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PARTIAL REPLACEMENT OF CEMENT WITH FLY ASH AND IT'S COMPRESSIVE STRENGTH

[1]PUJARI SAINATH, [2]PONNALA RAMAIAH

[1]M. Tech(Structural Engineering), Department of Civil Engineering, SVS Group of Institutions, Village Bheemaram, Mandal Hasanparthy, District Warangal, Telangana, India.

[2]Professor, Department of Civil Engineering, SVS Group of Institutions, Village Bheemaram, Mandal Hasanparthy, District Warangal, Telangana, India.

ABSTRACT- The utilization of fly-ash in concrete as partial replacement of cement is gaining huge importance these days, principally on account of the development within the future sturdiness of concrete combined with ecological advantages. Technological enhancements in thermal power station operations and fly-ash assortment systems have resulted in up the consistency of fly-ash. to review the impact of partial replacement of cement by fly-ash studies are conducted on concrete mixes with 300 to 500 kg/cum cementious materials at 7.5%, 15%, 25%fly ash replacement levels. during this project the result of fly-ash on workability, setting time, density, air content, compressive strength, durability, size of aggregate, modulus of elasticity Slump test and Compaction test are studied based on this study compressive strength v/s W/C curves are planned so concrete mixture of grade M20 with distinction proportion of fly-ash are often directly designed.

1. INTRODUCTION

Fly ash could be a major producer of greenhouse emission and thereby decreasing inexperienced house gas emissions. One ton of Portland cement production discharges 0.87 ton of greenhouse gas to the surroundings. Utilization of fly ash minimizes the CO_2 emission drawback to the extent of its proportion in cement

This can be achieved by utilization waste product (fly ash) by proper planning for assortment and considering the various forms of environmental impacts (E.g., global warming, resource depletion like coal) at totally different life cycle stages of Portland cement (e.g., producing, transportation, use, disposal).

Quality of fly ash as per BIS, ASTM Bureau of Indian standard

To utilize fly ash as a Pozzolana in Cement concrete and Cement Mortar, Bureau of Indian standard (BIS) has developed IS: 3812 part - 1 2003. in this code quality demand for silicious fly ash (class F fly ash) and carbonate fly ash (class C fly ash) with respect its chemical and physical composition are specified .

The hydration reactions are almost like the reactions occurring throughout the association of Portland cement. Thus, concrete contains ash pozzolana becomes denser, stronger and usually additional sturdy future as compared to straight Portland cement concrete mixtures.

2. LITERATURE REVIEW

S. Gopala Krishnan, et al studied the effect of different percentages of replacement of cement, that of 15, 20, 25, 30% with fly ash for M80 concrete. W/(C+F) ratio and the quantity of C.A. were kept constant. The quantity of fine aggregate was suitable adjusted for different CRL (Concrete Replacement Levels) with fly ash. The reported that: incorporation of fly ash resulted in a marginal reduction in workability. But the mixes were more cohesive and free from any bleeding and aggregation. The finishing of the mix was also better.

S.S. Rehsi & S.K. Garg replaced 20% cement by weight with 27.5% fly ash by weight. Water requirement was kept at 8% less than the amount of water required to keep W/(C+F) ratio equal to W/C ratio of the corresponding plain cement concrete mix. The quality of sand was reduced and coarse aggregate increased by an amount equal to the weight of fly ash added.

Kraiwood Kiattikomal, et al reported that for class-F fly ash, it was the fineness, not the chemical composition that has significant effect on compressive strength of mortars. The mortars with finer fly ashes gained higher compressive strength than those with the coarser ones.

P.Kumar Mehta referred to the work of Malhotra V.M and his colleagues according to which fly ash used in large volume imparts excellent workability to concrete at a water content 10 to 20% lower than that for concrete without the fly ash and further reductions in water content can be achieved with better aggregate grading and with the help of super plasticizing admixtures.

Dunstan, M.R.H in their studies at CANMET and university of Calgary, have indicated that structural concrete with 28days strength around 60MPa and of adequate durability can be produced with Canadian fly ashes replacing up to 60% cement by weight and by incorporating high range water reducer and air entraining admixtures in concrete.

3. MATERIAL DESCRIPTION AND MIX PROPORTION

A. Aggregates

For each and every aggregate are the necessary constituents in concrete. They provide body to the concrete, reduce shrinkage and impact economy. The mere proven fact that the aggregates occupy 70-80 per cent of the amount of concrete, their impact on varied characteristics and properties of concrete is without doubt considerable.

B. Cement

Cement is a binder material that sets and hardens independently, and can bind different materials along. Cement is formed from four main compounds ($3CaO\ SiO_2$), ($2CaO\ SiO_2$), ($3CaO\ Al_2O_3$), and ($4Caco\ Al_2O_3\ Fe_2O_3$). Small amounts of un-compounded lime and magnesium oxide are also present, together with alkalis and minor amounts of alternative components.

C. Fly ash

Fly ash may be a by-product from coal-fired electricity generating power plants. The coal utilized in these power plants is especially composed of

flammable parts like carbon, hydrogen and oxygen (nitrogen and sulphur being minor elements), and non flammable impurities (10 to 40%) typically present within the type of clay, shale, quartz, feldspar and sedimentary rock. the size of ash ranges from 1.0 to one hundred micron and the typical size is around 20 microns. it is found that particle size below ten microns contributes towards early Development of strength (7& 28 days).

D. Water

The pH value of water should be in between 6.0 and 8.0 as per IS 456-2000.

Effect of blending ocean Water in Concrete

The sea Water usually contains salinity of concerning 3.5% during which regarding 80th is Sodium Chloride. several researchers are conducted to review the corrosion drawback of steel Embedded in concrete wherever ocean water is employed as mixing water in concrete however the Indian standard is adamant and don't allow exploitation ocean water for mixing or curing in reinforced concrete constructions, however permits for exploitation of ocean water just for PCC work that too beneath inevitable circumstances.

Quality of Water for curing Concrete Members

Generally the water that's appropriate mixing of water in concrete is additionally suitable for curing. However where appearance is very important, water containing impurities that cause stains shouldn't to be used. The foremost necessary components that cause stains within the concrete are iron, and organic matters.

Quality of Water for hardening Concrete Cubes

The water that's appropriate mixing and curing of water for concrete is additionally suitable for hardening of cubes that are cured beneath water. But the curing water shouldn't to be allowed to stay in stagnant condition in water tanks for very long time. As a suggestion the water tanks shall be clean twice a week or when pH value of water reaches a value more than 9. The cleaned Water tanks shall be refilled with fresh water every time. Mix Design for M_{20} Grade

Grade designation = 20 Mpa

Type of cement = OPC

Maximum size of aggregate = 20 mm

Minimum cement content = 250 kg

Maximum water cement ratio = 0.50

Workability = 80 mm slump

Exposure condition = severe

Degree of supervision = Good

Type of aggregate = Crushed

Maximum cement content = 450 kg

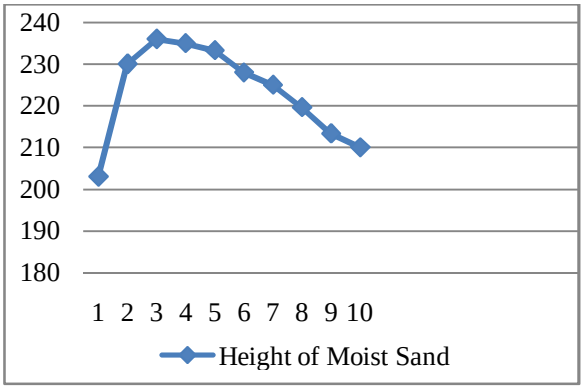
Water	Cement Kg/m^3	Fine aggregate Kg/m^3	Coarse aggregate Kg/m^3
191.6	383	545.16	1185.5
0.5	1	1.42	3.09

Table 1 shows the mix proportions of concrete

4. TESTS AND RESULTS

Physical Tests	Obtained results	Requirements as per IS codes
Fineness	0.47%	Not>10% as per IS 4031 part 1
Standard Consistency	32%	IS 4031 part 4
Initial Setting time	28 min	Not less than 30 minutes as per IS 4031 part 5
Final setting time	600 min	Not more than 600 minutes as per IS 4031 part 5
Soundness	0.2mm	Not>10mm as per IS 4031 part 3
Specific gravity	2.6	IS 2720 part 3 (3.15 is generally assumed)

Table 2 shows the physical Tests results of OPC cement



Graph 1 shows the Variations in Bulking of fine aggregates

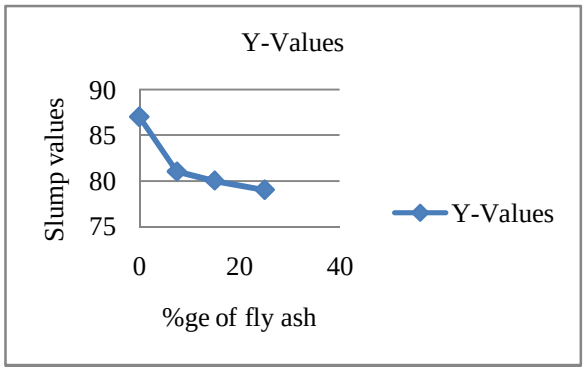
The property of fly ash is given below in Table which has conducted in the lab.

Material	Specific gravity
Fly ash	2.36

Table 3 which shows Specific gravity of fly ash

S.No	Percentage addition of fly ash to concrete (%)	Slump value in mm
1	0	87
2	75	81
3	15	80
4	25	79

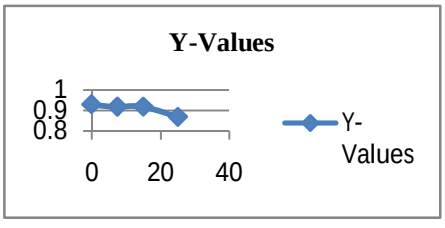
Table 4 shows the Slump Values



Graph 2 Y-Axis Slump values X-axis % fly ash

S.No	% of fly ash added	Compaction Factor Value
1	0	0.93
2	7.5	0.92
3	15	0.92
4	25	0.87

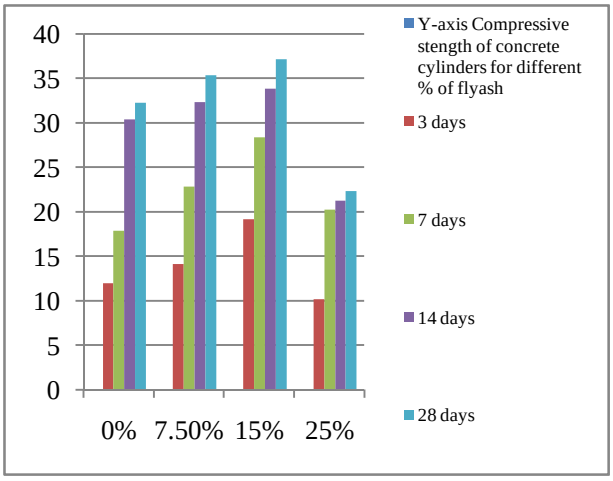
Table 5 Compaction Factor Values



Graph 3 shows the variations of compaction factor

% of fly ash added	3 days	7 days	14 days	28 days
0	11.98	17.92	30.4	32.3
7.5	14.2	22.9	32.4	35.1
15	19.2	28.4	33.9	37.2
25	10.2	20.34	21.3	22.4

Table 6 Compressive strength of concrete cylinders with replacement of cement by fly ash



Graph 4 shows Compressive Strength V/S different % of Fly ash

6. CONCLUSION

Based on restricted experimental investigation regarding the compressive & split strength of concrete, the subsequent conclusions are drawn:

Compressive strength reduces when cement replaced fly ash. As fly ash percentage will increase compressive strength and split strength decreases. Use of fly ash in concrete will save the coal & thermal trade disposal costs and manufacture a 'greener' concrete for construction. The cost analysis indicates that % cement reduction decreases cost of concrete, however at constant time strength also decreases.

This research concludes that ash will be innovative supplementary building material Construction Material however judicious selections are to be taken by engineers.

All the experimental knowledge shows that the addition of the economic wastes improves the physical and mechanical properties. These results are of great importance as a result of this type of innovative concrete needs great amount of fine particles. Because of its high fines of quarry dust it provided to be terribly effective in assuring very good cohesiveness of concrete. From the above study it's over that the quarry mud could also be used as a replacement material for fine aggregate. Quarry mud has been used for various activities within the construction industry appreciate for construction and manufacture of building materials appreciate light weight aggregates, bricks, tiles and auto clave blocks. But its use as rigid payment is incredibly abundant restricted. Thorough reaction with the concrete admixture, quarry dust, improved pozzolanic reaction, micro aggregate filling and concrete sturdiness. Because the properties are sensible as sand, the quarry mud is employed as fine aggregate in replacement with sand within the cement concrete.

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