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STUDY THE PROPERTIES OF CONCRETE BY REPLACING THE CEMENT BY EGGSHELL POWDER AND SILICA FUME

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Abstract- Concrete is the one of the most widely used construction material throughout the world. Hence it has been labelled as the backbone to the infrastructure development of nation. To fulfill the requirement of industries I have to replace fully or partially the constituent materials of concrete by using waste material. It was carried out to evaluate the properties of concrete by replacing the cement by eggshell powder and silica fume by varying the percentage of eggshell. A comparison of partially replaced concrete with conventional concrete was also include into the study. Comparison of weights of natural concrete with partially replaced concrete after 7, 14 and 28 days of curing was included. The mix design arrived for an M30 mix.

As I know the carbon dioxide produced by cement industry causes environmental pollution and global warming. In 1000Kg of cement manufacturing process approximately 900Kg of carbon dioxide is emitted. In order to reduce the cement production into atmosphere waste by products are used admixture in study so that environmental pollution and natural resources consumption is reduced. In India, eggshell powder which in calcium and silica fume is thrown away as waste. In the present study, I use eggshell and silica fume as a partial replacement of cement and various properties like workability, compressive strength was determined. Keep silica fume as constant and varying eggshell percentage I find strength of blocks.

1. INTRODUCTION

Cement is the costliest and energy intensive component of concrete. The unit cost of concrete can be reduced by partial replacement of cement with Eggshell Powder and partial replacement of cement with micro silica fume. Eggshell increases the solid waste which is a major issue for environment. The utilization of eggshell and silica fume instead of throwing it as a waste material can be partly used on economic grounds with partial replacement of cement.

It has been used particularly in mass concrete applications and large volume placement to control expansion due to heat and also helps in reducing cracking at early ages. Silica fume is byproduct of producing silicon metal or ferrosilicon alloys. One of most beneficial use of silica fume in concrete because its chemical and physical properties. Concrete containing silica fume can have high strength and can durable.

It is the action of human being that determines the worth of any materials having potentials for gainful utilization remain in the category of waste until its potential is understood and put to right use. Eggshell and silica fume is one such example, which has been treated as a waste material in India.

This project comprises of replacing of cement (OPC, 43 grades) for different percentage of Eggshell Powder and Silica fume and then testing them for their compressive strength.

2.CONCRETE MIX DESIGN

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability and workability as possible as economically is termed the concrete mix design. The ingredient proportioning of concrete is given by the required performance of concrete in 2 states, namely plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted. The Property of workability, therefor, becomes of vital importance. The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends upon many factors, e.g. quality and quantity of cement, water and aggregates; batching and mixing; Placing, compaction and curing. From technical point of view the rich mixes may lead to

high shrinkage and cracking in the structural concrete, and to evolution of high heat of hydration in mass concrete which may cause cracking.

2.1 Type of Mixing

Nominal Mix

In the past, the specifications for concrete prescribed the proportions of cement, fine and coarse aggregates. These mixes of fixed cement aggregate ratio which ensures adequate strength are termed nominal mixes. These mixes provide a marginal strength, however, due to the variabilit y of mix ingredients the nominal concrete for a given workability varies widely in strength.

Standard Mix

The nominal mixes of fixed cement aggregate ratio vary widely in strength and may result in varied mixes. For this reason, the minimum compressive strength has been included in many specifications. These mixes are termed standard mixes.

IS 456-2000 has designated the concrete mixes into a number of grade as M10, M15, M20, M20, M25, M30 and M40. In this designation, the letter M refers to the mix and the number to the specified 28-day cube strength of mix in N/mm2. The mixes of grades M10, M15, M20 and M25 correspond approximately to the mix proportions (1:3:6), (1:2:4), (1:1.5:3) and (1:1:2) respectively.

Designed Mix

In these mixes, the performance of the concrete is specified by the designer but the mix proportions are determined by the producer of concrete, except that the minimum cement content can be laid down. This is most rational approach to the selection of mix proportions with specific materials in mind possessing more or less unique characteristics. The approach results in the production of concrete with the appropriate properties most economically. However, the designed mix proportions for the prescribed performance.

It is a performance based mix where choice of ingredient and proportioning are left to the designer to be decided. The user has to specify only the requirement of concretes. The requirement in fresh concrete are workability and finishing characteristics, whereas in hardened concrete these are mainly the compressive strength and durability.

2.2 Factor Affecting the Choice of Mix Proportions

Compressive strength

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal water cement ration of the mix. The other factor affecting the strength of concrete at a given age is the degree of compaction this is cured at a prescribed temperature. As we know according to Abraham's law the strength of fully compacted concrete is inversely proportional to the water cement ratio.

Workability

The degree of workability required depends on three factors. These are the size of section to be concreted, the amount of reinforcement, and the method of compaction to be used. For the narrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved with a reasonable amount of effort. This also applies to the embedded steel sections. The desired workability depends on the compacting equipment available at the site.

Durability

The durability of concrete depends upon the aggressive environmental conditions. High strength concrete is generally more durable than low strength concrete. In the situations when the high strength is not necessary but the conditions of exposure are such that high durability requirement will determine the water cement ratio to be used.

Maximum nominal size of aggregate

The workability of concrete increase with increase in maximum size of the aggregate. In general, larger the size of aggregate smaller is the cement requirement. However, the compressive strength tends to increase with the decrease in size of aggregate.

Grading and type of aggregate

The grading of aggregate influences the mix proportions for a specific workability and water cement ratio. Coarser the grading leaner will be mix which can be

used. Very lean mix is not desirable since it does not contain enough finer material to make the concrete cohesive.

The type of aggregate influences strongly the aggregate cement ratio for the desired workabilit y and stipulated water cement ratio. An important feature of a satisfactory aggregate is the uniformity of the grading which can be achieved by mixing different size fractions.

Quality Control

Quality control can be estimated statistically by the variations in test results. The variation in strength results from the variations in the properties of the mix ingredients and lack of control of accuracy in batching, mixing, placing, curing and testing. The lower the difference between the mean and minimum strengths of the mix lower will be the cement content required. The factor controlling this difference is termed as quality control.

Mix Proportion Designations

To express the proportions of ingredients of a concrete mix is in the term of parts of ratios of cement, fine and coarse aggregate. E.g. a concrete mix of proportions 1:2:4 means that cement, fine and coarse aggregate are in the ratio 1:2:4 or the mix contains one part of cement, two parts of fine aggregate and four parts of coarse aggregate. The proportions are either by volume or by mass. The water cement ratio is usually expressed in mass.

3. MATERIAL PROPERTIES

Eggshell Powder:

Eggshell powder consists of fine, powdered particles predominated spherical shape, glassy which is amorphous in nature. The particle size distribution of eggshell is generally similar to silt less than 0.075mm and specific gravity ranges from 1.8 to 2.6. Eggshell has been added as percentage by weight of total cementitious material replacing cement by various percentage. Eggshell can be added to the concrete with the view of obtaining engineering properties. Since Eggshell poses pozzolanic properties similar to cement, it is expected to obtained the properties of concrete with the addition of eggshell through proper studies.

Figure 1 Eggshell powder

Manufacturing of Eggshell Powder

First, we have to collect the eggshell from the wanders, restaurants and dhabha. Eggshell is the outer part of eggs which is a waste material which can be pollute environment so it is the best way to utilize waste eggshell. Eggshell contains calcium to prepare eggshell powder we put the eggshells in water and cook for 30 min. After that we dry it completely. Once completed we put the shells into the grinder and grind it till it becomes a fine powder. After that we sieve the eggshells so that remaining large particle of eggshell can be remove.

Figure 2 Boiling of eggshell

SILICA FUME:
Silica fume also known as micro silica is an amorphous polymorph of silicon dioxide. It is an ultrafine powder collected as a byproduct of silicon and ferrosilicon alloys production.

First testing of silica fume in Portland cement based concrete carried out in 1952.The biggest drawback of silica fume was exploring the properties of silica fume with which to experiment.

PROPERTY:
Silica fume is an ultrafine material with spherical particles less than 1 μm in diameter, the average being about 0.15 μm. This makes it approximately 100 times smaller than the average cement particle. The bulk density of silica fume depends on the degree of densification in the silo and varies from 130 (unidentified) to 600 kg/m3. The specific gravity of silica fume is generally in the range of 2.2 to 2.3. The specific surface area of silica fume can be measured with the nitrogen adsorption method. It typically ranges from 15,000 to 30,000 m2/kg

APPLICATION:
Because of its extreme fineness and high silica content, silica fume is a very effective puzzolonic material. Standard specifications for silica fume used in cementitious mixtures are ASTM C1240 Silica fume is added to Portland cement concrete to improve its properties, in particular its compressive strength, bond strength and abrasion resistance. These improvements stem from both the mechanical improvements resulting from addition of a very fine powder to the cement paste mix as well as from the pozzolanic reactions between the silica fume and free calcium hydroxide in the paste.

Addition of silica fume also reduces the permeability of concrete to chloride ions, which protects the reinforcing steel of concrete from corrosion, especially in chloride-rich environments such as coastal regions and those of humid continental roadways and runways (because of the use of salts) and saltwater bridges.

Prior to the mid-1970s, nearly all silica fume was discharged into the atmosphere. After environmental concerns necessitated the collection and landfilling of silica fume, it became economically viable to use silica fume in various applications, in particular high-performance concrete.

4. MANUFACTURING OF SILICA FUME
Silica fume is a byproduct of producing silicon metal and other ferrosilicon alloys. These products are produced in an electric furnace and the smoke generated from the furnace is collected and known as silica fume or microsilica. This also helps reduce the carbon emissions of the producer.

Use of Silica Fume
The most common use of silica fume is in the production of concrete in which its compressive strength, bond strength and abrasive resistance improve the properties of the concrete. As the particle sizes are 1/100th the size of a normal cement particle, the compressive strength of the cement is increased resulting in high-strength concrete capable of a compressive strength of over 15,000psi - useful in supporting high rise building structures.

Figure 3 Silica fume

5. CONCLUSION
Conclusion from the test performed and the analysis of the results following conclusions seem to be valid with respect to the utilization of Eggshell powder. Use of eggshell powder improves the workability of concrete and workability increases with the increase in the eggshell powder content.

Bleeding in Eggshell concrete is significantly reduced and other properties like cohesiveness and surface finish are improved. Compressive strength of the concrete made with 25% showed a greater value of strength as compared to that other partial replacement. Further it can be clearly concluded from the results of the compressive tests that replacement of cement is satisfactory only when the initial strength of the structure is not of much importance.

It can be easily and satisfactory used for concrete used in Dams and other heavy structure where the heat of hydration is required to be kept to a smaller value. This can be easily proved from the strength that the 10%, 20%, 30% replacement of cement with eggshell powder showed after 28 days. This clearly proves that the initial strength of concrete with silica fume has lower strength but acquire higher strength after 28 days. This strength will be even more after 56 days. Though initial strength seems to be low it can be satisfactorily used for even in areas where initial strength keeps importance by adding admixtures. Adding admixtures accelerates the setting time hence greater initial strength.

As the replacement of cement with eggshell powder showed satisfactory results, we would highly recommend the replacement of eggshell in areas of construction like Dams, pavements, in bricks manufacturing. Use of eggshell powder should be encouraged as it not only makes the concrete economical but also saves the environment from the pollution eggshell. So that we can have a developed and healthy nation. Egg shell powder obtained from industrial wastes is added in various ratios for cement replacement and it was found that replacement of 5% Egg shell powder + 20 % Micro silica can be added without any reduction in compressive strength properties of conventional cement. And replacement of 5% Egg shell powder + 10% Micro silica replacement in cement yields similar flexural strength as in conventional concrete. And replacement of 5% Egg shell powder + 10% Micro silica replacement in cement yields higher Split Tensile strength as compared to other compositions.

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