Study on the Performance of Flyash and Msand in Rapid Hardened Concrete

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Abstract- **Concrete plays a vital role as an important construction material in the construction industry and its applications are very significant in this changing world. The main aim of this project is to investigate the performance of Rapid Hardening Concrete where cement is replaced by Flyash in various proportions and river sand replaced by M-Sand. The objective is to carry out characteristic studies of compression strength, split tensile strength and flexural strength of concrete.**

Ordinary Portland Cement of 53grade is used in this project which confirms to IS 8112-1976. To accelerate the setting and early strength gain of Portland cement concrete and mortar mixes, chloride free accelerating, water reducing admixture Conplast NC is added. In this project different types of mix proportions have been considered by partially replacing 10%, 20%, 30%, 40% and 50% of flyash with Msand. For each mix cubes, beams and cylinders are casted and tested for the compression, flexural and split tensile strength. The blocks were kept for curing for 3, 7 and 14 days in water before testing of concrete specimen. The characteristics of concrete produced with M-Sand and flyash is compared to that of normal conventional concrete mix. The strengths has shown better for the concrete mixed with M-Sand when compared to the strength of concrete with natural sand. The use of Flyash and M-Sand can provide durable and sustainable infrastructure where construction and maintenance of conventional concrete are not cost effective.

Key words- Flyash, Msand, Conplast NC, rapid hardened concrete, partial replacement.

I. INTRODUCTION

Concrete plays a vital role in the construction industry which is used in large quantities. Concrete is a unique materials used for all types of construction from low rise to high rise constructions, both along vertical and horizontal developments. Day by day the cost of materials concrete is increasing also the scarcity of materials like sand and aggregates are also increasing.

Although concrete may be adequately strong to bear the compressive loads, it is poor in characteristics like resistance to cracking, limited ductility and low tensile strength. The strength of concrete depends upon the components such as aggregates, quality of cement, water-cement ratio, normal consistency of mix proportions, age of concrete, workability and workmanship. Each industrial waste is a pollutant either to air or water or both unless it is properly collected and disposed off. At present lot of waste materials such as flyash, blast furnace slag, broken tile pieces, rise husk, stone dust are available from locally situated industries. The authorities are finding it extremely difficult to dispose the waste efficiently and economically. Flyash, a by-product generated from thermal power plants is not safe to disposal in open environment. Currently natural sand is used as fine aggregate in the production of concrete. Due to the increased demand in the construction the demand for river sand is more in the market.

II. SCOPE AND OBJECTIVE OF WORK

The scope of this study is to know the compressive strength, split tensile strength and flexural strength of concrete produced by using Conplast NC, Flyash and M-Sand. The properties of fresh and hard concrete were tested. In this study, the river sand normally used in the concrete was replaced by M-Sand, cement was replaced by Flyash and Conplast NC was added as an accelerator to reduce the setting time. In this project an effort is made to save the time, to make use of environmental hazard waste material and also to reduce the overall cost of concrete.

This project aims at using the waste materials obtained from coal plants and hence will help the environment to minimize the pollution and also solves the problem of disposal of flyash. Since flyash are considered as one of the waste materials, the cost of concrete will reduce when flyash is used in proportion as an alternative to cement. Cost of flyash is less than that of cement. Hence replacement of cement by certain proportion of flyash will also reduce the overall cost of concrete made with M-Sand and flyash.

Objectives:

- To mix the fly ash in different proportions in place of cement with M-Sand in the production of concrete.
- To find the effectiveness in terms of strength of concrete with M-Sand and fly ash.
- To make use of fly ash, which is an industrial waste so as to keep our environment free from environmental hazardous and to control the environmental pollution.
- To carry out characteristic studies of compression strength, split tensile strength and flexural strength of concrete.
- To compare the characteristics of concrete produced with M-Sand and flyash to that of normal conventional concrete mix.

- To find the cost effectiveness of flyash and M-Sand mixed concrete with conventional concrete mix.

III. LITERATURE REVIEWS

Yash and Ketan et al, (2012) have studied emphasis on the performance of Flyash (FA) in the soil stabilization with replacement it with different soil for 10 to 60%. Besides this it presents the fresh and hardened properties such as compressive and flexural strength of High Volume Flyash Concrete (HVFAC) through prism and cubes, with 35%, 50% and 70% of cement replacement with flyash. The results showed that up to 50% replacement of cement can be used for construction with in addition reduces 12% overall cost. By detailed analysis they came to a conclusion that with the increase in flyash, expansion of soil decreases and drainage characteristics becomes better and make it suitable for sub-grade and sub-base.

Dale P et al, (1997) carried out a study on High-volume flyash (HVFA) mixtures promoted as one potentially significant contributor to reducing the carbon footprint of in-place concrete, while concurrently increasing the utilization of a readily-available waste stream material. HVFA concrete mixtures, where flyash replaces 50% or more of the cement, would substantially reduce theCO2 footprint of a concrete structure.

Vanita aggarwal et al, (2010) gave a detailed study of replacement of flyash in a proportion in concrete from 30%-80%for various grade of concrete. The literature surveyed reported that incorporating flyash in concrete reduces the compressive strength at early ages but there is a drastic increase in the compressive strength at later ages. The early strength is reduced further if the percentage of replacement is increased. But, on the other hand when the percentage of replacement is increased the water/ binder ratio gets reduced, thereby, increasing the later age compressive strength. Also, it is observed that the later age strength of concretes having more than 40% replacement of cement by flyash suffers adversely though water/ binder ratio is gradually reduced. For concretes with less than 40% replacement of cement, the characteristic strength at 28 days is on higher side.

P. Kumar Mehta et al, presented a brief review of the theory and construction practice with concrete mixtures containing more than 50% flyash by mass of the cementitious material. Mechanisms are discussed by which the incorporation of high volume of flyash in concrete reduces the water demand, improves the workability, minimizes cracking due to thermal and drying shrinkage, and enhances durability to reinforcement corrosion, sulphate attack, and alkali-silica expansion.

Gunavant k. kate et al, (2013) presented the results of an experimental investigation carried out to evaluate the shrinkage of High Strength Concrete. High Strength Concrete is made by partial replacement of cement by flyash. The shrinkage of High Strength Concrete has been studied using the different mixes from a minimum of 10% to maximum of 70 %. From the test results of the above investigation it can be concluded that the shrinkage strain of High Strength Concrete increases with increase in flyash content. The rate of increase in shrinkage with time is uniform for low flyash content, whereas it generally increases after 28 days for high volume of flyash and the high volume flyash concrete yields slow strength development at an early age. In this investigation shrinkage properties of high strength concrete with varying contents of flyash have been studied.

Malhotra et al (1990), studied in detail the properties of concrete with a wide range of Canadian flyash at 58% of the total cementitious materials. These concretes were tested for compressive strength, creep strain and resistance to chloride ion penetration at various ages up to one year. The results of study by Joshi et al (1994), indicated that with flyash replacement level up to 50% by cement weight, concrete with 28 days strength ranging from 40 to 60 MPa and with adequate durability can be produced with cost saving of 16% by 50% replacement level.

IV. MATERIALS USED

Concrete is a man made material. It is most commonly employed construction material. It consists of hard inorganic material called aggregates such as gravel, sand, crushed stoned, etc. Concrete attains great strength and possess high compressive strength. The ingredients of concrete are:

1. Cement
2. Aggregates (coarse aggregates and fine aggregates)
3. Water

Cement

Cement is the most important constituent of concrete that forms the binding medium for the discrete ingredients. It is made out of naturally occurring raw materials and sometimes blended inter ground with industrial waste content which come in various types and chemical composition for general concrete construction.

The raw materials used in the manufacture of cement consist mainly of lime, silica, alumina and iron oxide. Ordinary Portland Cement of 53grade was used in this project which confirms to IS 8112-1976.

Properties:

- Normal consistency = 36%
- Initial setting time = 10min
- Final setting time = 240min
- Specific gravity of cement = 3.15

Fine Aggregates

Fine aggregates are those which pass through I S sieve number 4.75 mm. The important function of fine aggregates is to fill up the voids in the coarse aggregates and to give density to concrete. The fine aggregates make use of cement paste to hold the coarse aggregate particles in suspension of paste.

Properties:

- Specific gravity = 2.63
- Zone-II

Coarse Aggregates

Coarse aggregate in concrete are in greater volume which contributes stability and durability to the concrete. It forms bulk of the concrete. It should be of proper shape, hard, strong and well graded. Coarse aggregate are those which are retained in IS sieve 4.75 mm for structural concrete. The coarse aggregate used in this project was crushed stone.

Properties:

- Specific gravity =2.71
- Impact value = 25.35%
- Crushing value =28.41%
- Abrasion value =32.62%

Water

Water is an important ingredient in the concrete mass, as it actively participates in the chemical reaction with the cement. It has been estimated that an average of 23% of water by weight of cement is required for chemical reaction with cement compounds. The water should be added to required consistency for suitable workability.

Fly ash

In this project different types of mix proportions have been considered where 10%, 20%, 30%, 40% and 50% of flyash is replaced in place of cement.

Ingredient Value

- Silica (SiO2)- 56.88 %
- Aluminum trioxide (Al2O3)- 27.65 %
- Ferric oxide (Fe2O3 + Fe3O4)- 6.28 %
- Titanium dioxide (TiO2)- 0.31 %
- Calcium oxide (Cao)- 3.6 %
- Magnesium oxide (MgO)- 0.34 %
- Sulphate (SO4)- 0.27 %
- Loss of ignition (LOI)- 4.46 %
- Specific gravity of Fly Ash- 2.12

Conplast NC

Chloride free accelerating, water reducing admixture.

To accelerate the setting and early strength gain of Portland cement concrete and mortar mixes without the introduction of chloride. Acts as a plasticiser, so gives significant increases in both ultimate and early strengths. Conplast NC is guaranteed completely free of all forms of chloride and is supplied as a light straw coloured liquid. The main active ingredient is an inorganic formate.

Properties

Specific gravity = 1.260 - 1.270 at 270C
Freezing point = -160C
Chloride content = Nil to BS 5075
Air entrainment = Less than 1%

V. SUMMARY AND FUTURE SCOPE

The use of Flyash and M-Sand can provide durable and sustainable infrastructure where construction and maintenance of conventional concrete are not cost effective. After detailed analysis, it has been found that M-Sand gives higher strength than that of natural sand when replaced in concrete. As flyash is a waste by-product, it will not only reduce the amount of cement content but also help in easy disposal. Using Conplast NC, it has been found that there is a rapid increase in strength with time. This project work will benefit the construction industry to complete the project within less time and to achieve higher strength values. As M-Sand is found effective 100% replacement to natural sand, this will help the environment in controlling river bank erosion, and also will help in reducing the overall cost of production of concrete.

Future scope of the work

Different type of admixtures can be added to concrete to check the performance of rapid hardening concrete in place of Conplast NC. High Volume Flyash can be used in place of flyash which may result in better values and strength aspects. Further studies can be carried out in order to reduce the cost of production of concrete.

VI. REFERENCES

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