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Effect of Fly Ash and Brick Kiln Dust in Cement Concrete

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Abstract: ***Now day's construction work is going on a very large scale so requirement of cement concrete plays an important role. On the basis of topic, cement concrete will be mixed with some waste materials like fly ash and brick kiln dust. in this thesis the cement and fine aggregates were partially replaced by fly ash and brick dust. the main theme was to use the wastage by replacing wealthy materials. Bust fly ash and brick dust are available in metric tons. The objective was to study the workability and compressive strength of cement concrete. In the ancient period, construction work was mostly carried out with help of mudstone from industry. Fly ash is a by-product of burned coal from power station and brick dust are the wastage from the brick kilns are commonly used nowadays in order to improve the mechanical properties of concrete. Especially Synthetic (Polypropylene, polyester etc.,) glass, nylon, asbestos, carbon and steel fibers used in concrete caused good results to improve numerous concrete properties. Considerable efforts are being taken worldwide to utilise natural waste and bye –product as supplementary cementing materials to improve the properties of cement concrete. Brick dust and Fly ash (FA) with are such type of materials. Brick dust is the powder from brick kiln which is available in tonnes. FA is finely divided produced by coal-fired power station. Fly ash possesses pozzolonic properties similar to naturally occurring pozzolonic material. The detailed experimental investigation is doing to study the effect of partial replacement of cement by FA, brick dust in concrete. In this paper started proportion form 5% FA and 10% brick dust mix together in concrete by replacement of cement and fine aggregate ,last proportion taken 15% FA and 10% brick dust, with gradual increase in fly ash by 5% and simultaneously taking constant brick dust by 10% and to improve the strength of concrete. The purpose of this research is to study the effects of fly ash on the workability, compressive strength, flexural tensile strength, splitting tensile strengths, durability.***

Keywords: Admixture, Cement, Concrete, Fly Ash, brick dust

1. Introduction

Concrete is made up of cement, fine aggregates (sand), coarse aggregates and water. Being the basic engineering material it is used in most of the civil engineering structures, it is the only construction material used throughout the world in most of construction works. Cement concrete solidifies or hardness after mixing with water and placement due to a chemical process known as hydration. During the process of melination water reacts with cement which binds the other materials together eventually constructs a stone like material.

2. Advantages

- Eco friendly material.
- Increases density of concrete
- Reduces bleeding
- Reduces segregation of concrete
- Gives concrete early strength.
- Increase in compressive strength

Strength of concrete is one of the most important factor engineering properties of construction material. In any construction, structure which involves concrete as binding materials there comes a major problem that concrete does not gain its strength within given specific of time i.e. 28days. A decision should be taken at the time 28 days to remove formwork depend on the rate of strength gain by concrete which considers safety as well as quality also. Some of the researchers have given their opinions on concrete strength as given below-

Chatterjee, (2011) reported that about 50 % of fly ash generated is utilized with present efforts. He also reported that, one may achieve up to 70% replacement of cement with fly ash when high strength cement and very high reactive fly ash is used along with the sulphonated naphthalene formaldehyde superplasticizer. He reported improvement in fly ash property could be achieved by grinding and getting particles in submicrocrystalline range.

Bhanumathidas, &Kalidas, (2002) with their research on Indian fly ashes reported that the increase in ground fineness by 52% could increase the strength by 13%. Whereas, with the increase in native fineness by 64% the strength was reported to increase by 77%. Looking in to the results it was proposed that no considerable improvement of reactivity could be achieved on grinding a coarse fly ash. Authors also uphold that the study on lime reactivity strength had more relevance when fly ash is used in association with lime but preferred pozzolanic activity index in case of blending with cement**.**

Subramaniam, Gromotka, Shah, Obla& Hill, (2005) investigated the influence of ultrafine fly ash on the early age property development, shrinkage and shrinkage cracking potential of concrete. In addition, the performance of ultrafine fly ash as cement replacement was compared with that of silica fume. The mechanisms responsible for an increase of the early age stress due to restrained shrinkage were assessed; free shrinkage and elastic modulus were measured from an early age. In addition, the materials resistance to tensile fracture and increase in strength were also determined.

(Siddique, 2003) carried out experimental investigation to evaluate mechanical properties of concrete mixes in which fine aggregate (sand) was partially replaced with class F fly ash. Fine aggregate was replaced with five percentages (10%,

20%, 30%, 40% and 50 %) of class F fly ash by weight. The test result showed that the compressive strength of fly ash concrete mixes with 10% to 50% fine aggregate replacement with fly ash were higher than control mix at all ages. Also the compressive strength of concrete mixes was increasing with increase in fly ash percentages. This increase in strength due to replacement of fine aggregate with fly ash was attributed to pozzolanic action of fly ash. The splitting tensile strength also increased with increase in percentage of fly ash as replacement of fine aggregate. The tests on flexural strength and modulus of elasticity also showed improvement in the results as compared to control concrete.

3. Methodology

This chapter deals with the materials used & methods adopted to conduct study on compressive strength & workability characteristics of concrete containing fly ash & brick kiln dust with superplastizer.

Material Used

Portland Cement

Portland cement (referred to as OPC) is by far the most important type of cement & is fine powder produced by grinding Portland cement clinker (more than 90%), a limited amount of calcium sulphate, which control the setting time & up to 5% minor constituent. The OPC is classified into 3 grades, namely 33 grade, 43 grade & 53 grade depending upon the strength of cement at 28 days. It has been possible to upgrade qualities of cement by using high quality lime stone modern equipment, maintaining better particle size distribution, finer grinding & better packing. Generally use of high grade cement offer many advantages for making stronger concrete. Although they are little costlier than low grade cement, they offer 10-20% saving in consumption & they also offer many other hidden benefits. One of the most important benefits is faster rate of development of strength. The various constituents of OPC are Cao- 60 to 67 %, Sio_2- 17to 25 %, Al_2O_3 – 3 to 8 %, Fe_2O_3 – 0.5 to 0.6 %, Mgo -0.1 to 0.4 %, Alkalis (k_2o, Na_2O)- 0.4 to 1.3 % &SO_3 -1.3 to 3 %.

Ultratech 43 grade OPC was used in this study. Kit was fresh & without any lumps. The properties of cement were determined.

Portland Cement (OPC)

Ordinary Portland cement as already discussed is having different grades of cement which gives different strengths. But I used 43 grade of cement in making concrete. The cement was fresh and smooth without any lumps.

Below table 3.1 & 3.2 shows the different properties of the 43 grade cement and the results of tests which I performed practically.

Table 3.1: Properties of OPC 43 grade cement

S. NO.	Characteristics	Values obtained experimentally	Values obtained by IS: 8112:1989
1	Standard Consistency	30%	00
2	Specific Gravity	2.795	00
3	Initial Setting Time	115 min	30 min (minimum)
4	Final Setting Time	420 min	600 min (maximum)
5	Compressive Strength At Different Periods 3 Days 7 Days 28 Days	 24.28 N/mm^2 34.98 N/mm^2 46.65 N/mm^2	 23 N/mm^2 33 N/mm^2 43 N/mm^2

The present chapter deals with the result of tests conducted on concrete cube using fly ash, brick dust to determine the effect of fly ash, and brick dust on compressive strength & workability of concrete. The experimental program consist of casting, curing and testing of fly ash and brick dust concrete specimens at different ages. The compressive strength was investigated at the ages of 3,7,28 days. Workability of various mixes was also determined. The details of materials, equipment and experimental procedure adopted for various tests have already been described in chapter 3.

In the experimental program, a reference mix was prepared without fly ash; brick dust.4 mixes were prepared other than reference mix. Cement was replaced with fly ash & brick dust in reference mix to bring cement contents within the minimum range 360kg/m^3 as recommended by Indian standards.

In present study, 20 specimens were prepared by varying percentage of fly ash & brick dust as a part of replacement of cement besides 4 specimens of reference mix. In all 20 specimens were casted. The specimens were tested after 3, 7 & 28 days of casting. The ratio of different materials used in each mix & mix designation are shown in table 4.1.

Table 4.1: Designation of concrete Mix

Mix designation	Fly ash (%)	Brick dust (%)	Cement (%)	Fine aggregates (%)
Reference mix M_0	0	0	100	100
M_1	5	10	95	90
M_2	10	10	90	90
M_3	15	10	85	90

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