International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

A Study to Understand the Effect of Metallic Sand Waste added in Construction Concrete

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Abstract - Low-cost concrete production by replacement of fine sand with Metallurgical Waste Sand (MWS) is a new trend and makes effectively use of MWS as engineering material by reducing disposal and pollution problem. MWS are by-products which appears to possess the potential to partially replace regular sand as a fine aggregate in concretes, providing a recycling opportunity for them. This Project will identify a potential use of wastes from Metal industry for utilization in construction industry and represents the experimental investigation on utilization of MWS as partial replacement of natural sand in different percentages. Concrete mixtures were produced, tested and compared in terms of strength with the conventional concrete. These tests were carried out to evaluate the strength for 7 and 28 days. The project will review the utilization of metallurgical waste sand and as the concrete constituent and important results from the experiment will be analysed with works of various researchers. Workability with different admixtures will be analysed during the project. After a careful study of large number of research papers on the topic it was felt by the authors to integrate all the important results for streamlining the potential of this area of research. This project will summarize the conclusions of experiments conducted for the properties like strength workability and durability. The utilization of metallurgical waste sand in concrete provides a sustainable solution for waste management and reduces the environmental impact of the construction industry. The findings of this research can contribute to the development of guidelines and standards for the use of waste materials in concrete, promoting the circular economy and sustainable development in the construction industry.

Key Words: Metallurgical Sand, Compressive strength, Workability, Flexural strength, Sustainable Development, Waste Management.

1. INTRODUCTION

The worldwide consumption of sand as fine aggregate in concrete production is very high and several developing countries have encountered some strain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years. To overcome the stress and demand of river sand, researchers and practitioners in the construction industries have identified some alternatives. Ferrous and nonferrous metal casting industries produce several million tons of by-products in the world. MWS is major by-product of metal casting industry and successfully used as a land filling material for many years. But use of MWS for land filling is becoming a problem due to rapid increase in disposal cost. In an effort to use the MWS in large volume, research has been carried out for its possible large-scale utilization in making concrete as partial replacement of fine aggregate.

Metallurgical Waste Sand

Metallurgical waste sand, generated as a by product of various metallurgical processes, possesses different characteristics compared to natural sand. Understanding these characteristics is essential for evaluating the suitability of waste sand as a replacement for natural sand in concrete production. Here are some key characteristics of metallurgical waste sand. Metallurgical waste sand can exhibit a wide range of particle sizes, including both fine and coarse particles. The particle size distribution affects the workability and strength of concrete, as well as its permeability and porosity. Shape and texture of waste sand particles can vary depending on the metallurgical process. They may be angular, rounded, or irregular in shape. The particle shape influences the packing density and interlocking behaviour within the concrete mix, affecting the mechanical properties and workability of the resulting concrete.

Metallurgical waste sand often contains chemical compounds derived from the metallurgical processes. The composition can vary depending on the specific metallurgical industry, but common components may

include oxides, sulphides, carbonates, and trace elements. The chemical composition can influence the setting time, hydration, and durability of concrete. Metallurgical waste sand can potentially contain contaminants, such as heavy metals, organic compounds, or other pollutants. These contaminants may arise from the metallurgical process itself or from impurities in the raw materials used. The presence of contaminants must be carefully evaluated to ensure that the waste sand meets safety and environmental regulations when used in concrete.

The specific gravity and absorption capacity of waste sand can differ from natural sand. These properties influence the yield, workability, and density of the concrete mix. Understanding the specific gravity and absorption characteristics helps in adjusting the water content and aggregate proportions in the concrete mixture. The surface properties of waste sand, including surface texture and porosity, can affect the bond strength between the sand particles and the cement paste. These properties influence the interfacial transition zone and the overall strength and durability of the concrete**.** It is important to note that the characteristics of metallurgical waste sand can vary depending on the specific metallurgical industry, the process employed, and the treatment or conditioning methods used to handle the waste sand. Therefore, a detailed characterization of the waste sand from a specific source is essential to assess its suitability and potential performance when incorporated into concrete.

RESEARCH OBJECTIVES

The primary objective of this research work is to investigate the utilization of metallurgical waste sand as a viable substitute for natural sand in concrete production. The specific research objectives include-

1. Analysing the physical and chemical properties of metallurgical waste sand to understand its suitability as a construction material
2. Assessing the fresh and hardened properties of concrete incorporating waste sand to determine its effects on workability, strength, durability, and providing recommendations for optimizing the use of waste sand in concrete mixtures and addressing potential implementation challenges.
3. Investigating the micro-structural characteristics of waste sand concrete to understand its performance at the microscopic level & to carry out the concrete mix design for decided grade of concrete.

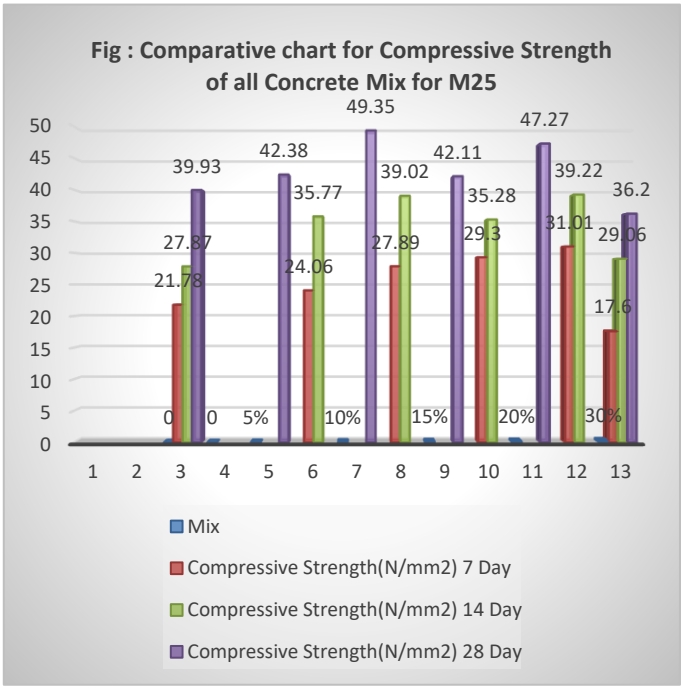
METHODOLOGY

1. Data Collection
2. Literature Review
3. Collection of Raw materials
4. Initial Testing on Materials
5. Preparation of Mix Design
6. Casting of Concrete Specimen
7. Testing of Mechanical Properties

RESULTS AND OBSERVATION

Sr. No.	Mix	Compressive Strength(N/mm2)		
	Normal CC (0%)	7 Day	14 Day	28 Day
		21.78	27.87	39.93
1	5%	24.06	35.77	42.38
2	10%	27.89	39.02	49.35
3	15%	29.30	35.28	42.11
4	20%	31.01	39.22	47.27
5	30%	17.60	29.06	36.20

Table: 7th,14th 28th day average compressive strength of concrete cube



Bar chart for 7th& 28th compressive strength of concrete cube

The above test results tables and graph of compressive strength shows that the optimum replacement of fine aggregate is achieved at 20% replacement of fine aggregate by crushed brick debris compared to the respective conventional concrete strength.

4. CONCLUSIONS

1) MWS have a porous structure which results in a low density of the sand and hence the density of concrete decreases.
2) The 7days, 28 days and 56 days compressive strengths of concrete increase initially as the replacement percentage of MWS increases and become maximum at about 20% and later decreases.
3) The flexural strength of concrete increases initially as the replacement percentage of MWS increases and becomes maximum at about 20% and later decrease.
4) The split tensile strength of concrete increases initially as the replacement percentage of MWS increases and becomes maximum at about 20% and later decrease.
5) The slump of concrete decrease monotonically as the replacement Percentage of MWS increases. The workability decreases Sand replaced with metallurgical sand.
6) The present study shows that there is a great potential for the utilization of MWS concrete as partial of sand. About 20% of natural sand may be replaced with metallurgical waste sand without any sacrifice on the compressive strength.

REFERENCES

1. Marek, C.R .Gallaway, B.M. and Long, R. E., “look at processed rubble – It is a valuable source for Aggregates, roads and Streets, Vol.114Sept. 1971,p 82-5.
2. Khan and Choudhry (2013) “Evaluation of the compressive strength of concrete for partial replacement of Over burnt brick ballast Aggregate” International Journal of Scienceand Modern Engineering (IJISME) Volume-2, Issue-1, December 2013
3. R. Ilangovan, N. Mahendran and K. Nagamani, "Strength and durability properties of concrete containing quarry rock dust as fine aggregates", ARPN Journal of Engineering and Applied Science, Vol.3(5), pp.20-26,2008.
4. Splitting tensile strength concrete method of test, IS5816:1999, Bureau of Indian Standards, New Delhi.
5. Mehta and Monteiro, Concrete Structure, Properties, and Materials (Prentice-Hall, Inc., Englewood Cliffs, NJ, 1993)