as split tensile strength gets increased.
- Workability of specimen after addition of eggshell powder and silica fume get increased upto 10 % as compared to controlled concrete.

References:

1) Dhanlakshmi M., Sowmya N. J., " A Comparative Study on Egg Shell Concrete with Partial Replacement of Cement by Fly Ash", International journal of engineering Research and Technology (IJERT),- Volume 4, may(2015) (3)
2) Praveen Kumar R., Vijaya sarathy. R., Jose Ravindraraj.B., "Experimental Study on Partial Replacement of Cement with Egg Shell Powder", International journal of innovations in engineering and Technology (IJIET) Volume- 5, (2015) (4)
3) M. Sivakumar, N. Mahendran,"Strength and Permeability Properties of Concrete using Fly Ash (FA), Rise Husk Ash (RHA) and Egg Shell Powder (ESP)", Journal of Theoretical and Applied Information technology,Volume-66, No-2, (Aug.2014) (5)
4) HanifiBinici, OrhanAksogan, Ahmet H, Sevinc, ErdiCinpolat, "Mechanical and Radioactive Shielding Performances of Mortars made with cement, sand and egg shells" Construction and Building Material, (2015), pp.0950-0618.(6)
5) FazeeraUjjin, Kamran Shavarebi Ali, ZarinaYasminHanurHarith, "Viability of Eggshells Ash Affecting the Setting Time of Cement", International journal of civil, Environmental, Structural, Construction and Architectural Engineering, Vol-10, No-3(2016)(7)
6) P. Pliya, D. Cree, "Limestone derived eggshell Powder as a replacement in Portland cement mortar", Construction and Building Material, 95 (2015), pp.01-09.(8)
7) Okonkwo U.N., Odiong I.C., Akpabio E.E., "The effects of Eggshell Ash on Strength Properties of Cement-Stabilized Lateritic", International journal of Sustainable Construction Engineering and Technology, Vol-3, (2012)(10)
8) Kevin Beck, Xavier Brunetaud, Muzahim Al-Muhtar, "On the use of Eggshell lime and tuffeau powder to formulate an appropriate mortar for Restoration purpose" The geological society of London, Special Publication, pp. 137-145, (2014)(11)