Effect of Percent Replacement of GGBS on Pond Ash Mixed Concrete

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Abstract— Concrete is the most commonly used material in the field of construction. Due to the rapid growth of construction industry the demand for concrete is increasing drastically. Ground Granulated Blast Furnace Slag (GGBS) is the by-products formed at the steel manufacturing industry and pond ash is the by-products formed at the thermal power plants during the combustion of pulverized coal. In this present study GGBS and pond ash are partially replaced for cement and sand respectively. Keeping the GGBS 40% constant the percentage of pond ash is varied from 10%, 20% and 30%.Compression test is done for cubes of cross section 150mmx150mmx150mm. The curing period for cubes and beams is 3 days 7days and 28 days.

Key words: Compression Strength, GGBS, Pond Ash

I. INTRODUCTION

One of the main ingredients used for the production of concrete is Ordinary Portland Cement (OPC) and it has no alternative in the civil construction industry. Unfortunately, carbon dioxide gas is emitted in large amounts into the atmosphere during the production of cement, and this gas is a major contributor for greenhouse effect and the global warming, and therefore it is necessary either to search for another material or replace it partly by some other material. The search for any such alternative material which can be added in production of cement should lead to global sustainable development and lowest possible environmental impact.

Energy generation is increasing day by day due to rapid industrialization. Energy generation through thermal power plants is very typical now days. Pond ash (PA) is available in large quantities from these thermal plants. Pond ash utilization helps to reduce the consumption of natural resources. Today natural sand is being used and it is costly so it is require to be replacing by Pond Ash. Use of alternative material in concrete such as industrial by - product coal Ash (Fly Ash and Pond Ash) is an important eco efficiency drive. It is also the social responsibility of researchers to encourage the "beneficial use of industrial by- products in order to preserve resources, conserve energy and reduce or eliminate the need for disposal of industrial waste in landfills. And to get some of the important engineering properties like increase in compressive strength with low capillarity and water absorption, Pond Ash are being preferably used in various percentages and the perfect strength combination of GGBS replacement and pond ash percentage is found out.

II. PROBLEM STATEMENT

In almost every construction activity, concrete is widely used. As cement is getting costlier and demand for cement is growing day by day, investigators have been trying to replace cement with other materials to save money either by maintaining the properties using waste materials or by enhancing the properties using selected materials. This paper is an attempt, to study various engineering properties of a concrete made with cement which is replaced by ground granulated blast furnace slag. To maintain the engineering properties, replacement of natural sand with pond ash which is manufactured and is easily availableby thermal power plants, has been used in various proportions. The experimental investigation includes basic tests for cement, and conventional tests for concrete such as compressive strength have been taken up.

III. OBJECTIVES OF PROJECT WORK

The objective of the present work is to develop concrete with good strength, less porous, less capillarity so that durability will be reached.

- To replace the cementitious material and fine aggregate (i.e. river sand) with sustainable material.
- To find perfect combination of GGBS and Pond Ash
- To find optimum percent replacement by GGBS.
- To reduce the percent of cementitious material and use sustainable material on that replacement of percentage.
- To optimize the cost

IV. SIGNIFICANCE OF STUDY

This paper is an attempt to study the various engineering properties of a concrete made with additives such as a Pond Ash replacement for natural sand and a super plasticizer in combination with Portland slag cement in different material proportions. Attempt has also been made to use GGBFS in order to replace partly the Portland slag cement. Pond Ash manufactured by thermal power plant and commonly available in the local retail market has been used.

V. SCOPE OF WORK

High-performance concrete cannot always be achieved by routinely using conventional constituents and normal mixing, placing, and curing practices, it is concrete that meets special combinations of performance and uniformity requirements. The term high-performance concrete was there on introduced into the industry. Later it was widely used in large scale concrete construction that demands high strength, high durability flow ability and high durability flow ability.

A high-strength concrete is always a high-performance concrete, but a high performance concrete may not always be a high-strength concrete. Durable concrete detailing a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously fulfils all of the Properties. There are some different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), High Reactive Metakaolin, silica fume, Rice husk ash, Fly ash, which can be used in concrete as partial replacement of cement and are very essential ingredients to produce high performance concrete.

Use of Pond Ash in different percentage i.e. 10%, 20%, 30% to that of total weight of concrete and casting was done. Finally we used different percentage i.e. 10%, 30%, 40%, 50% of GGBS with the replacement of cement and concrete was casted. In our study we used two types of cement, Portland slag cement and ordinary Portland cement. We prepared mortar, cubes, compressive test conducted.

VI. MATERIALS

A. Cement

Ordinary Portland Cement (OPC) of 53 grade confirming to specifications as per IS12269-1987 is used.

B. Fine Aggregates

The sand used for the experimental study is locally procured and was confirming to zone-II. The specific gravity of fine aggregate is formed to be 2.73.

C. Coarse Aggregate

By conducting the physical test on coarse aggregate the obtained value of specific gravity 2.69.

D. Water

Clean potable water available in the laboratory satisfying the requirements of IS 456:2000 is used for concrete mix.

E. Pond Ash

Pond Ash from Eklahare Power Station is used as a replacement from 10%, 20% and 30% for fine aggregate. Which contributes to the concrete mix.

F. Ground Granulated Blast Furnace Slag (GGBS)

GGBS from counto microfine product pvt. Ltd. is used as a replacement of 20%, 30%, 40% and 50% for cement.

G. Chemical Admixture

The Zentrament F BV super plasticizer manufacture by Fosroc Chemicals (India) Pvt. Ltd is used.

H. Experimental Investigation

The experimental investigation is carried out by replacing cement and sand partially with GGBS and Pond Ash in varying percentage to improve the strength of concrete. The required materials were weighed and mixed manually. The cube specimens of size 150 mm x 150 mm x 150 mm was casted. The specimens has been de molded after 24 hours from the casting and the specimens were cured at a room temperature in water tank.

VII. METHODOLOGY

In this present study partial replacement of cement and sand has done by using GGBS and Pond Ash. The grade of concrete is M_{40}. In this cube and beam specimens are casted and cured for 3 days, 7 days and 28 days.

A. Test Procedure

1) Compressive Strength Test

The cubes were taken after a curing period of 3 days, 7 days and 28 days from water tank, surface dried and tested using a compression testing machine. These cubes were loaded on their sides during compression testing machine and the exerted perpendicularly to the direction of casting. The compression strength of concrete with partial replacement of cement and sand with GGBS and Pond Ash is shown in the below graph.

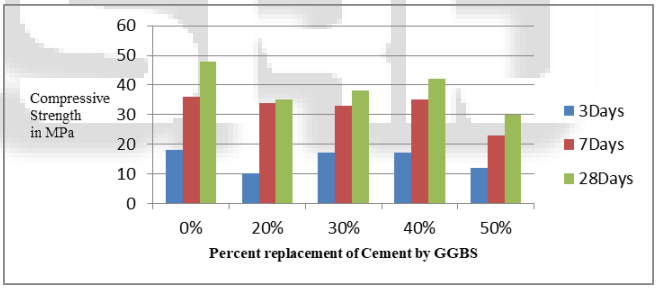
B. Test Data for Materials

a)	Cement used	= OPC 53 grade conforming to IS 8112
b)	Specific gravity of cement	= 3.15
c)	Specific gravity of:	
	Coarse Aggregate	= 2.69
	Fine Aggregate	= 2.736
d)	Water absorption:	
	Coarse aggregate	= 0.4%
	Fine aggregate	= 0.3%
e)	Free surface moisture:	
	Coarse aggregate	= Nil
	Fine aggregate	= Nil

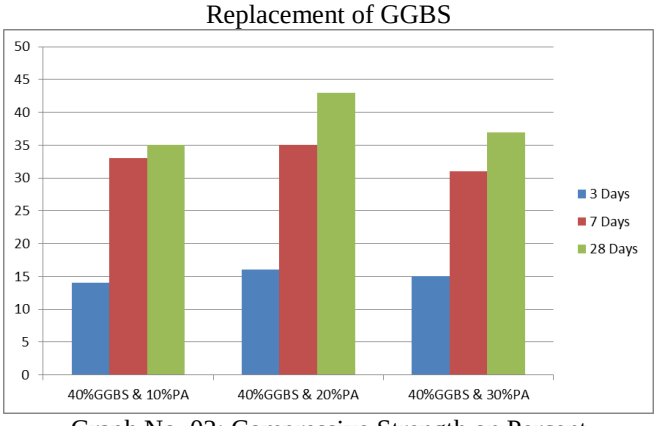
Table 1: Mix proportion of Trial (Control Concrete)

MATERIAL	DRY WT.
Cement	435 kg/m3
Water	165 kg/m3
Fine aggregate	676 kg/m3
Coarse aggregate	1201 kg/m3
Chemical admixture	4.35 kg/m3
Water-cement ratio	0.38

Table 2: Test results of Concrete Cubes specimens for M40 Grade



Graph No. 01: Compressive Strength on Percent Replacement of GGBS



Graph No. 02: Compressive Strength on Percent Replacement of GGBS & Pond Ash

– Cost Analysis

1) OPC cement cost – Rs. 4600/- per Tonne
Rs. 230/- per 50 kg

2) GGBS cost – Rs. 2800/- per Tonne
Rs. 140/- per 50kg

VIII. CONCLUSION

Using Portland cement and locally available aggregates, super plasticizer and water, an attempt has been made to study first, the effect of part replacement of cement by ground granulated blast furnace slag on engineering properties of concrete

- The following conclusions are drawn.
- The normal consistency increases with replacement of cement by pozzolanic material such as GGBFS.
- Satisfactory results are obtained with 40% to 50% replacement of GGBS to cement.
- By keeping the 40% of GGBS constant in concrete and replacement of Pond Ash with 20% gives a satisfactory results.
- In case of normal concrete, part replacement of cement by GGBFS decreases the compressive strength. However, satisfactory results are not obtained with 20% to 30% replacement.
- The use of sustainable material like GGBS as replacement for cement in concrete is more effective as environmental point of view.
- It has been observed that use of GGBS in concrete up to 40% to 50% replacement to cement reduce the cost of concrete. Concrete is a major component of construction and if cost of concrete is reduced it will automatically reduce the cost of construction project.

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