Experimental Study on Behaviour of Concrete by using Welding Slag as A Partial Replacement of Sand

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***Abstract*—In India, natural river sand (fine aggregate) is traditionally used in concrete. However, growing environmental restrictions to the exploitation of sand from riverbeds leads to the research for utilization of an alternative material (industrial waste) for fine aggregates in the construction industry. This project investigates about using welding slag as a fine aggregate replacement material, was tested as an alternative to traditional concrete. The fine aggregate has been replaced by welding slag consequently in the range of 10%, 20%, 30%, 40%, and 50% by weight for M30 grade concrete. In this project, materials were collected and tested for determination and comparison of material properties of fine aggregates and welding slag. Concrete mixtures were produced, tested and compared in terms of workability and strength with the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7 and 28 days. As a result, the compressive strength increased up to 10% addition of used welding slag. Then from 20% to 50% addition of welding slag in concrete has reduced the compressive strength.This research work is concerne**

Key Words : Fine aggregate, welding slag , compressive strength, workability.

I. INTRODUCTION

1.1 General

Construction aggregate or simply aggregate is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag . Aggregates used in concrete should comply with the requirement of IS 383:1970.Aggregates are commonly classified into fine and coarse aggregates. The fine and coarse aggregates occupy about 60-75 percent of the concrete volume (70-85% by mass).Fine aggregates generally consist of natural sand or crushed stone with particle size smaller than about 5mm (materials passing through 4.75mm IS sieve) 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. So there is large demand for alternative materials for fine aggregates in construction industry.

To overcome the stress and demand for river sand, researchers have identified some alternatives for sand, namely scale and steel chips, waste iron, crushed granite fine, slag, etc. the welding slag were obtained from local arc welding industries. And this is used replace the fine aggregate partially in the production of concrete. The physical and chemical characteristics of welding slag were determined in the laboratory as per standard methods. The consumption of slag in concrete not only helps in reducing the green house gases.

1.2 Welding slag

Welding slag is a by-product from submerged arc welding process. Submerged arc welding is a versatile welding process in which coalescence is produced by heating the metal with an arc maintained between a bare metal electrode and the workpiece. The arc is shielded by a blanket of granular fusible material known as flux placed over the welding area. Filler metal is obtained from the electrode and sometimes a supplementary welding rod or metallic addition. Flux contributes a major part towards welding cost in submerged arc welding. The flux is converted into slag during welding which is treated as waste and discarded.

Fig 1.1 : submerged arc welding slag

The welding slag which is collected from the submerged arc welding was crushed using a crusher. Crushed mass then sieved so that the grains of the slag should confirm to the practical size of the original flux. About 2500 tonnes of flux was consumed in India alone in year of 1982 which has risen to 10000 tonnes in the year of 2006. Such a large quantity of flux that becomes slag after welding and it has to be disposed-off. Land fill space is required to dump the slag waste. It is non bio-degradable and will not decay with time.

The following flow chart explains about the experimental procedure of this present project investigation,

Table 1.2 chemical characteristics of welding slag

S.NO	Metals	Concentration (mg/l)	
		Acid soluble	Water soluble
1	Fe	26.03	2.11
2	Mg	6.16	2.03
3	Zn	0.62	0.05
4	Al	63.9	5.49
5	Cu	0.13	0.02
6	Ca	50.82	22.28

1.3MATERIALS USED:

1.3.1. CEMENT:

Portland cement (often referred to as Ordinary Portland Cement or OPC) is the most common type of cement in general use around the world. According to The Bureau of Indian Standards (BIS) OPC has been classified as follows:

1. 33 grade OPC, IS 269:1989
2. 43 grade OPC, IS 8112:1989
3. 53 grade OPC, IS 12269:1987

In the present investigation, we have adopted 43 grade OPC, IS 8112:1989. The following tables will explain about the physical and chemical properties of Ordinary Portland Cement (43 grade

1.3.2. FINE AGGREGATE

Fine aggregates generally consist of natural sand or crushed stone with particle size smaller than about 5mm (materials passing through 4.75mm IS sieve).aggregates must be clean, hard, strong and durable. Grading or particle size distribution of aggregates is a major factor determining the workability, segregation, bleeding, placing, and finishing characteristics of concrete

1.3.3. COARSE AGGREGATE:

The coarse aggregate is the strongest and least porous component of concrete .it consists of one or a combination of gravels or crushed stone with particle size larger than 5mm (usually between 10mm and 40mm).The factors that may directly or indirectly influence the properties of concrete such as specific gravity/porosity, crushing strength, chemical stability, surface texture, etc…

WATER: Water plays an important role in workability, strength, and durability of concrete.

II. OBJECTIVES

Present experimental work explores the possibility of using welding slag as a replacement of natural sand in concrete in this work fine aggregate has replaced by welding slag in various percentages 10, 20, 30, 40, 50 with constant W/C ratio of 0.4. and the compressive strength for 7 and 28 days has been investigated.

III. RESULT AND DISCUSSION

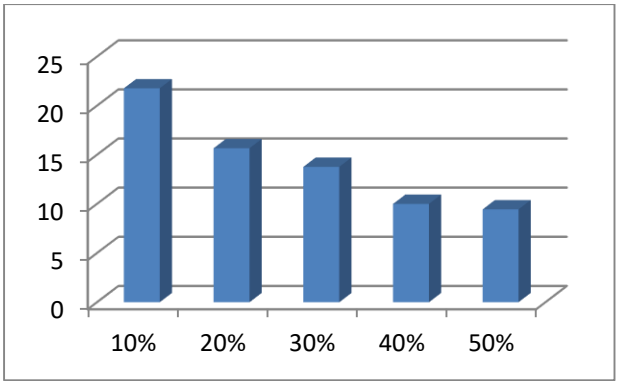
General

This chapter deal with the presentation of test results and discussion on compressive strength and split tensile strength of Ordinary Portland Cement Concrete for 7days and 28 days curing. The present investigation is based on the IS method of conventional concrete. Trial mix proportions have been obtained for M30 grade conventional concrete from the mix design. In this present investigation compression test, split tensile strength test are carried out on the concrete cubes and cylinders.

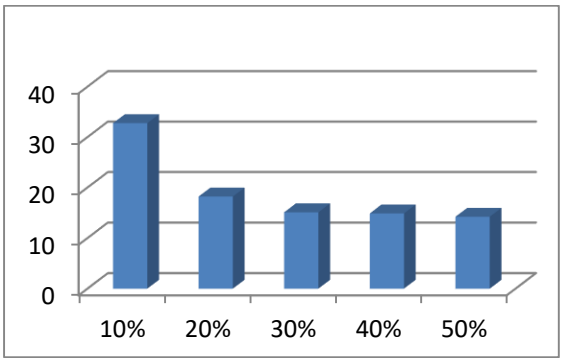
Report for compressive strength in 7days

Date of casting = 19/2/2015

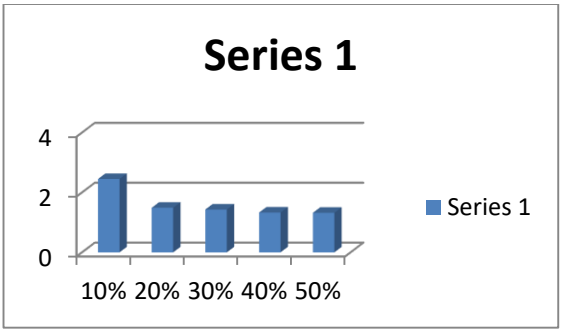
Date of testing = 25/3/2015



compressive strength 7 days



compressive strength 28 days



IV. CONCLUSION

1. From this test, replacement of fine aggregate with this welding slag material provides maximum compressive strength at 10% replacement.
2. Split tensile strength is also decrease on increase in percentage of welding slag.
3. Use of welding slag as a replacement material for fine aggregate will produce low cost concrete and also helpful in industrial waste management.
4. Application of this study leads to develop in construction sector and innovative building material.

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