International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 12 | Dec 2020 www.irjet.net p-ISSN: 2395-0072

STEEL FIBER REINFORCED CONCRETE ADDITION OF STEEL SLAG BY REPLACEMENT OF FINE AGGREGATE

S.K. Gowtham[1], S. Arun[2]

[1]Assistant Professor, Department of Civil Engineering, Nandha Engineering College, Tamilnadu, India
[2]PG Student, Department of Civil Engineering, Nandha Engineering College, Tamilnadu, India

---

Abstract - Concrete is the third biggest material devoured by individuals after sustenance and water according to WHO. Concrete assumes a fundamental part in the outline and development of the country's foundation. Practically fourty percent of the volume of concrete consists of fine aggregates. These are acquired from common rocks furthermore river beds, accordingly debasing them gradually. Hence the idea of substitution of fine aggregate with steel slag appears to be encouraging. In this study the experimental investigation is done on the study of the Fibre reinforced concrete using steel slag as the replacement for fine aggregate. M30 grade of concrete was used. Possible optimum replacement of slag material was found to be 50%.To this optimum replacement of slag material steel fibres are dispersed at different volume fractions. The dimensions of the steel fibres are of length 30mm and diameter 0.5mm and are of crimped type. The results showed that the steel slag can be partially replaced as the fine aggregate up to 50%.Tests of compressive strength, flexural resistance, split tensile strength and the Young's modulus tests are carried out on the specimens in which the steel fibres are dispersed in volume fractions of 0.5%, 1% and 1.5%. Key words: Steel slag, fine aggregate, steel fibres, etc,. Over a period of time, waste management has become one of the most unavoidable complex and difficult problem in the world which is affecting the environment. Cupola slag is byproduct material which is gathered from cast iron manufacturing unit.

Key Words: Steel fiber, Steel slag

I. INTRODUCTION

Concrete is a mixture of cement, fine aggregate and coarse aggregate, which is mainly derived from natural resources. Increasing population, expanding urbanization, climbing way of life due to technological innovations has demanded a huge amount of natural resources in the construction industry, which has resulted in scarcity of resources. This scarcity motivates the researchers to use, solid wastes generated by industrial, mining, domestic and agricultural activities. They also studied the relationship between the concrete made using this type of materials; environmentally friendly concrete and green building rating systems. Issues like emission of carbon dioxide, use of energy, water, aggregates, fillers and demolition waste in concrete look less compatible with environmental requirement of a modern sustainable construction industry. At the same time, concrete made using agricultural wastes has shown better mechanical and durability properties in research which can result in sustainability points in the energy.

OBJECTIVES OF THE STUDY

- To study about the performance of the new composite material using industrial specific wastes.
- To reduce the use of conventional building materials and saving the environment from environment pollution.
- To determine the permeability waste.

II. LITERATURE REVIEW

- **A. Aderibigbe and A. E. Ojobo (1982)** Investigations conducted on the pozzolanic properties of a Steel slag revealed that on the basis of chemical constituents alone, the steel slag could be considered a pozzolana. Physical tests, however, showed that the steel slag exhibited little pozzolanic activity. An improvement in physical properties was obtained by calcining the slag at 700°C for 5 hr. Without sacrificing appreciable strength (e.g. a 13.5% reduction in strength), up to 20% replacement of Portland cement by steel slag is possible in the preparation of cement mortar. This results in appreciable cost savings in areas where cement is expensive and steel slag is considered a waste product.

- **A.M. Shende et.al., (2012)** "Experimental Study on Steel Fiber Reinforced Concrete for M-40 Grade" The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cemetitious material, aggregate and water and by adding some special ingredients. The presence of micro cracks in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The weakness can be removed by inclusion of fibres in the mixture. Different types of fibers, such as those used in traditional composite materials can be introduced

into the concrete mixture to increase its toughness, or ability to resist crack growth.

- **Joseph O. Afolayan and Stephan A. Alabi (2013)** The compressive strength of the concrete designed using steel slag as a coarse aggregate and partial replacement for cement was investigated. A series of experimental studies were conducted involve concrete production in two stages. The first stage comprised of normal aggregate concrete (NAC) produced with normal aggregates and 100% ordinary Portland cement (OPC). Meanwhile, the second stage involved production of concrete comprising of cupola furnace slag an aggregates with 100% ordinary Portland cement (OPC) and subsequently with 2%, 4%, 6%, 8% and 10% cementitious replacement with steel slag that had been grounded and milled to less than 75 µm diameter. The outcomes of compressive strength test conducted on the slag aggregate concrete (SAC) with and without granulated slag cementitious replacement were satisfactory compared to normal aggregate concretes (NAC).

- **P. Jyotsna Devi et.al.(2014)** in their work "A Study on the Flexural and Split Tensile Strengths of Steel Fibre Reinforced Concrete at High Temperatures "mixing with 1% volume of steel fibers to evaluate its performance at normal (M30) and at high strength concrete (M60).They introduced good results with that of steel fibres. By adding steel fibres flexural resistance can be increased. The test is carried out for 7, 28 and 91 days.

- **Mekala Prathap Reddy and Dr. K. Chandrasekhar Reddy (2015)** This paper investigation on M-30 grade of concrete with water cement ratio 0.45 to study the compressive strength, and tensile strength of steel fibers reinforced concrete (SFRC) containing fibers of an interval of 0.5%,1%,1.5% volume fraction of hook end steel fibers of aspect ratio 60 were used. The different percentage of one or more mineral admixtures with combination of steel fibers is used in this study. After curing this specimen were tested as per relevant codes of practice Bureau of Indian standard. A result data obtained has been analyzed as compared with a control specimen.

- **Girish Sharma(2015)** studied in his work "Beneficial effects of steel slag on concrete" with the aim of replacing steel slag of M35 grade with aggregates(fine & coarse), the percentage from 0% to 55% and tested on its 7th and 28th day after curing. Their deep analysis concludes that there is constant increment when replaced with that of steel slag and can be used practically. Decrement is mentioned after 55% in case of coarse aggregate.

III. MATERIALS TO BE USED

INGREDIENTS OF CONCRETE

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as steel fiber and steel slag. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregate, and for economy no more cement paste is used than in necessary to coat all the aggregate surfaces and fill all the voids. The concrete paste is plastic and easily moulded into any form or trowel to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increases the strength. Too much water, however, produces a concrete that is more porous and weaker.

CEMENT

Cement is a binding material in concrete. In this study, we used Ordinary Portland Cement (OPC) for our entire experimental works. Many tests were to be conducted to cement like specific gravity, consistency, initial and final setting test, fineness test.

FINE AGGREGATE

Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word. Due to the depletion of good quality river sand for the use of construction

COARSE AGGREGATE

It is a construction component made of rock quarried from ground deposits. They are irregular in shape**.** Coarse aggregate maximum size of 20 mm have to be used in concrete.

STEEL FIBER

Steel fibers have continuously been present in friction material, although they had a decline in the first decade of the twenty-first century. However, the banning of copper in car brake pads in certain states in the United States (virtually causing it to no longer be used throughout the country) has started a revival of steel fibers. As said, steel fibers are involved in the noise process. Their revival is linked to their

substitution for Cu, to contribute to thermal conductivity. Nevertheless, this process required a rethinking of steel fiber processing: i.e., the content of carbon must be lowered and the annealing processes to release stresses must be considered as well. For instance, several companies already offer steel fibers with less than 0.10% carbon to decrease noise problems. Steel fibers as metallic compounds are also involved in the stability of friction and in the thermal conductivity of the brake pad composite.

STEEL SLAG:

There are many grades of steel that can be produced, and the properties of the steel slag can change significantly with each grade. Grades of steel can be classified as high, medium, and low, depending on the carbon content of the steel. High-grade steels have high carbon content. To reduce the amount of carbon in the steel, greater oxygen levels are required in the steelmaking process. This also requires the addition of increased levels of lime and dolime (flux) for the removal of impurities from the steel and increased slag formation. There are several different types of steel slag produced during the steel-making process. These different types are referred to as furnace or tap slag, raker slag, synthetic or ladle slags, and pit or cleanout slag. The general flow and production of different slags in a modern steel plant. The steel slag produced during the primary stage of steel production is referred to as furnace slag or tap slag. This is the major source of steel slag aggregate. After being tapped from the furnace, the molten steel is transferred in a ladle for further refining to remove additional impurities still contained within the steel. This operation is called ladle refining because it is completed within the transfer ladle. During ladle refining, additional steel slags are generated by again adding fluxes to the ladle to melt. These slags are combined with any carryover of furnace slag and assist in absorbing deoxidation products (inclusions), heat insulation, and protection of ladle refractories. The steel slags produced at this stage of steel making are generally referred to as raker and ladle slags.

REFERENCES

1. Abdul Ghaffar, Amit S. Chavhan and Dr. R. S. Tatwawadi, (2014) 'Steel Fibre Reinforced Concrete', International Journal of Engineering Trends and Technology (IJETT), Vol.9 (15), ISSN:2231-5381.

2. D. A. Aderibigbe and A. E. Ojobo (1982), 'Properties of Cupola Slag as a Pozzolana and its effects on partial replacement of a cement in a mortar' , Volume 5 No. 4 , PP 203-208.

3. Bashar Taha and Ghassan Nounnu. (Dec.2009) Utilization waste recycled glass as Sand/Cement Replacement in Concrete. American Society of Civil Engineers, ISSN: 0899-1561, Vol. 21, Issue 12(709).

4. Bagal Shreyash Vinayak and Shee Gunderao N. (2017) 'Evaluation of the Strength Properties of Hooked End Steel Fiber Reinforced Concrete Produced with Fly Ash', IRJET , Vol. 4, Issue.4, pp.2395 -0056.

5. P. Jyotsna Devi and Dr.K.Srinivasa. (June 2014) A Study on the Flexural and Split Tensile Strengths of Steel Fibre Reinforced Concrete at High Temperatures. International Journal of Education and Applied Research, ISSN: 2249-4944, Vol. 4, Issue Spl-2,

6. Joseph O. Afolayan and Stephan A. Alabi (2013) 'Investigation on the Potentials of Cupola Furnace Slag in Concrete' International Journal of Integrated Engineering, Vol. 5, issue.2.

7. Mekala Prathap Reddy and Dr. K. Chandrasekhar Reddy (2015) 'Determination of Mechanical Properties of Steel Fiber Reinforced Concrete with Mineral Admixtures' IJSR, Vol.4, Issue 5, pp.231-706.

8. P. Sateesh Kumar, V. V. S. Sarma, N. Vidya Sagar Lal. (2015) Study on Behaviour of Concrete Mix Replacing Fine Aggregate with Steel Slag at Different Properties. Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 5, Issue: 11, (4), pp: 39-46.

9. Shetty MS. (2006) Concrete Technology Theory and Practice. S Chand & company ltd, India.