Partial replacement of Fine Aggregate By using Spent Fire Brick Waste

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ABSTRACT

The best method to deal with these environment concerns is to use or recycled material as spent fire bricks waste as a substitute for fine aggregate in the range of 0%, 10%, 20% by weight of M20 grade concrete. Sieve analysis is done for spent fire bricks waste for the replacement of fine aggregate. Concrete mixtures were prepared tested and compared in terms of compressive strength to the conventional concrete. These tests were carried out to evaluate the strength properties for 28 days .In this direction a preliminary investigation was under taken SPENT FIRE BRICKS WASTE material from foundry bed and walls and lining of chimney which is adopted in many industries for partial replacement of sand in making good concrete .

I.INTRODUCTION

A composite material that consists essentially of a binding medium, such as a mixture of portland cement and water, within which are embedded particles or fragments of aggregate, usually a combination of fine and coarse aggregate. Concrete is by far the most versatile and most widely used construction material worldwide. It can be engineered to satisfy a wide range of performance specifications, unlike other building materials, such as natural stone or steel, which generally have to be used as they are. Because the tensile strength of concrete is much lower than its compressive strength, it is typically reinforced with steel bars, in which case it is known as reinforced concrete.

The proportions of cement, aggregate, water and admixture (if required) are important in making high quality and inexpensive concrete. Concrete is made up of about 65% - 80% aggregate and the rest is made up of water and cement using the water cement ratio which can be calculated by the formula W/C = water amount /cement weight, i.e. 20 L/ 40 kg = 0.5 The lower the ratio, the stronger the concrete. For example, the water cement ratios for 35MPa concrete is 0.5; for 20MPa concrete it is 0.75; and for 10MPa concrete it is 1.0. Hence, the lowest water cement ratio has the highest MPa. (Concrete Basics, 2004)

Aggregates come in different textures and sizes but for standard concrete the average aggregate size should be 20 mm (metromix.com.au). Coarse aggregates consist of crushed rock and gravel. Sand is an example of a fine aggregate. Aggregates should be free of all dirt and clay and should not consist of soft stones that crumble easily, such as sandstone, as these weaken the concrete. Aggregates need to be strong and durable stones that withstand the elements, for example, granite. Aggregate shapes are either angular or rounded Angular aggregates create a less workable but stronger concrete as they bond together much better than rounded aggregates. Rounded aggregates create a more workable but weaker concrete (Concrete Basics, 2004).

II. LITERATURE REVIEW

2.1 GENERAL

Concrete is a most versatile construction material because it is designed to withstand the harsh environments. Engineers are continually pushing the limits to improve its performance with the help of innovative chemical admixtures and supplementary materials. These materials are majority by products from other processes. The use of these by product not only helps to utilize these waste materials but also enhances the properties of

concrete in fresh and hardened states. The usage of industrial by-products especially industrial slag in making of concrete is an important study of worldwide interest. Many researchers have investigated the possible use of copper slag as a concrete aggregate. For this study, some of the important literatures were reviewed and presented briefly.

of iron in it.

2.3 REVIEW OF LITERATURE

Balasubramanian.B, Gopalakrishna GVT and saraswathy.v in their paper. "**Investigation on partial replacement of coarse aggregate by SFB in concrete**" in June 2016. In this paper an experimental work have been done to determine the compressive strength, tensile strength and flexural strength of concrete by using spent fire bricks waste as a partial replacement material for fire aggregate. Different types of conventional cubes with partial replacement of SFB on a percentage of 5%, 10%, 15%, 20%, 25% and 30% to fine aggregate with water cement ratio as 0.5 was made. The compressive strength of concrete when comparing with conventional concrete at 28 days strength. It is found that 27% higher when coarse aggregate is replaced by 15% with SFB. More than 15% of replacement for fine aggregate is not considerably useful for construction field because of strength decreases. Thus the environmental effects from industrial waste can be significantly reduces.

Suchithra S, Manoj Kumar, Indu V.S in their paper **"Study on replacement of coarse aggregate by spent fire bricks waste in concrete**" published by International Journal of Technical Research and Applications in July-August 2015. This paper presents the partial replacement of spent fire bricks with fine aggregate. The work was conducted on M20 grade mix. The replacement of fine aggregate with spent fire brick waste in the range of 0%,5%,10%,15% and 20%. Finally the mechanical properties and durability of the concrete mix specimens obtained from the addition of these materials is comparedwith control concrete mix. The test results showed that a significant improvement in compressive strength was achieved in the SFB concrete compared to conventional concrete and can be used effectively in concrete.

PanneerSelvam. N1, Gopala Krishna GVT in their paper **"Recycle of SFB in Concrete**" published in International Journal of Science and Research (IJSR), April 2016. In this work printed circuit board is used as a SFB waste material. Benefits of recycling are extended when responsible recycling methods are used. Concrete mixes with different percentages of SFB were casted. It has been decided to make three different types of conventional specimens with partial replacement of SFB on a percentage of 10%, 20%, and 30% to coarse aggregate with water cement ratio of 0.45. For conventional specimens are also prepared for M20 Concrete without using SFB aggregates. The effect of physical and mechanical properties of the concrete were studied.

Manikandan.P, Senthamilkumar.S in their paper **"Behavior of SFB in Concrete"** published in International Journal for Research in Applied Science & EngineeringTechnology (IJRASET) inOctober 2015.An experimental study utilization of SFB materials in concrete with a percentage of 0% to 20% at the strength criteria M25 grade of concrete. Following that thechemical properties like chloride and sulphate testing also conduct for this study. Finally this study gives the environmentalaspects for the SFB and basic mechanical properties and chemical behavior of conventional and SFB concrete for M25grade.

P.KrishnaPrasanna, M.KantaRaoin their paper **"International Journal of Education and applied research Strength Variations in Concrete by Using SFB as Fine Aggregate"** published in Jan - June 2014.An experimental study is made by preparing specimens by utilizing SFB particles as fine aggregates in concrete with a percentage replacement from 0% to 20% i.e. (5%, 10%, 15%, and 20%). And Conventional specimens are also prepared for M30 grade Concrete without using SFB aggregates. By conducting tests for both the specimens the hardened properties of concrete are studied. It is found that use of SFB aggregates results in the formation of concrete which has lesser weight than that of conventional concrete. This study ensures that reusing of SFB waste as fine aggregate substitutes in concrete gives a good approach to reduce cost of materials and solve solid waste problems posed by SFB.

R. Ilangovana, N. Mahendrana and K. Nagamanib in their paper, "**Strength and durability properties of concrete containing SFB as fine aggregate**" published in ISSN 1819-6608, ARPN Journal of Engineering and Applied Sciences in October 2008.This paper presents the feasibility of the usage of SFB as hundred percent substitutes for Natural Sand in concrete. Mix design has been developed for three grades using design an approach IS, ACI, USBR, RN.No.4 and BRITISH for both conventional concrete and SFB concrete. Tests were conducted on cubes and beams to study the strength of concrete made of SFB and the results were compared with the Natural Sand Concrete. An attempt has also been made to durability studies on SFB when compared with the Natural Sand concrete.

III.PROPERITIES OF MATERIALS

Cement, fine aggregate, coarse aggregate, Spent fire bricks waste are the various materials used in this project. Before casting the specimens various tests of materials has been conducted and a study on them is presented in this chapter.

3.2 STUDY OF MATEIALS

CEMENT

Cement is defined chemical entity formed from predetermined ratios of reactants at a fairly precise temperature.Cement is obtained from limestone (calcium carbonate) and small quantities of other materials (such as clay) through a heating process in kilns, the process known as Calcinations. The resulting hard substance, called 'clinker', is then ground with a small amount of gypsum to form Ordinary Portland Pozzolana Cement also referred as PPC. This forms a basic ingredient of concrete, mortar, grout etc. and its most common use is in the production of concrete. Concrete is a composite material which consist of cement, aggregates (both coarse [gravel] and fine [sand]), and water. It has a wide application in the construction industry since it can be cast and molded in any desired shape. After it hardens, it can be effectively used for load bearing structures.

b)FINE AGGREGATES

Fine aggregate consist of mainly sand which may be natural, manufactured or a combination of both. It consists of clean and durable particles generally spherical or cubical in shape. The use of flat or elongated fine aggregate particles should be restricted and also care should be taken to ensure that there are no contaminating substances - dirt, dust, mud, and construction debris - present in fine aggregates. Fine aggregates particle size varies from 0.075 to 0.425 mm. The specific gravity of sand is 2.5.

c) COARSE AGGREGATE

Coarse aggregates consist of aggregates larger than fine aggregates and their sizes vary from 20 to 4.75mm. These tend to improve quality and bond characteristics and generally results in a higher flexural strength of concrete. It also helps in reducing shrinkage. These aggregates occupy 70-80% of volume of the concrete. The specific gravity of sand is 2.7.

d) SPENT FIRE BRICKS WASTE

Spent fire bricks is a waste product obtained from the lining of chimneys in foundry bed walls or in some industries. In general a SFB is used a filler materials attempt was made in partial replacement of fine aggregate (sand). In addition to this, an alternative source for the potential replacement of natural aggregates in concrete has gained good attention. As a result reasonable studies have been conducted to find the suitability of SFB in brick manufacturing industry in conventional concrete. SFB is fine sand particles. When boulders are broken into small pieces SFB is formed. It is gray in color and it is like fine aggregate. The fineness modulus of SFB is 2.98.

E)WATER

Water for construction of concrete structure should be same quality as drinkable water. The strength of concrete is totally depend upon the water thus water should be free from impurities. Impurities like suspended solids, dissolved salts organic matter. Which affect properties of concrete. These impurities can be changed setting time, hardening, strength, durability and etc. Water should be tested from an approved lab and should be checked regularly and pH value of water is 7.

III Mix design of Concrete for M20

Design mix of concrete for 25 grade are made as per IS 10262: 2009. Water cement ratio and minimum cement content is taken as per IS 456: 2000 (Table 5). Size of nominal maximum ofaggregates is 20 mm used. Minimum water content as per IS 10262: 2009.

IV TESTING OF MATERIALS

SPECIFIC GRAVITY TEST:

Specific gravity of fine aggregates is found to be 2.5. And as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.2 to 3.2.

SIEVE ANALYSIS TEST:

Fineness modulus of Fine Aggregate is 4.82%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST

% of water absorption of fine aggregate = 1.2%.

SPECIFIC GRAVITY TEST:

Specific gravity of coarse aggregate is found to be 2.71 and as per IS 2386 (part3):1963, the specific gravity of coarse aggregate should be 2.6 to 2.9.

SIEVE ANALYSIS TEST:

Fineness modulus of Coarse Aggregate is 5.18%.The soil belongs to zone II of classification (IS383).

WATER ABSORPTION TEST:

% of water absorption of coarse aggregate = 0.72 %

v)RESULT

1 GENERAL

The values obtained for Compressive Strength of cubes are tabulated. Comparisons are made and are presented in this chapter.

8.2 COMPARISON OF RESULTS

a) COMPRESSIVE STRENGTH OF CUBES

The values obtained from the compression test on cubes (28^{th} day) are tabulated. Graphs are plotted for compressive strength vs. % adding for waste SFB. Further satisfactory results are obtained for 0%, 10%, 20%, 30%.

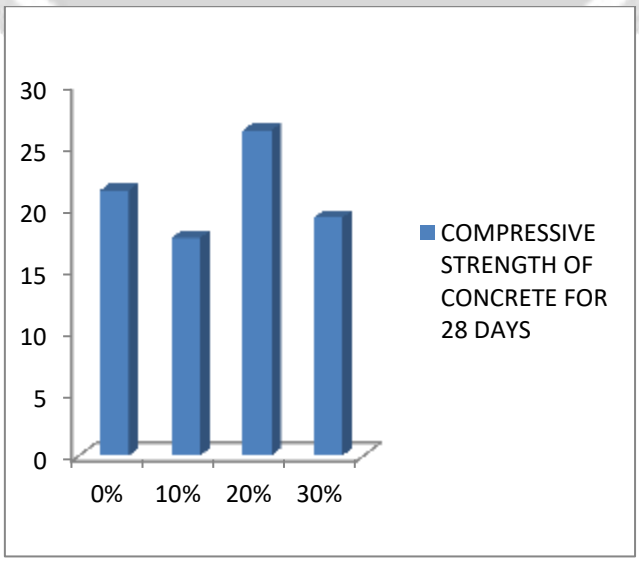
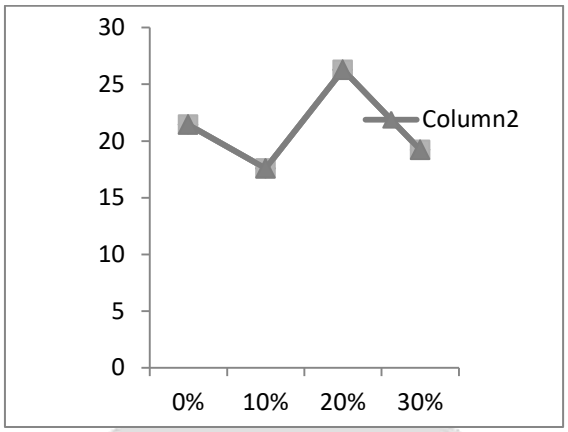


Fig 8.1 Compressive strength of concrete at 28 days

Fig 8.2 Compressive strength of concrete at 28 day



V) CONCLUSION

- A lot of benefits are derived by management of industrial waste, some of which are conservation of raw materials in term of cost and environmental preservation.
- SFB produced by partially replacing sand with spent fire bricks is compatible with conventional concrete production and construction techniques.
- Use of SFB as partial replacement for sand in concrete enhances the resistance of concrete to moisture absorption and transport of deleterious ions, resulting in improved durability characteristics.

VI.FUTURE SCOPE

1. It will slightly reduce the dependency on natural sand.
2. High strength gives in tension as compare to conventional concrete.
3. Accidental fire bricks or fire bricks who has deformed or recycled bricks are easily available in India when partially replaced with sand then cost will be reduced.
4. Natural aggregates are the natural resources and which are limited. Thus fire bricks aggregates concrete can be best cheap material instead of natural sand.
5. This project will open the new benchmark in research.In future work, the security can be increased by implementing searchable encryption is of increasing interest for protecting the data privacy in secure searchable cloud storage. In future, investigate the security of a well-known cryptographic primitive, namely, public key encryption with keyword search (PEKS) which is very useful in many applications of cloud storage.
Unfortunately, it has been shown that the traditional PEKS framework suffers from an inherent insecurity called inside keyword guessing attack (KGA) launched by the malicious server.

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