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Experimental Approach to Find out Effective Use of Molasses and Steel Slag in Concrete

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Abstract – In present era vast development occurred in the field of concrete technology. Many scientists and researchers have been developed abundant techniques to improve strength and durability parameters of the concrete. A number of studies have been carried out to investigate the possibility of utilizing a broad range of materials as partial replacement material for cement in the production of concrete. The use of supplementary cementations material in production of concrete can result in major saving of energy and cost. It also helps to improve strength, durability, and chemical resistance of concrete.

Use of admixtures has been a costly affair in concrete mix. Though it enhances the properties of the final product the cost incurred is not optimum. Every production industry produces some by-products which may not be useful for them in the future and are termed as waste products. One such waste that is generated in Sugar industries is molasses. It is generally the waste floating on the sugar juice during the production of sugar from sugarcane. Being cheaper in cost it can widely be used as an admixtures. This study has found that use of molasses as an admixture enhances the properties of concrete such as initial and final setting time, strength and workability. In this study a comparison between concrete with 3%, 4% and 5% of molasses addition with constant water cement ratio is done. Molasses obtained from sugar industries have been used for the experimental purpose. Workability is carried out at initial fresh concrete stage. Compressive strength, Split tensile strength and flexural strength is carried out on hardened concrete. Strength characteristics are tested on 3rd day, 7th day and 28th day of casting of concrete Keywords: Concrete, strength, molasses, cost, workability, admixtures.

Keywords: Fly Ash, Coconut shell, Glass, Compressive Strength, Tensile strength, waste material

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I. INTRODUCTION

General

The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. These include the use of by-products and waste materials for building construction.

Aggregates categorized under this section are those directly used without the need for processing. The high cost of conventional building materials is a major factor affecting construction in India. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used for various purposes in construction industry. This will have double the advantages, reduction in the cost of construction material and also as a means of disposal of wastes. Due to industrialization, consumption of construction materials is increased which causes the decrease of natural resources day by day. It create environmental imbalance, so it needs to find alternative materials such as industrial waste or agricultural waste which can be replaced with construction materials completely or partially. Thus the approach is logical, worthy and attributable. Therefore an attempt has been made in this study to utilize the coconut shell, glass powder and fly ash as partial replacement of coarse aggregate, fine aggregate and cement in the development of light weight concrete.

II. OVERALL REVIEW OF CONCRETE:

A composite product obtained by mixing cement, water, coarse aggregate, fine aggregate is called as concrete. Concrete is a composite material composed of aggregate bonded together with cement which hardens over time. In Portland cement

concrete when the aggregate is mixed together with the dry cement and water, they form a fluid mass that is easily moulded into shape.

The cement reacts chemically with the water and other ingredients to form a hard matrix which binds all the materials together into a durable stone- like material which forms the concrete. There are various types of concrete available, created by varying the proportion of the main ingredients which varies its properties such as strength, density, chemical or thermal resistance.

One of the most familiar cementitious material is fly ash which is added as mineral admixture either pre-blended with the cement or directly as a concrete component- and become a part of the binder for the aggregate. A major component of concrete is cement, which has its own large environmental impacts. The cement industry is one of the primary producers of carbon dioxide (CO2), a major greenhouse gas. Concrete dust released by building demolition and natural disaster can be a major source of dangerous air pollution. The concrete industry is one of second largest producers of carbon dioxide (CO2), creating up to 5% of worldwide man-made emissions of this gas, 50% is from the chemical process and 40% from burning process of fuel.

Cement manufacturing process contributes to greenhouse gases directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide, and also from the combustion of fossil fuels. The carbon emissions are so high as cement has to be heated to very high temperatures in order to form clinker. To reduce this approach the partial replacement of conventional clinker with such alternatives as fly ash, bottom ash, and slag can be made. Fly ash and bottom ash come from thermoelectric power plants, while slag is a waste from blast furnaces in the ironworks industry. These materials are slowly gaining popularity as additives they can potentially increase strength, decrease density, and prolong durability of concrete.

Steel Slag:

Slag is a by-product generated during manufacturing of pig iron and steel. Through the action of various fluxes upon gangue materials over the iron ore during the process of pig iron making in blast furnace and steel manufacturing in steel melting shop. Initially, slag consists of aluminum silicates, magnesium, manganese andcalcium in various combinations. The cooling process of slag is mainly responsible for generating different types of slags required for various end-use consumers. Although, the physical properties vary widely with the changing process of cooling but chemical composition of slag may remain unchanged.

III. OBJECTIVE

Following are the objectives of the research:

1) To study the properties of molasses and Steel slag

2) To study the properties of ingredient of concrete (Standard Concrete For M 20 Grade)

3) Comparative Study between conventional concrete and molasses and steel slag concrete with the following

Tests (For M 20Grade of Concrete)

i) Compression Strength

ii) Tensile Strength

IV. PROBLEM STATEMENT & METHODOLOGY

Problem Statement: Now-a-day's construction of infrastructure and housing increases rapidly in our country. Due to this consumption of cement, coarse aggregate and fine aggregate increases day by day, for manufacturing of these ingredients requires the natural recourses so due to this large amount of utilization natural recourses environmental imbalance takes place, due to this need of alternative materials essentially require to partially replacement of these ingredients. So, the effective use of molasses and steel aggregate can be best alternative for coarse aggregate, and cement in concrete

Methodology: For this research, the following flow of work followed –

Step 1- Collect the molasses and steel slag from the adjoining industry.

Step 2- Further analysis of this molasses and steel slag to be carried out, to identify the physical and engineering properties of the same.

Step 3- Molasses and steel slag with different proportion added to concrete mix design for M 20 grade of concrete and different elements like a cube and cylinders of this concrete to be cast.

Step 4- Different tests will be carried out on cast elements and test results compared with conventional concrete.

Step 5- Cost analysis is to be calculated.

Experimental Details: -

The ingredients of concrete i.e. cement, fine aggregate, coarse aggregate, steel slag, molasses are tested before producing concrete. The respective Indian standard codes are followed for conducting various test on ingredients materials of the concrete. The raw materials used in this experiential work locally available and these included Ordinary Portland Cement (O.P.C) and molasses as binding agent, sand as fine aggregate and steel aggregate as coarse aggregate flay ash as cement. Potable tap water was used for mixing and curing throughout the entire casting. The permissible and tolerance limits of water were checked as per the I.S 456-2000.

Test of properties of different materials

Cement:- Ordinary Portland cement grade 43, conforming to I.S 12269-2009 was used.

Table No 1: Properties of Cement

Sr No	Physical Property	Test Result
1	Standard Consistency	36%
2	Fineness	4.6%
3	Soundness	1mm
4	Initial Setting Time	50 min
5	Final Setting Time	563 min

Coarse Aggregate, Fine Aggregate and Steel Slag

Test	Fine Aggregate	Coarse Aggregate	Steel Slag
Specific Gravity	2.56	2.7	2.71
Moisture Content	1.5	Nil	0.41
Fineness Modulus	3.48	6.9	3.15

Casting of Sample:

1. For the determination of compressive strength of concrete the mould of size 150x150x150 mm for M30grade of concrete are used It is cured for 3,7& 28 days.

2. For the determination of split tensile strength of concrete the specimen are casted of size 150mm dia.&300 mm ht. for M30grade of concrete are used It is cured for 3,7& 28 days.

3. The necessary precautions were taken during casting after 24 hrs all the specimens are demoulded & curing was done under standard conditions.

V. RESULTS:

Compressive Strength

As per IS 516:1959, test specimens of size 150x150x150 mm were prepared for testing the compressive strength concrete. Fly Ash, coconut shell and glass with different proportion (10 %, 20%) added to concrete mix design for M 30 and different elements like a cube, cylinders, are casted.

The rate of applied loading should be 140 kg/ cm2 per minute. In this study, to make concrete, cement and fine aggregate are first mixed dry to uniform colour and then coarse aggregate was added and mixed with the mixture of cement and fine aggregates.

Water was then added and the whole mass mixed.

The interior surface of the moulds and the base plate were oiled before concrete was placed. After 24 hours the specimens are removed from the moulds and placed in clean fresh water at a temperature of 27ºC. The specimens casted are tested after 3 days, 7 days and 28 days after curing. For testing in compression, no cushioning material was placed between the specimen and the plates of the machine. The load was applied axially without shock till the specimen was crushed. Results of the compressive strength test on concrete are as follow:

Results: Compressive Strength (0,25%, 50%, 75%, 80%, 90% addition of Steel Slag and 0,0.3,0.6,0.9,.1.2,1.5 % of Molasses)

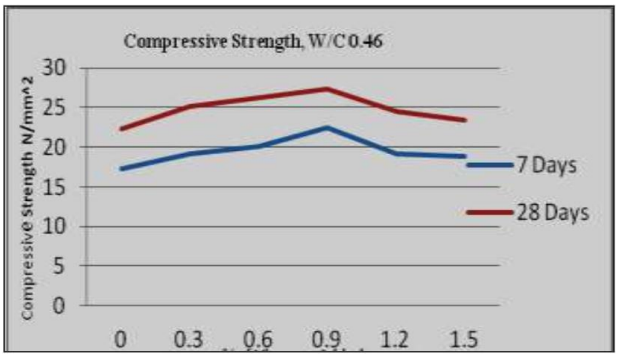

Figure 1: Compressive Strength of Concrete (W/C 0.46)

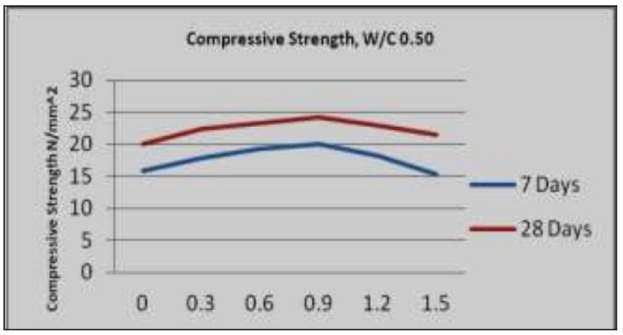

Figure 2: Compressive Strength of Concrete (W/C 0.50)

Experimentally it is found that by adding molasses up to 0.90 % and 75% steel slag causes to increase the Compressive strength of concrete. This is due to the quantity of macromolecular micelle-forming compounds present in molasses is an important factor creating good conditions for homogeneity in density of the concrete. extra increases in the dosage, cause segregation of surface ingredients; an mass increase in the amount of gels produced by hydration; and the formation of defects in the microstructure of concrete, resulting in a decrease in its strength.

SPLIT TENSILE STRENGTH

Concrete is sufficient in strength only in one direction. The tensile strength of concrete is approximately one-tenth of the compressive strength and it is not generally used in the design of concrete structure. Nevertheless, it is an important property in many applications. The splitting indirect tensile is also known as the Brazil test, which developed originally in Brazil. The testing of specimens in pure tension is very difficult and usually determines by indirect mean, applying tension in the form of splitting. Concrete specimens for indirect tensile test were 150mm diameter and 300mm height. The specimens were placed with its axis horizontal, between the platens of a compression testing machine. Load was applied until the specimen fails in its vertical diameter. The splitting test is simple to conduct and gives more consistent results than other tension tests. It is believed that the strength obtained by splitting test is near to that of the true tensile strength of the concrete than modulus of rupture. Tensile strength of a concrete is a measure of its ability to resist forces, which stretch or bend it. Unlike steel, the concrete is sufficient in strength only in one direction. The tensile strength of concrete is approximately one-tenth of the compressive strength and it is not generally used in the design of concrete structure. Nevertheless, it is an important property in many applications. The splitting indirect tensile is also known as the Brazil test, which developed originally in Brazil. The testing of specimens in pure tension is very difficult and usually determines by indirect mean, applying tension in the form of splitting. Concrete specimens for indirect tensile test were 150mm diameter and 300mm height. The specimens were placed with its axis horizontal, between the platens of a compression- testing machine. Load was applied until the specimen fails in its vertical diameter. The splitting test is simple to conduct and gives more consistent results than other tension tests. It is believed that the strength obtained by splitting test is near to that of the true tensile strength of the concrete than modulus of rupture.

Concrete cylinders casted .cured and then it is tested for split tensile on 7th and 28th day, under the UTM. The specimen having diameter 150 mm and height 300 mm tested. Fig 3 and 4 shows the experimental results for 0.46 and 0.50 W/C.

Results: Split Tensile Strength (0,25%, 50%, 75%, 80%, 90% addition of Steel Slag and 0,0.3,0.6,0.9,.1.2,1.5 % of Molasses)

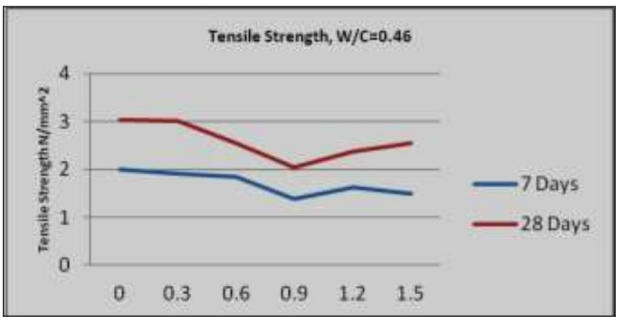

Figure 3: Split Tensile Strength of Concrete (W/C 0.46)

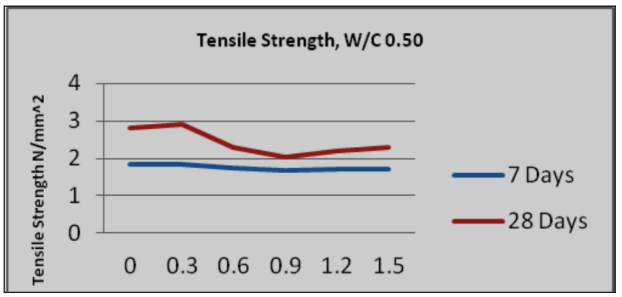

Figure 4: Split Tensile Strength of Concrete (W/C 0.50)

VI. CONCLUSION:

After this experimental study, it has proved to be better way for disposal Molasses. The replacement of cement by molasses has increased the compressive strength, and split tensile strength of concrete. The optimum percentage of cement replacement with molasses was found to be 0.9%.and steel slag 75% As we increase the percentage of molasses and steel slag in concrete it shows decrease in strength.

When we used this optimized value, it will give additional durable concrete and excellent strength as compared to conventional concrete. It is prove that the waste material of distillery units of sugar factories are excellent modifiers of the properties of concrete. Large use of distillery molasses in the construction industry saves cement also improves the quality of concrete mixtures; and minimize the environmental problems, because the wastes from distillery units is directly dump in water bodies and open land, which causes pollution of water and soil.

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