International Journal For Technological Research In Engineering
Volume 5, Issue 10, June-2018 *ISSN (Online): 2347 - 4718*

TO STUDY THE MECHANICAL PROPERTIES OF CONCRETE ON REPLACEMENT OF FINE AGGREGATES WITH COAL BOTTOM ASH

Er. Sanampreet Dhillon[1], Er.Sunil Kumar[2], Er.Vikram[3]
[1]M.Tech Scholar, Department of Civil Engineering, JCDMCOE, Sirsa, India
[2]Assistant Professor, Department of Civil Engineering, JCDMCOE, Sirsa, India
[3]Assistant Professor and H.O.D, Department of Civil Engineering, JCDMCOE, Sirsa, India

Abstract: In this study, the effects of partial replacement of natural fine aggregate with coal bottom ash of M20 concrete and the relationship between compressive strength and split tensile strength has been observed. In this study the concrete incorporate with coal bottom ash with 0%, 15%, 25%, 35%, and 45%, by weight of natural fine aggregate. The water to cement ratio was kept constant to 0.5 and all other variables of concrete were also kept constant in order to incorporate, Only the effect of coal bottom ash on the compressive and split tensile strength of M20 concrete.

At the age of 7 days the average compressive strength of M20 mix with different percentage replacement of natural fine aggregate with coal bottom ash (**CBA**). It has been observed that at 0% replacement the average compressive strength 12.90 N/mm^2 was observed, at 15% replacement the average compressive strength 11.48 N/mm^2 was observed, at 25% replacement the average compressive strength 10.83 N/mm^2 was observed, at 35% replacement the average compressive strength 6.16 N/mm^2 was observed, and at 45% replacement the average compressive strength 5.99 N/mm^2 was observed. Hence it has been observed that as the replacement % of coal bottom ash increases strength of concrete and decreases.

At the age of 28 days the average compressive strength of M20 mix with different percentage replacement of natural fine aggregate with coal bottom ash (CBA). It has been observed that at 0% replacement the average compressive strength 19.76 N/mm^2 was observed, at 15% replacement the average compressive strength 23.05 N/mm^2 was observed, at 25% replacement the average compressive strength 24.22 N/mm^2 was observed, at 35% replacement the average compressive strength 27.23 N/mm^2 was observed, and at 45% replacement the average compressive strength 23.88 N/mm^2 was observed. Hence it has been observed that as the replacement % of coal bottom ash increases strength of concrete and decreases.

At the age of 7 days the average split tensile strength of M20 mix with different percentage replacement of natural fine aggregate with coal bottom ash (CBA). It has been observed that at 0% replacement the average split tensile strength 1.96 N/mm^2 was observed, at 15% replacement the average split tensile strength 1.77 N/mm^2 was observed, at 25% replacement the average split tensile strength 1.10 N/mm^2 was observed, at 35% replacement the average split tensile strength 1.01 N/mm^2 was observed, and at 45% replacement the average split tensile strength 0.62 N/mm^2 was observed. Hence it has been observed that as the replacement % of coal bottom ash increases strength of concrete and decreases

At the age of 28 days the average split tensile strength of M20 mix with different percentage replacement of natural fine aggregate with coal bottom ash (**CBA**). It has been observed that at 0% replacement the average split tensile strength 3.07 N/mm^2 was observed, at 15% replacement the average split tensile strength 2.70 N/mm^2 was observed, at 25% replacement the average split tensile strength 3.18 N/mm^2 was observed, at 35% replacement the average split tensile strength 3.47 N/mm^2 was observed, and at 45% replacement the average split tensile strength 3.40 N/mm^2 was observed. Hence it has been observed that as the replacement % of coal bottom ash increases strength of concrete and decreases

I. ADDITIVES USED IN PRESENT STUDY COAL BOTTOM ASH

Coal Bottom Ash is the by-product of coal combustion. The rock detritus in the fissures of coal become separated from the coal during pulverization. In the furnace, carbon and other combustible matter burns, then non-combustible matter result in coal ash. Swirling air carries the ash particles out of hot zone where it cools down. The boiler flue gas carries away the finer and lighter particles of coal ash. The boiler flue gases pass through the electrostatic precipitators before reaching the environment. In the electrostatic precipitators, coal ash particles are extracted from the boiler flue gases. The coal ash collected from the electrostatic precipitators is called fly ash. Fly ash accumulates about 80% of coal ash. During the combustion process some particles of the coal ash accumulate on the furnace walls and steam pipes in the furnace and form clinkers. These clinkers build up and fall to the bottom of furnace. In addition, the coarser particles, which are too heavy to remain in suspension with the flue gases, settle down at the base of the furnace. The ash collected at the bottom of furnace is called coal bottom ash. Coal bottom ash constitutes about 20% of coal ash and the rest is fly ash.

Physical Properties of Coal Bottom Ash

The coal bottom ash is mainly due to the presence of rock detritus in the fissures of the coal seams. The variability in the rock detritus from one source to another therefore causes variation in the properties of coal bottom ash as well. The

factors that affect the properties of coal bottom ash are:-
Degree of Pulverization of coal
Firing temperature in the furnace
Types of Furnance
Coal bottom ash has angular, irregular, porous and rough surface textured particles. The particles of coal bottom ash range from fine sand to fine gravel. Coal bottom ash has appearance and particle size distribution similar to that of river sand. Coal bottom ash is usually is a well graded material although variations in particle size distribution can be encountered from the same power plant. Particles of coal bottom ash have interlocking characteristics. Coal bottom ash is lighter and more brittle as compared to natural river sand. The specific gravity of coal bottom ash varies from 1.2 to 2.47 depending upon the source and type of coal. Coal bottom ash with low specific gravity has a porous texture that readily degrades under loading or compaction. Coal bottom ash derived from high sulphur coal and low rank coal is not very porous and is quite dense. The published literature shows wide variation in physical properties of coal bottom ash.

Chemical Properties of Coal Bottom Ash
Coal ash produced on burning of lignite or sub bituminous coal contains high calcium oxide content. This type of coal ash has cementitious properties in addition to pozzolanic properties. Anthracite or bituminous coals on burning result in low-calcium coal ash which has pozzolanic properties and very small fraction of calcium oxide. Coal bottom ash is mainly composed of silica, alumina and iron with small amounts of calcium, magnesium, sulphate etc. Its chemical composition is controlled by the source of the coal. The data reported in published literature shows variation in chemical composition of coal bottom ash.

Pozzolanic Properties of Coal Bottom Ash
Pozzolanic activity of coal bottom ash starts after 14 days. They observed that after 14 days, the coal bottom ash particles started reacting with calcium hydroxide and after 90 days of hydration, the consumption of calcium hydroxide was very significant.
Significant of the Study
The purpose of the present study is:

- Reduce the usage of sand by replacing bottom ash as a sand replacement in concrete.
- To reduce waste municipal solid waste.

Objective of the Study
The objective of the study is:
To determine the effect of coal bottom ash on compressive and split tensile strength of concrete by partial replacement with fine aggregate.

Scope of the Study
Based on the objectives that has been listed, this study is concentrated on investigation of cement concrete using coal bottom ash (CBA) as a fine aggregates replacement. In order to determine the strength of concrete, the concrete mixes will be designed as per constant grade follows designation as M20, the plain cement concrete formulation is compose of cement, coarse aggregate and sand without addition of coal bottom ash.
This waste product was taken from Guru Nanak Dev Thermal Plant at Bathinda, Malout Road, Bathinda, Punjab. The normal cement concrete will stand as the control mixture. The mix will be casted and poured into mould and the hardened sample was taken out from mould after 24 hours. Then, the hardened specimens were cured in water for 7 and 28 days for all mixes. (i.e. 0%, 15%, 25%, 35% & 45%)

II. METHODOLOGY

Total 60 concrete specimens were cased which includes 30 cubes & 30 cylindrical specimens of M20 mix with different CBA % (i.e. 0%, 15%, 25%, 35% & 45%), of each CBA% 6 cubes and 6 cylindrical samples were casted, out of which 3 cubes having dimensions 150mm x 150mm and 3 cylindrical specimens
having dimensions 150mm x 300mm are casted for 7 days and three cube and three cylinder for 28 days strength determination .

III. CONCLUSIONS

Mixes	Compressive Strength (N/mm2)	Average Compressive Strength (N/mm2)
AS0%	14.19	12.90
	11.52	
	12.99	
AS15%	11.42	11.48
	11.42	
	11.60	
AS25%	9.14	10.83
	11.13	
	12.22	
AS35%	8.13	6.16
	6.14	
	4.21	
AS45%	7.18	5.99
	5.64	
	5.15	

7- Day Compressive Strength

Mixes	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
AS0%	21.93	19.76
	23.95	
	13.42	
AS15%	23.93	23.05
	17.11	
	28.13	
AS25%	22.92	24.22
	20.95	
	28.80	
AS35%	28.80	27.23
	23.95	
	28.96	
AS45%	23.93	23.88
	23.80	
	23.93	

28 Day Compressive Strength

- The compressive strength and split tensile strength at the age of 7 days decreases at the 15%, 25%, 35% and 45% of CBA replacement with the fine aggregate.
- The compressive strength and split tensile strength at the age of 28 days increases at the 15%, 25%, 35% and 45% of CBA replacement with the fine aggregate.
- A decrease in 7-Days compressive strength and split tensile strength was observed on addition of coal bottom ash as compared to control mix concrete whereas 28-Days compressive strength and split tensile strength was observed at 25% CBA but then it starts increasing with maximizing at 35% CBA.
- At 35% replacement of fine aggregate with CBA, 28-day compressive strength was observed to increase by 37.80%, and 28-day split tensile was observed to increase by 13.03% as compared to control mix concrete.

REFERENCES

[1] Kim and Lee 2011 "Use of power plant bottom ash as fine and coarse aggregates in high strength concrete." Department of civil and Environmental Engineering, Korea Advanced Institute of Science and Technology, Guseong-dong, Yuseong-gu, Daejeon 305-701, Republic of Korea.

[2] Arumugam K., Ilangovan R. and James M.D. (2011), "A study on characterization and use of pond ash as fine aggregate in concrete" International Journal of Civil and Structural Engineering, 2:466-474

[3] Sani et al.(2010), "The Properties of Special concrete Using washed Bottom Ash as Partial Sand Replacement." International Journal of Sustainable Construction Engineering and Technology.: 2180-3242

[4] Topcu and Bilir. (2010), "Effect of Bottom Ash as Fine Aggregate on Shrinkage Cracking of Morars."ACI Materials Journal; 107(1): 48-56

[5] Kou and Poon (2009), "Effect of bottom ash as replacement of fine aggregates in concrete." Asian Journal of Civil Engineering (Building and Housing); 8: 49-62

