INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 3)
Available online at: www.ijariit.com

Effect of partial replacement of sand by glass powder and steel powder over the properties of concrete

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ABSTRACT

In the present research, a series of experiments had been performed to compare the use of glass powder and steel powder as partial replacement of sand in different proportions. Blended cement prepared by mixing Portland cement with Fly ash in 1:0.5 and 1:1 proportion has been used for this study. Concrete mixes are modified by 10%, 15% and 20% and 25% of glass powder and steel powder in replacement.

Keywords: *Steel powder, Glass powder, Concrete.*

1. INTRODUCTION

Concrete is a mixture of cement, sand, coarse aggregate and water. Its success lies in its versatility as can be designed to withstand harshest environments while taking on the most inspirational forms. Engineers and scientists are further trying to increase its limits with the help of innovative chemical admixtures and various waste materials. Utilization of glass powder, steel powder or other desecrate materials in preparing concrete for various civil engineering projects is a subject of high significance. Integration of extra materials in concrete or mortar affects its several characteristics such as strength, workability and other performances.

Global utilization of concrete presently is around 9 billion tons per year and it is expected to increase during this century because concrete has become the most important material for construction of highways, dams, bridges, and other types of civil construction work. This means, more than 1.3ton concrete is required per person in the world. In other words, the production of concrete could be more than the production of food. The researches on concrete have been introducing innovative types of cement based on the utilization of wastes and byproducts from the industries. The investigators and field experiences have been shown that the benefits attained when the basic ingredients of concrete are intermingle with wastes that have been verified not to be deleterious to the performance of cement based products.

There are various purposes of applying additional materials as a substitute to cement and other components in concrete – first is the financial saving obtained by replacing a considerable part of the sand or other ingredients with these materials and second is an enhancement in the properties of concrete. The ecological aspects of cement are now receiving more concern of researchers, as cement developing is liable for about a large amount of total worldwide waste emissions from manufacturing sources. The trend of mixing several kinds of additional materials in building engineering is now growing. This has a double advantage -

(a) To reduce the quantity of deposited waste.
(b) To conserve natural resources.

2. OBJECTIVES OF STUDY

In the present research, a series of experiments had been performed

- To compare and determine various mechanical properties of concrete mixes prepared by blending Portland cement and Fly ash cement in two different proportions.

- To determine the effect on properties of concrete mixes which are modified by adding 10%, 15% and 20% and 25% of glass powder and steel powder as partial replacement of sand.

- To study the variation of properties when ingredients are mixed in M20 proportions. The properties studied are 3 days, 14days and 28 days compressive strengths, workability and setting time.

3. METHODOLOGY

Experimental work had been conducted on cement concrete mixes by using a different type of binder mix modified with different percentages of steel powder and glass powder in partial replacement of fine aggregates. Two separate types of concrete mixes were prepared in first category Blended cement has been prepared by mixing Portland cement with Fly ash in 1:0.5 and 1:1 proportion has been used for this study. Concrete mixes are modified by 10%, 15% and 20% and 25% of glass powder and steel powder in replacement. For each replacement, several cubes have been cast for determining the compressive strength and workability.

Out of many tests applied to the concrete, a compression test is of the utmost chief which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. For cube test, two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm depending on the size of aggregate are used. In the present work cubical moulds of size, 15 cm x 15cm x 15 cm have been used to cast the concrete cubes for testing. This size of the cube is as per the IS 10086 – 1982. These specimens are tested by compression testing machine after 7 days, 14 days and 28 days of curing.

4. EXPERIMENTAL PROCEDURE

Experiments have been performed for evaluating compressive strength of concrete blocks prepared by replacing sand with glass powder and steel powder in different percentage. Several concrete cubes have been prepared by replacing 10%, 15%, 20% and 25%, sand by weight with these waste materials. For preparing mix the cement, sand, and aggregate have been batched as 1:1.5:3 proportions for forming M-20 mix. Cube moulds of 15 x 15 x 15 cm have been used for casting cubes.

Additives used in the present study

- Steel Powder
- Sand
- Glass Powder

Steel powder is formed from steel cutting factories during the sawing and finishing of steel parts, and almost 20 - 25% of the processed steel is converted into the powder. Though, waste material from steel industry can be used to enlarge several properties of concrete. It has been analyzed that typically compressive strength increased with an accumulation of this powder in place of cement or sand.

Sand is the main material needed for fulfilling the modern infrastructure needs. The most common constituent of sand, in inland continental settings and non-tropical coastal settings, is silica (silicon dioxide, or SiO2), usually in the form of quartz which, because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering. It is used as fine aggregate in concrete.

The glass powder is a significant material utilized in the building production. During the last decade, considerable attention has been given to the use of Glass powder as a partial replacement of sand to produce high-strength concrete. Bigger energy levels are needed to manufacture cement, which releases huge amounts of carbon dioxide (CO2) and also adds to the green house gases.

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