International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 04, April 2016
www.ijates.com
ijates
ISSN 2348 - 7550

INVESTIGATIVE STUDY OF FLY ASH ON COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

Fly ash, a waste generated by thermal power plants is in and of itself a giant environmental concern. The investigation revolves around during this paper is applied to check the employment of ash in cement concrete as a partial replacement of cement similarly as AN additive thus on give AN environmentally consistent method of its disposal and apply. This work could be a case study for thermal power station of kota ,Rajasthan. The cement in concrete matrix is replaced from five-hitter to twenty fifth by step in steps of fifty. It's discovered that replacement of cement in any proportion lowers the compressive strength of concrete similarly as delays its hardening. This provides an environmental friendly technique of Kota thermal power plant ash disposal.

Keywords: Compression, Cement, Flexural strength, Fly ash.

I. INTRODUCTION

Fly ash is incredibly a lot of like volcanic ashes employed in production of the earliest famed hydraulic cements concerning two,300 years ago. Those cements were created close to the little Italian city of Pozzuoli - that later gave its name to the term "pozzolan". A pozzolan may be a oxide or oxide / aluminous material that once mixed with lime and water forms a building material compound. Ash is that the best famed, and one among the foremost unremarkably used, pozzolans within the world. Ash is that the ill-famed waste of coal based electricity generating thermal power plants, famed for its unwell effects on agricultural land, surface and sub-surface pollution, soil and pollution and diseases to world. Researchers have projected few ways that of reusing ash for kind of application. one among the foremost common use of ash is in cement concrete. Ash particles are virtually altogether spherical in form, permitting them to flow and mix freely in mixtures. That capability is one among the properties creating ash a fascinating admixture for concrete. These materials greatly improve the sturdiness of concrete through management of high thermal gradients, pore refinement, depletion of cement alkalis, resistance to chloride and salt penetration, and continued small structural development through a long association and pozzolanic reaction. the employment of by-products because the partial replacement of cement has necessary economical, environmental and technical edges like the reduced quantity of waste materials, cleaner atmosphere, reduced energy demand, sturdy service performance throughout service life and value effective structures. During this experimental investigation, an endeavour has been created to check the techno-economic analysis for the compressive strength of ash concrete. The ash is procured from kota Thermal powerhouse. It consumes 7500-8500 MT/day of coal and produces 2550 to 2800 MT/day ash. Here, in our work a comparative study of the characteristics compressive strength between standard Portland cement concrete and

ash based mostly concrete has been created. Ash is employed in numerous proportions starting from 100 percent to five hundredth by weight of cement in steps of fifty. Exploitation the experimental knowledge, a column section is meant. The relative price of column section designed with OPC similarly as numerous proportion of ash is calculable and compared. It's ascertained that ash may be safely and economically used. This conjointly provides Associate in Nursing environmental friendly methodology of ash disposal.

II. EXPERIMENTAL WORK

2.1 Properties of fly ash:

Various tests were done to find out the physical and chemical properties of fly ash which is illustrated in table 1.

Table no. 1: Physico-chemical properties of fly ash

PARAMETER	OBSERVED VALUE	PERMISSIBLE VALUE AS PER IS : 3812-2003
Specific surface area	340 - 360 m^2/kg	> 250 m^2/kg
Particle retained on 45 micron sieve	28.9 %	< 35%
Compressive strength at 28 days	44 - 48 N/mm^2	> 39 - 43 N/mm^2
Silica	58 - 60 %	35 %
Silica +Alumina +Iron Oxide content	88 - 91 %	> 70 %
Soundness	0.014 to 0.018 %	< 8 %
Sulfur as SO_3	0.26 - 0.32 %	< 0.3 %
MgO	0.26 - 0.34 %	< 0.5 %
Available alkalies as Na_2O	0.16 - 0.02 %	1.5 %
Chlorides	0.016 - 0.02 %	0.05 %
Loss on ignition	0.9 - 1.05 %	< 1.5 %

It can be seen that all parameters are within permissible limits.

2.2 Cement fly ash blends:

The fly ash is blended in cement at a rate of 10 to50% by weight of cement in steps of 10%. The cement-fly ash blends are then tested for following properties: consistency, setting time, soundness, workability and compressive strength, as per IS 546- 2003.

2.3 Concrete Mix Design:

In the present study, M20 grade with nominal mix as per IS 456-2000 was used. The concrete mix proportion (cement: fine aggregate: coarse aggregate) is 1: 1.5: 3 by volume and a water cement ratio of 0.5 is taken. The fly ash is blended in cement at a rate of 5 to 25% by weight of cement in steps of 5%.

2.4 Compressive strength determination:

In this test sample of concrete is filled in the mould of size 15cm x 15cm x 15cm and top of mould is strike off. A total number of 18 cubes were casted. Fly ash is added in place of cement in concrete in 6 different ercentages starting from 0%, and raised the mixing of fly ash upto 25%, at an interval of 5%. The specimens are covered with the wet gunny bags for 24 hours. Then after sample is removed and kept for curing in curing tank. At the end of curing period sample is removed and tested immediately. The testing is done under Universal Testing machine. The load is applied smoothly and gradually. The crushing loads are noted and average compressive strength for three specimens is determined for each which is given in table 2.

III. RESULTS AND DISCUSSION:

3.1 Properties of fresh concrete:

As described in $2.2, various properties of fresh concrete are determined. Considering space limitations, here data sheet is not presented only results are discussed: The consistency of cement has increased with the addition of fly ash from 32% for 0% fly for 50% fly ash. It may be attributed to the increased specific surface area of cement – fly ash blend due to finer particles of the later. The initial setting time (IST) has increased from 155 minutes for 0% fly ash to 250 minutes for 50% fly ash. This may be attributed to the retardation of cement hydration due to fly ash. The workability of cement concrete mix has increased from 25 mm (for 0% fly ash) to 120 mm (for 25% fly ash). This may be attributed to the soothing effect of fine fly ash particles in the concrete mix. It is an encouraging result.

3.2 Compressive strength of fly ash concrete

The characteristic compressive strength of various blends of concrete is presented in table no. 2. Figure2 shows the graphical representation of data of table no 2.

Table 2: Compressive strength of cement-fly ash concrete (three sample average)

% FLY ASH	COMPRESSIVE STRENGTH (N/mm^2)					
	3 DAYS	7 DAYS	21 DAYS	28 DAYS	60 DAYS	90 DAYS
0	8.44	11.55	21.77	26.06	37.10	37.99
5	8.00	12.44	24.15	24.88	29.00	36.88
10	7.55	7.77	20.14	21.29	31.33	40.44
15	5.77	7.99	15.55	19.86	26.21	35.41
20	4.44	8.44	14.22	19.10	30.22	39.88
25	5.59	6.21	11.84	18.66	23.33	33.77

The curves in figure 2 show the rate of compressive strength development of various blends of fly ash concrete over a span of 90 days. It can be seen that 0% fly ash i.e. concrete with no replacement of cement with fly ash, has maximum rate of compressive strength development at 60 days and after it becomes nearly constant. 5% fly ash has maximum rate of compressive strength development upto the age of 21 days and then after its rate decreases. Strength development at later stage is negligible. The rate of strength development is large upto 21 days for 10% fly ash and then after its rate becomes negligible for few days and after 28 days it increases

uniformly. Its final strength development is also maximum than any other fly ash blends. After 90 days of storage the concretes containing 10 % of fly ash, related to cement mass, gained a compressive strength about 6 % higher than the concrete without addition for Ordinary Portland cement. For fly ash blends greater than 10% fly ash, the rates of strength development as well as final strengths both reduce with addition of fly ash. In long terms, concrete with higher proportions of fly ash gains strength comparable with that of pure concrete.

It is important to note from table 2 that the strength of concrete decreases with the increase in % of replacement of cement with fly ash at 28 days. But, at 90 days we get maximum strength for 10% fly ash addition.

IV. CONCLUSIONS

This study proves that fly ash can be successfully used in the cement concrete in minor amount as an additive. Considering the intangible cost of disposal problem of fly ash and hidden cost of environmental protection, the methodology appears to be indeed successful. Fly ash is actually a solid waste. So, it is priceless. If it can be used for any purpose then it will be good for both environment and economy. Use of this fly ash as a raw material in Portland cement is an effective means for its management and leads to saving of cement and economy consequently. Hence it is a safe and environmentally consistent method of disposal of fly ash. However the rate of strength development is less, Due to lesser rate of strength development, fly ash finds specific application in mass concreting e. g. dam construction. It can be concluded that power plant waste is extensively used in concrete as a partial replacement for cement and an admixture.

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