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EXPERIMENTAL INVESTIGATION OF CONCRETE AND PARTIAL REPLACEMENT OF SAND BY CALCITE CRYSTALS POWDER

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Abstract: Nowadays throughout the world concrete is being widely used for the construction of most of the building, bridges etc. Hence it has been properly labeled as the backbone to technical infrastructure development of a nation. To meet out this rapid infrastructure development, a high quantity of concrete is required. Unfortunately, India is not self sufficient in the production of cement. The demand for the main ingredients of concrete exceeds the supply and makes the construction activates very costlier. Hence currently the entire construction industry is in search of a suitable and effective waste product that would considerably minimize the construction cost. A few of such products have already been identified like rice husk ash, fly ash, silica fumes etc. In this paper we have proposed an approach which uses the calcite crystal as the fine aggregate and minimizes use of cement and also reduces the weight of the concrete and achieves the required strength of concrete.

Keywords: Silica fumes, Calcite crystals, Compressive strength, Infrastructure

1. INTRODUCTION

Throughout the world concrete is being widely used for the construction of most of the building, bridges etc. Hence it has been properly labeled as the backbone to technical infrastructure development of a nation. To meet out this rapid infrastructure development a high quantity of concrete is required. Unfortunately, India is not self sufficient in the production of cement. The demand for main ingredients of concrete exceeds the supply and makes the construction activates very costlier. Hence, currently the entire construction industry is in search for a suitable and effective waste product, that would considerably minimize the use of ultimately reduces the construction cost. A few of such products have already been identified like rice husk ash, fly ash, silica fumes etc. Among this, calcite crystals are known to have good prospects in minimizing the usage cement. In this paper we have proposed an approach to replace the fine aggregate by egg shell which reduces the weight of the concrete and achieves the required strength of concrete.

2. METHODOLOGY

In this section we explain the methodology as the sequential process of carrying out the work. The materials should be tested as per the IS procedure. Mix design for concrete proportion has been developed as per IS: 10262 – 2009. Casting and curing of the concrete specimens is done as per the IS procedures. The property of fresh concrete was tested as per IS: 1199 – 1959. The characteristic strength of hardened concrete specimen was tested as per IS: 456 – 2000. Compare the results of conventional concrete and partial replaced concrete.

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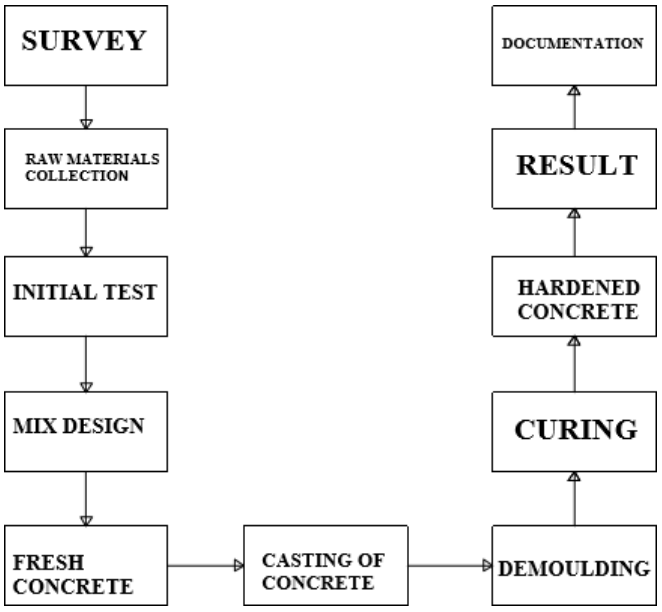

Figure 1. Methodology of project

2.1 Objectives of the research

The objective of this research is to study the maximum usage of egg shell in concrete mixture by partial replacement of fine aggregates. It has investigated the physical and chemical properties of egg shell when it is used in the concrete mixture. The results in the increase of the value of slump, unit weight and compaction factor of the fresh concrete are measured. In addition, this study has examined the effects egg shell in the characteristic strength of concrete on compression strength test, spilt tensile test, water absorption test and flexural test. The concrete is a composite material. The workability and strength development with age depends upon the properties of constituent materials and their combined action. The role of fine aggregate on strength and workability has to be checked before examining the possibility of replacement of fine aggregate. The choice of suitable materials for sand in concrete depends on several factors such as their availability, cost, physical properties and chemical ingredients etc.

2.2 Scope of project

- To provide an economical concrete.
- It should be easily carried out in construction field.
- To use the environmental waste in a useful manner.
- To reduce the cost of construction.
- To make the maximum usage of locally available material.
- To increase the compressive strength of the concrete.
- To make use of it in our day to day life.
- To increase the durability of the concrete.

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3. MATERIALS AND ITS PROPERTIES

3.1 General

The properties of the material, which are used in this work, are presented in this section. All the experiments are carried out as per Indian standards that are adopted to determine the characteristics of the material.

3.2 Calcite crystals powder

Egg shell powder (ESP) may be considered as a better replacement of fine aggregate for durable concrete structure. The study fulfilled the objective of the investigation and contributes to research on strength of concrete. Earlier reports illustrated the studies carried out only on the physical and chemical propertiesof egg shell powder (ESP).

Table 1. Properties of Egg Shell Powder

S.No.	PHYSICAL PROPERTIES	Value
1	Specific gravity	0.85
2	Fineness passing through 45µ sieve	2%
3	Moisture content	1.18
4	Particle density	1.012
5	Surface area	21.2

Dimensions of Slump Cone: Height: **300 mm**, Top Diameter: **100 mm**, Bottom Diameter: **200 mm.(IS)**

Table 2. Slump test value

Percentage of Egg Shell Powder Added To The Concrete	Diameter of Slump Flow
Concrete having no replacement	605mm
10%	680mm
20%	610mm
30%	520mm

3.3 Vee-Bee Consistometer Test

Table 3. Value of Vee Bee Test

Percentage of egg shell powder added to the concrete	Vee Bee (Sec)
Concrete have no replacement	2.5 sec
10%	2 sec
20%	3 sec
30%	5 sec

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3.4 L-Box test

This Method is used to determine flow rates and possibility of SCC in confined spaces. This is a widely used test, suitable for laboratory and perhaps site use. It assesses filling and passing ability of SCC, and serious lack of stability (segregation) can be detected visually. Segregation may also be detected by subsequently sawing and inspecting sections of the concrete in the horizontal section.

Figure 2. L – Box test for concrete

Unfortunately there is no arrangement on materials or dimensions or reinforcing bar arrangement, so it is difficult to compare test results. If the concrete flows as freely as water, at rest it will be horizontal, so H2/H1=1. Therefore the nearest this test value, the 'blocking ratio', is unity and better the flow of concrete.

Table 4. Value of L – box test

Percentage of egg shell powder added to the concrete	**Ratio (H2 / H1)**
Concrete have no replacement	0.93
10%	0.97
20%	0.90
30%	0.85

3.5 V-Funnel test

V-funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum aggregate size of 20 mm. Though the test is designed to measure flow ability, the result is affected by concrete properties other than flow. The inverted cone shape will cause any liability of the concrete to block to be reflected in the result-if, for example there is too much coarse aggregate.

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This test measures the ease of flow of concrete, shorter flow time indicates greater flow ability. For SCC a flow time of 10 seconds is considered appropriate. The inverted cone shape restricts the flow, and prolonged flow times may give some indication of the susceptibility of the mix to blocking. After 5 minutes of settling, segregation of concrete will show a less continuous flow with an increase in flow time. High flow time can also be associated with low deformability due to a high paste viscosity, and with high inter-particle friction.

Table 5. Value of V – Funnel Test

Percentage of ESP added to the concrete	**Time taken for flow (sec)**
Concrete have no replacement	7.5
10%	7
20%	8
30%	11

3.6 Casting

We can determine the strength of hardened concrete for which fresh concrete casted in cube and cylinder moulds as are casted as per standards. Size of the specimen is given below:

Cube size – **150 x 150 x 150 mm**
Cylinder size – **150 x 300 mm**

3.7 Curing

Curing is a process of reducing the rate of hydration of concrete and also it is useful to achieve the long term durability and strength. Curing can be done for 7, 14 and 28 days

Figure 3. Curing of concrete

4. HARDENED CONCRETE TEST

Hardened concrete test is used to determine the strength, durability, creep and shrinkage parameters of concrete structures. The concrete can be tested for two methods:

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i. Compressive strength test
ii. Spilt tensile strength test

4.1 Compressive Strength Of Concrete:

Table 6. Value of Compressive Strength Test

Percentage of egg shell powder added to the concrete	**7 Day Test N/mm^2**	**14 Day Test N/mm^2**	**28 Day Test N/mm^2**
Concrete have no replacement	35.1	38.5	41.2
10%	36.7	39.8	42.5
20%	34.9	37.1	39.7
30%	29.8	31.2	34.6

4.2 Split Tensile Test

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. After the curing period, the specimen is taken out from the curing tank and wipes it clean. Then the specimens are placed horizontally between the loading surface of the Compression testing machine and the load is applied till the specimens fails. The ultimate load at the time of the failure is noted down:

Horizontal compressive strength = $\mathbf{2P / \pi LD}$

Where,

P = Compressive load,

L = Length of the cylinder;

D = Diameter of the cylinder

Table 7. Value of Split Tensile Test

Percentage of egg shell powder added to the concrete	**7 Day Test N/mm^2**	**14 Day Test N/mm^2**	**28 Day Test N/mm^2**
Concrete have no replacement	2.9	4.5	6.9
10%	4.6	6.4	8.2
20%	3.1	4.8	7.1
30%	1.2	2.2	2.8

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5. RESULTS

In this test the results are obtained and it is clear that the replacement can be advantageously done up to 20%. Thus the 20% replacement of egg shell powder with fine aggregate in concrete can increase the strength up to 10 to 20 % and workability is also increased when compared with conventional concrete. Thus the 20% replacement of egg shell powder the strength is equal to the conventional concrete. But 30% replacement of egg shell powder in concrete decreases the strength from 10 to 20% and workability is highly reduced when compared with conventional concrete.

6. CONCLUSION

From the observations we gained knowledge about the workability and the performance of egg shell powder in concrete can be revised. The strength parameters of egg shell powder can also be revised by testing the strengths in both compressive and tensile at proper curing periods of 7,14 and 28 days in different ratios. We conclude that the experiment results show that every 10% increase of replacement egg shell powder decreases the strength of the concrete. The investigations revealed that the optimum percentage of using egg shell as a partial replacement in fine aggregate would yield considerable strength and sustainability.

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