Characterization and Use of Pond Ash in Concrete as Replacement of Sand

Shashi Sharma[1], Er. Ritu[2]
[1]M.Tech Scholar, [2]Assistant Professor OmInstitutes of Technology & Management , Hisar
sashant.sharma@gmail.com

ABSTRACT:- *Pond ash is one, out of three category of fly ash available from thermal power stations. Other two categories are Dry fly ash and Bottom ash, Dry fly ash is collected from different rows of Electro-static precipitators in dry form, Bottom fly ash is collected at the bottom of boiler furnace, Pond ash is collected from Ash Pond area. Coal-based thermal power plants all over the world face serious problems of handling and disposal of the ash produced. The high ash content (30-50%) of the coal in, India makes this problem complex. At present, about 80 thermal power stations produce nearly 100 million tons of coal ash per annum. Safe disposal of the ash without adversely affecting the environment and the large storage area required are major concerns. Hence attempts are being made to utilize the ash rather than dump it. It have been introduced into Indian concrete industry to conserve natural resources of ingredients of concrete. In India, most of the Thermal power plants adopt wet method of ash disposal. Pond ash is collected from Thermal power plant at the bottom, in that it contains significant amount of relatively coarser particles (spanning from 150 microns to 2.36 mm). Pond ash utilization helps to reduce the consumption of natural resources. Also it is help to solve the problem of disposal of Pond ash because it contains huge amount of chemical compounds such as SiO_2, Al_2O_3 etc. These chemical compounds plays an important role in hydration reaction and helps to produce bond between two adjacent particles.. Study shows the properties of Pond ash suitable for improving the properties of concrete. The Partial replacement of pond ash with sand as 0%, 10%, 20%, 30% causes increase in compressive strength of concrete and give the maximum and minimum strength output with 20% and 10% of pond ash respectively. Partial replacement does not cause any adverse effect on properties of fresh concrete rather its shows better workability and improve strength with partial replacement of fine aggregate. The result shows that concrete giving good strength with partial replacement of fine aggregate. Thus, it is suitable to use pond ash as fine aggregate or partial replacement with natural sand.*

Keywords: *- Concrete, compressive strength Industrial Waste Product, Pond ash.*

1 INTRODUCTION:-

Current ashes generation in India is about 112 million metric tons and its current utilization is only about 42 million metric tons (38% of ash generated). Rest of the unutilized ash is being disposed off on to the ash ponds. Disposal of this enormous amount of fly ash faces problem of huge land requirement, transportation, ash pond construction and maintenance. Also to meet the rising energy demand power generating industries in India growing rapidly. India shall continue to depend on coal as the prime source of energy. In India environmental issues became a major concern in the 21st century so the solid waste management for coal based thermal power plants shall continue to be a major area of priority. In developing country like India where the problems like increasing population, scarce natural resources specially land, increasing urbanization and energy requirements goes side by side with the development, it is almost impossible for power generation sector to function in isolation. So now a day's use of resource material like Fly ash became a major area of research. The past years have witnessed a significant growth in the technological level with respect to fly ash disposal & utilization in the country and in the next millennium fly ash in itself is going to emerge as a major industry.

1.2 Materials Used:

Materials used for experimental work are cement, natural fine and coarse aggregate, recycled fine and coarse aggregate. These materials are described as

1.2.1 Cement:

Ordinary Portland cement of grade 43 has been used for the experimental work. Portland cement referred as (Ordinary Portland Cement) is the most important type of cement and

is a fine powder produced by grinding Portland cement clinker. The OPC is classified into three grades, namely 33 Grade, 43 Grade, 53 Grade depending upon the strength of 28 days. Various tests were performed on cement as per IS 4031-1988.

1.2.2 Fine aggregates:

Locally available river sand passed through 4.75 mm IS sieve has been used for the experimental works. It confirms to IS 383-1970. Aggregate are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates were considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interface of aggregate and paste. The physical properties of sand like Fineness Modulus, Specific Gravity and water absorption are 3.49, 2.67 and 2.31% respectively.

1. Natural sand, i.e., the fine aggregate resulting from natural disintegration of rock and/or that which has been deposited by stream and glacial agencies.
2. Crushed stone sand, i.e., the fine aggregate produced by crushing hard stone.

1.2.3 Coarse aggregates:

The coarse aggregate with a maximum size 20mm having a specific gravity 2.89 has been used. Coarse gravel of 20mm and crushed aggregate of 10mm are mixed in 60:40 for the experimental works. The physical Properties of coarse aggregates like Fineness Modulus, Specific Gravity are 2.31, 2.89 respectively

1. Crushed gravel or stone obtained by the crushing of gravel or hard stone.
2. Uncrushed gravel or stone resulting from the natural disintegration of rock.

1.2.4 Water:

Water used for mixing and curing was clean and didn't contain harmful impurities such as oils, acids, alkalis, salts and sugar, organic substances that may be deleterious to concrete. As per IS 456-2000 Potable water is generally considered satisfactory good for mixing and curing of concrete.

1.2.5 Pond Ash:

Pond ash is one, out of three category of fly ash available from thermal power stations. Other two categories are Dry fly ash and Bottom ash, Dry fly ash is collected from different rows of Electro-static precipitators in dry form, Bottom fly ash is collected at the bottom of boiler furnace, Pond ash is collected from Ash Pond area. Fly ash and Bottom ash are mixed together with water to form slurry, which is pumped to the ash pond area. In ash pond area, ash gets settled and excess water is decanted .For preliminary characteristics pond ashes from two different locations are used. One sample is taken from H.V.P.N. Thermal Power Station, Panipat (PNP ASH) and other one is from N.T.P.C. Thermal Power Station, Badarpur, New Delhi (BDR ASH).

EXPERIMENTAL PROGRAMME AND INVESTIGATIONS:-

Standard cubical moulds of size 150mm × 150mm×150mm made of cast iron has been used to cast concrete cube specimens to test compressive strength of concrete. To determine the compressive strength of concrete with pond ash, total 36 no's of cubes were casted. The quantities of cement, fine aggregates, coarse aggregates, and water for each batch were taken as per the design requirements. These constituents thoroughly mixed to get a uniform mixture throughout the batch. Required dosage of water added in the course of mixing and a suitable correction is applied as per the standards for counteracting effect of the water content already present in the constituents. Thorough mixing has done until concrete appeared to be homogeneous and of desired consistency. Concrete mix so prepared has tested for workability requirements like for slump value and readings recorded for the evaluation. The

inner surfaces of moulds were oiled so as to avoid the sticking of concrete. Concrete then filled in prepared moulds with suitable compacting measures to the concrete. Surface of concrete is then level using a trowel and marked with date and batch number. Finished specimens were then left to harden and extracted from moulds carefully, approximately after 24 hours of casting. They are placed in water tank for curing for various periods under consideration. For conducting this study, the mix design was prepared in accordance with IS 10262:2009 and IS 383:1970.

Mix specifications	w/c ratio	Workability (Slump in mm)	7 days compressive strength, N/mm^2		28 days compressive strength, N/mm^2	
			Specimen (results)	Avg.	Specimen (results)	Avg.
0%	0.45	80	16.89	16.89	25.30	25.28
		90	16.87		25.28	
		85	16.91		25.26	
	0.50	110	14.79	15.80	24.26	23.28
		105	15.80		22.30	
		100	16.81		23.28	
	0.55	125	15.60	15.40	23.15	24.10
		120	15.40		24.10	
		125	15.20		25.05	
10%	0.45	90	13.92	13.90	17.12	17.10
		85	13.90		17.10	
		95	13.88		17.08	
	0.50	90	13.18	13.20	24.42	24.40
		100	13.20		22.38	
		95	13.22		22.40	
	0.55	100	14.15	12.95	21.88	21.90
		95	12.70		21.90	
		105	12.00		21.92	
20%	0.45	95	20.40	20.40	30.55	30.55
		90	20.38		30.40	
		85	20.42		30.70	
	0.50	100	17.10	17.40	24.28	24.30
		90	17.80		24.30	
		95	17.30		24.32	
	0.55	110	18.18	18.20	27.80	27.40
		105	18.20		27.15	
		100	18.22		27.25	
30%	0.45	80	18.20	18.50	28.10	28.40
		90	18.80		28.30	
		85	18.50		28.80	
	0.50	80	15.88	15.90	23.78	23.80
		100	15.90		23.80	
		90	15.92		23.82	
	0.55	90	16.80	16.40	26.08	26.20
		100	16.10		26.30	
		95	16.30		26.22	

7 days compressive strength, Comparison of results					
w/c ratio	compressive strength with FA	compressive strength with pond ash	pond ash replacement	total percentage	increase/ decrease
0.45	16.89	13.9	10%	82.29722	-17.70%
		20.4	20%	120.7815	20.80%
		18.5	30%	109.5323	9.50%
0.5	15.8	13.5	10%	85.44304	-14.56%
		17.4	20%	110.1266	10.20%
		15.9	30%	100.6329	0.63%
0.55	15.4	12.95	10%	84.09091	-16.00%
		18.2	20%	118.1818	18.18%
		16.4	30%	106.4935	6.50%

28 days compressive strength, Comparison of results					
w/c ratio	compressive strength with FA	compressive strength with pond ash	pond ash replacement	total percentage	increase/ decrease
0.45	25.28	17.1	10%	67.6	-32.40%
		30.55	20%	120.8	20.80%
		28.4	30%	112.3	12.30%
0.5	23.28	20.2	10%	86.8	-13.20%
		24.3	20%	104.4	4.40%
		23.8	30%	102.2	2.20%
0.55	24.1	21.9	10%	90.9	-9.10%
		27.4	20%	113.7	13.70%
		26.2	30%	108.7	8.70%

CONCLUSIONS:-

- The 20% replacement of pond ash with FA gives the maximum increase in strength with w/c ratio 0.45. whereas with 10% replacement declines the

strength gain up to 16% and 32% in 7days and 28 days respectively.

- It was observed that with the replacement of 20% of pond ash with FA compressive strength increases as compared with the concrete with natural aggregates. So it can be concluded that pond ash can be effectively used as strength increasing agent by partially replacing FA between range above 10 % and below 30%.
- Cubes gives satisfactory results and concrete can be efficiently used with replacement of pond ash in various construction projects in range 10-30% pond ash.

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