EXCHANGING CEMENT AND RIVER SAND PARTLY BY USING "GROUND GRANULATED BLAST FURNACE SLAG (GGBS) " & "COPPER SLAG (CS)"

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Abstract

The construction industry consumes a huge amount of concrete due to fast urbanization and an increase in the construction field is depleting the resources of natural sand and manufactured sand at a high rate of concern hence leading to various problems in the environment. Besides that, cementitious material in concrete releases a large amount of CO2 into atmosphere. Similarly cost of concrete is attributed to the cost of its ingredients. The concept of using eco-friendly materials in concrete enhances scope for green concrete which utilizes many kinds of industrial by-products thus resulting in the use of substitute materials which are economical in concrete production. This has attracted the attention of investigators to look out for new replacements for fine aggregate and cement. The copper slag, which is an industrial by-product produced while smelting and refining copper may be a partial alternative for fine aggregate and GGBS, a byproduct of steel manufacturing industry can effectively replace cement with better durable concrete mix.

In the present study river sand will be partially substituted by Copper slag 35 % constant and cement will be partially replaced by GGBS 5%, 10% and 20% and The strength parameters such as compressive strength, tensile strength will be confirmed for both 7 days, 14 days and 28 days of curing period. Based on the test appropriate results will be derived.

Key words

River Sand, Cement, Copper Slag, Ground Granulated Blast-Furnace Slag(GGBS), Compressive Strength and Tensile Strength.

Introduction

Development in science and technology in the last decades have expanded various industries. As a result, there is an increased need for materials, such as iron, steel, copper, and concrete. Concrete has become an essential construction material that cannot be avoided. According to current trends, concrete has avoided the phase of system of four components, namely, cement, water, coarse aggregate and fine aggregate. It can be a combination of various other factors. In recent times, apart from the four ingredients of fly ash, ground granulated blast furnace slag, silica fume, rice husk ash, metakaolin and super plasticizer, there are six more materials used in the manufacture of concrete. The situation demands. The main aim of sustainable construction is reducing the negative impact on the environment caused by the construction industry which is the largest consumer of natural resources. Over the years, managing waste has become one of the most difficult and challenging issues in the world affecting the environment to a great deal. Many kinds of by products have been generated due to the fast growth of industrialization kinds of waste which have proved hazardous to the environment and has also given rise to storage problems. The construction industry has constantly been at the forefront in the consumption of these waste products in huge quantities. The use of slag in concrete not only helps in decreasing greenhouse gases but also helps in producing materials which are environmental friendly.

Objectives

1) To partially replace sand with Copper slag and cement with GGBS in concrete as it Directly influences economy in construction.To design and proportion the concrete mix for M25 grade concrete, As per the recommendation of IS:10262:2019. To find the percentage of replacement alternative material.

2) To find the Volume proportions of the concrete mixes by partially replacing Sand with Copper slag and cement GGBS in one phase.

3) To check the variation of Compressive Strength, Split Tensile Strength and Flexural Strength results by constant replacing the sand 40% with Copper Slag and the cement partial replacement rate of 10%, 20%and with GGBS compared with controlled concrete and plotting the corresponding graphs separately in another phase.

4) To reduce the demand of river sand and protect the natural resources. Environmental friendly disposal of waste copper and steel slag.

Material

1) Copper Slag Sand :-

In nature, iron, copper, lead, nickel and other metals are found in impure states called ores, often oxidized and mixed in with silicates of other metals. During smelting, when the ore is exposed to high temperatures, these impurities are separated from the molten metal and can be removed, that impurities crushed with help of crusher with appropriate size that’s matches to the natural sand.

So we use the waste copper slag in concrete to become the construction economical as well as eco-friendly. The iron slag sand used in the present study is brought from bhagvati Steel industry, Sinner. This material replaces the natural sand in mix proportion.

2) Granulated Blast-Furnace Slag (GGBS) :-

Ground-granulated blast-furnace slag (GGBS) is obtained by quenching molten iron slag from a blast furnace in water, to produce a glassy, granular product that is then dried and ground into a fine powder. Ground-granulated blast furnace slag is a latent hydraulic binder forming calcium silicate hydrates (C-S-H) after contact with water. It is a strength-enhancing compound improving the durability of concrete. It is a component of metallurgic cement. Its main advantage is its slow release of hydration heat allowing to limit the temperature increase in massive concrete components and structures during cement setting and concrete curing, or to cast concrete during hot summer.

3) Cement :-

Cement consists of four major compounds tricalcium silicate (C_3S), Dicalcium silicate (C_2S), Tricalcium Aluminates (C_3A) and Tetra Calcium Alumino ferrite (C_4AF). Tricalcium Silicate (C_3S) and Dicalcium silicate (C_2S) is the most important compound responsible for strength. Together they constitute 70-80 percent of cement. The average C_3S content in modern cement is about 45 percent and that of C_2S is about 25 percent. During the course of reaction of C_3S and C_2S with water, calcium silicate hydrate (C-S- H) and calcium hydroxide ($Ca(OH)_2$) are formed. Calcium silicate hydrates are the most important products and determines the good properties of concrete. C_3S readily reacts with water and produces more heat of hydration. It is responsible for early

strength of concrete. C_2S hydrates rather slowly produces

less heat of hydration. It is responsible for later strength of concrete. The C_3A portion of cement hydrates more rapidly, thereby reducing the workability of fresh concrete. Regarding particle size distribution, it may be noted that finer particles hydrate faster than coarser particles and hence contribute more to early age strength; however, at the same time, the faster the rate of hydration may lead to quicker loss of workability due to rapid and large release of heat of hydration. After reviewing all above requirements Ordinary Portland cement (OPC) of grade 43 cement is used throughout the experimental work.

4) Aggregate :-

Aggregate is a collective term for the mineral materials such as sand, gravel and crushed stone that are used with a binding medium (such as water, bitumen, Portland cement, lime, etc.) to form compound materials (such as asphalt concrete and Portland cement concrete). Aggregate is also used for base and sub base courses for both flexible and rigid pavements.

The importance of using the right type and quality of aggregates cannot be overemphasized. The fine and coarse aggregates generally occupy 60% to 75% of the concrete volume (70% to 85% by mass) and strongly influence the concrete's freshly mixed and hardened properties, mixture proportions, and economy. Fine aggregates generally consist of natural sand or crushed stone with most particles smaller than 4.75mm. The importance of using the right type and quality of aggregates cannot be overemphasized. Coarse aggregates consist of one or a combination of gravels or crushedstone with particles predominantly larger than 4.75 mm and generally between 9.5 mm and 37.5 mm

5) Water :-

Water plays an active role in the chemical process of hydration and in curing concrete. It is important ingredient of concrete as it actively participates in the mix design consideration. The strength of concrete is mainly due to binding action of heat of hydrated cement gel. The requirement of water should be reduced to that required for chemical reaction of heat of hydration and required for workability. The excess water form undesirable voids and capillary cavities in the hardened cement paste in concrete.

It is necessary that water used for mixing and curing should be clean and free from injurious material likes oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete and steel. Drinking water is generally considered satisfactory for mixing concrete.

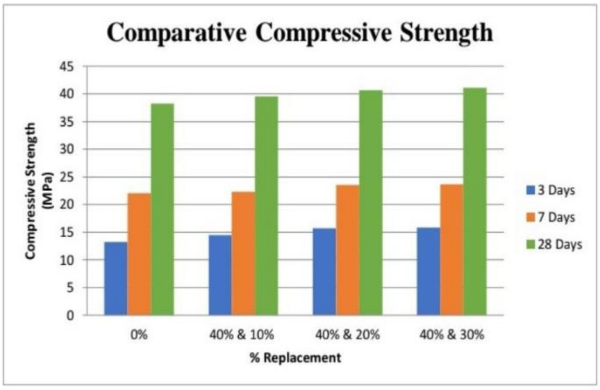
Conclusion

A large amount of copper slag and GGBS is produced during production of copper and Iron. Some of these are used in the mechanical industry for Sand blasting and other purpose. Copper slag and GGBS can be used in civil industry. Properties of copper slag and GGBS are related to river sand and Cement.So it can be partially used in concrete. This will reduce the consumption of natural sand and Cement to a great amount and help to maintain the environment balance. Partially use of copper slag and GGBS in Concrete can be increase its strength and durability. Due to this some advantages we are using copper slag and GGBS in concrete.

Acknowledgment

We have great pleasure in delivering the project on the topic "**EXCHANGING CEMENT AND RIVER SAND PARTLY BY USING "GROUND GRANULATED BLAST FURNACE SLAG (GGBS)" & "COPPER SLAG (CS)"** This project has helped to express extracurricular knowledge with incredible help from guide of our project Prof. S.V. Jadhav We would like to thanks especially to the HOD civil department Prof.R.B. Ghogare As well as staff members of civil department, all of them very compassionate and really went off their Way to help. We would like to thanks especially to Prof. S.M. Kale, Project coordinator, for his timely help and guidance toward successful completion of our project .We would like to thanks especially to Dr. S.T Shirkande, Principal of S.B.P.C.O.E. INDAPUR, for his guidance toward successful completion of our project.

Result



Graph 4.2.4 Comparative Compressive Strength of Concrete with Cement replacement with GGBS and Natural Sand Replacement with Copper Slag Sand for 28 Days

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