Use of Sintered Fly Ash Aggregates as Coarse Aggregate in Concrete

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ABSTRACT

Many researchers have been carried out in the area of sintered fly ash utilization in the past. A mix design was done for M25 Grade of concrete by IS method. Ordinary Portland cement of 43 Grade was selected and sintered fly ash aggregates were prepared by mixing sintered fly ash with cement and water. Which is a waste material of coal firing Thermal power plants (TPPs) and its accumulation near power plant. Sintered fly ash aggregate is a group of material that can vary significantly in composition. It is residue left from burning coal, which is collected on an electrostatic precipitator. These theses explain the various utilization of sintered fly ash and its ordinary Portland cement and properties in concrete causes severe pollution problems. Its utilization as a raw material for cube and prism making will be a very usefully solution in our economical and environmental aspects.

Keyword-Sintered Fly Ash Aggregates, OPC 43 grade, concrete, sands, strengths.

1. INTRODUCTION

India produces approximately 120 million tonnes of fly ash annually. However, lack of a viable technology and absence of a market have dissuaded Indian entrepreneurs from producing sintered fly ash aggregate. Fly ash based artificial lightweight aggregate offer potential for large-scale utilisation in the construction industry. Apart from using it in concrete industry as cement replacement, fly ash usages by other related industries have been for cube and prism manufacture, cellular concrete, prefabricated items and road construction. Yet about 75% of fly ash remains unutilised.

The management of coal fly ash produced by coal thermal power station is a major problem in many parts of the word. However, its generation tends to increase every year. Although some coal fly ash is used in a range of applications, particularly as a substitute for cement in concrete. Large amount remain unused and thus required disposal. At present, coal fly ash is used in civil engineering for production of cement, concrete, cube and artificial aggregate.

OBJECTIVE

- To find economical and environmental helpful solution for high cost of concrete.
- To use the replacement of coarse aggregate in concrete.

2. Materials Used

The following materials were used for preparing the test specimens

I. Ordinary Portland cement 43 grade confirming to IS:8112-1989
II. Sintered fly ash aggregates obtained from Thermal Power Plant,
III. Local river sand confirming to Grading Zone III of IS: 383-1970
IV. Coarse Aggregates IS:2386-1963
V. Bore well water of MMMUT Gorakhpur campus for mixing and curing of specimens.

3. EXPERIMENTAL PROGRAM

Properties of Material

The materials used in this experiment were Ordinary Portland Cement (OPC), sand as fine aggregate and sintered fly ash aggregate, Potable water was used for mixing and curing.

Cement: Ordinary Portland cement 43 grade in one lot was procured and stored in air light container. The cement used was fresh i.e., used within three month of manufacture .Theproperties of cement are determined as per the IS 8112–1989 and result are physical property was given below:

Table No.1.Physical Properties of Cement

S.N	Physical Properties		Test results
1.	Fineness modulus		7.12
2.	Specific Gravity		2.62
3.	Water Absorption (%)		0.15
4.	Consistency		32%
5.	Setting time	Initial setting time	75 min
		Final Setting time	320 min

Fine Aggregate:The Fine aggregate use for casting in clean river sand from rapti river and it was clean and dry. It is of size pass through 1.19 mm sieve. Sand conforming to Zone-III was used as the fine aggregate, as per I.S 383-1970. The properties of the fine aggregates are given in Table 2.

Table No. 2.Physical Properties of Fine Aggregates

S.N	**Physical Property**	**Test Result**
1.	Fineness modulus	2.42
2.	Specific Gravity	2.45
3.	Bulk Density(kg/m^3)	1540-1600
4.	Water Absorption (%)	0.74

Coarse Aggregates: The coarse aggregate used was broken granite-crushed stone and it was free from clay, weeds, and other organic matters are non- porous. The water absorption capacity is less than 1%. The size of which pass through 26 mm sieve and retained on 19 mm sieve. The properties of the coarse aggregate are given in Table3.

Table. No.3 Physical Properties of Coarse Aggregates

S.N	**Physical Property**	**Test Result**
1.	Maximum Size (mm)	20
2.	Fineness modulus	7.20
3.	Specific Gravity	2.67
4.	Bulk Density(gm/cc)	1.4-1.6
5.	Water Absorption (%)	0.16
6.	Aggregate Crushing Value	15.85%
7.	Aggregate Impact Value	12.36%

Water: Portable water was used for casting all specimens of this investigation. The quality of water was found to satisfy the requirement of IS456-200.

Sintered Fly Ash Aggregate:

The sintered fly ash aggregate is produced by mixing materials, Then the mix is made into spherical shape and over dried at a temperature of 1100 ºC in muffle furnace. The properties of sintered fly ash aggregates are given in Table 4.

Table No.4.Physical Properties of Sintered Fly ash Aggregates

S.N	Properties of Sintered Fly ash Aggregates	Values
1.	Fines modules	6.24
2.	Bulk density(kg/m^3)	645-755
3.	Sizes produced(mm)	4.70-10.0
4.	Water absorption (%)	0.14

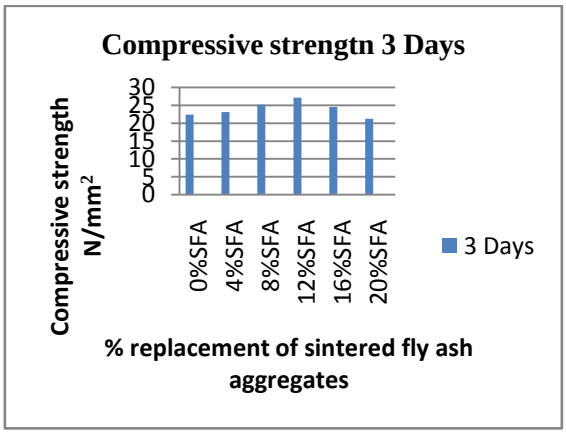
4. RESULTS AND DISCUSSIONS

Compressive Strength

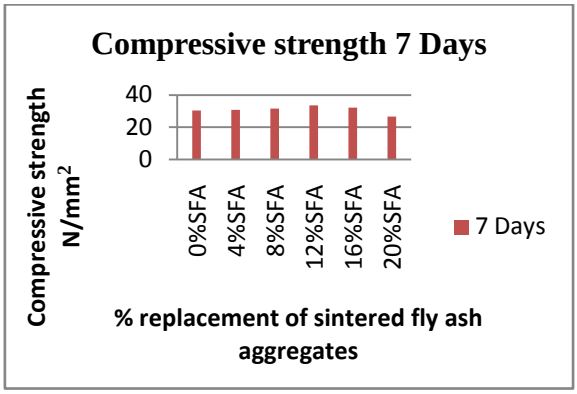
Compressive strength of the specimen shall be calculated by dividing the maximum compressive load taken by the specimen by its cross-sectional area. Values of compressive strength at different percentage of replacement at different age are given below:

TableNo.5.Compressive Strength of Corse aggregate with sintered fly ash aggregate

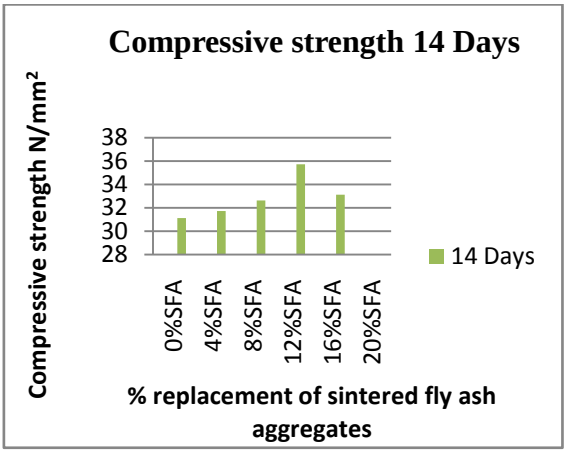
Days	0%SFA (N/mm^2)	4%SFA (N/mm^2)	8%SFA (N/mm^2)	12%SFA (N/mm^2)	16%SFA (N/mm^2)	20%SFA (N/mm^2)
3	22.35	23.07	25.17	27.13	24.52	21.22
7	30.44	30.89	31.59	33.59	32.15	26.67
14	31.11	31.73	32.64	35.73	33.12	30.22
28	32.44	33.15	34.07	37.87	34.11	31.56



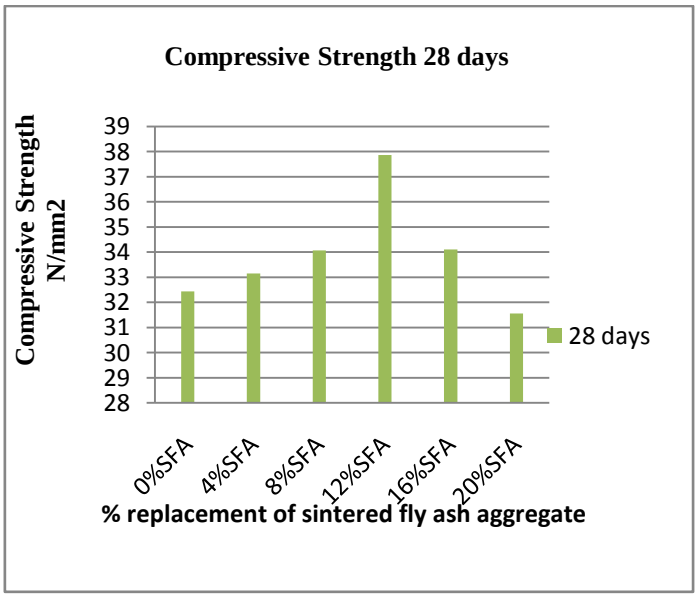
Compressive strength on 3 Days



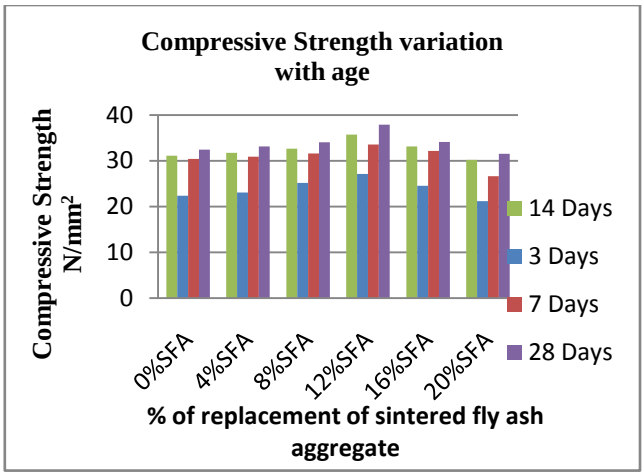
Compressive strength on 7 Days



Copressive strength on14 day



Compressive strength on 28 days



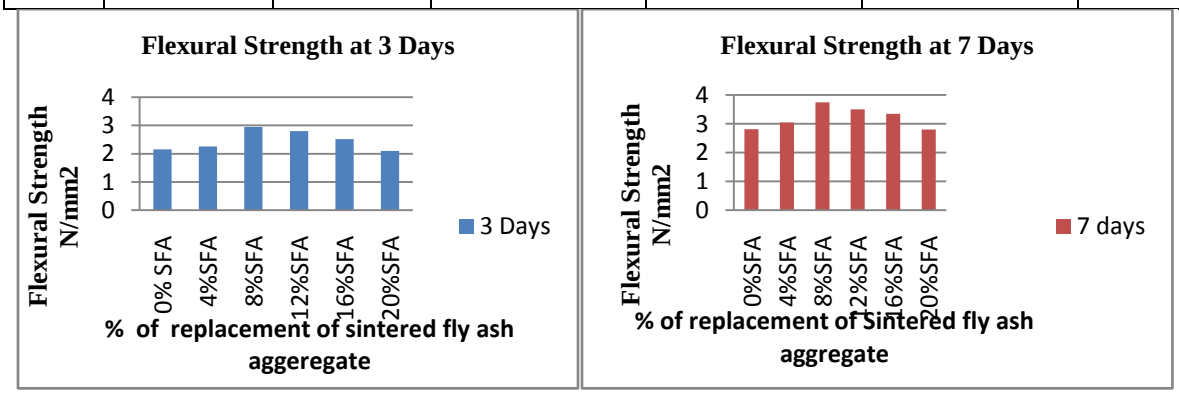
Compressive strength at various sages

4.2Flexural Strength

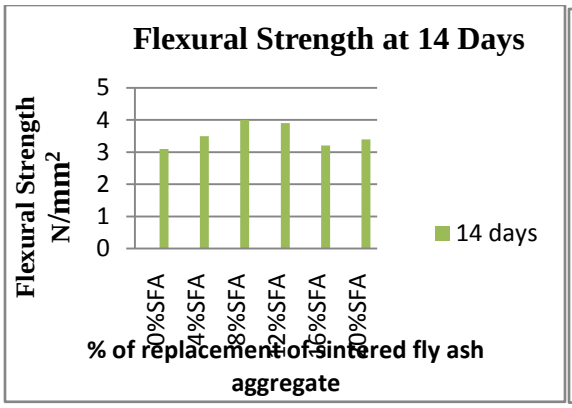
For flexural test beams of 150 mm×150 mm×700 mmsize were adopted. The load was applied without shock and was increased until the specimen failed, and the maximum load applied which is on the meter to the prism during the test was recorded. The appearances of the fractured faces of concrete failure were noted. Three-point load method was used to measure the flexural strength of Sintered fly ash aggregate concrete.

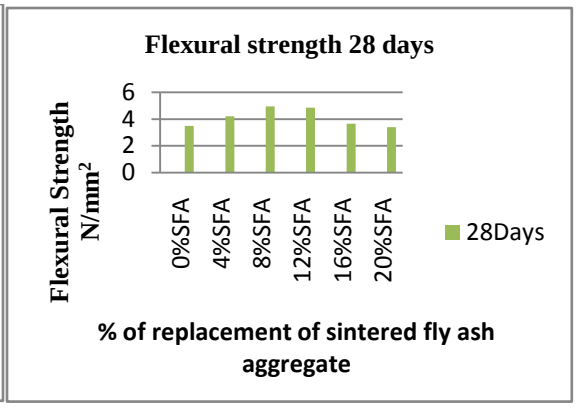
Table No.6. Flexural strength at different ages (N/mm^2)

Days	0%SFA (N/mm^2)	4%SFA(N/mm^2)	8%SFA(N/m m^2)	12%SFA(N/m m^2)	16%SFA(N/m m^2)	20%SFA(N/ mm^2)
3	2.15	2.25	2.95	2.80	2.51	2.10
7	2.81	3.05	3.75	3.50	3.35	2.51
14	3.1	3.50	4.00	3.90	3.21	2.89
28	3.48	4.20	4.95	4.85	3.65	3.41

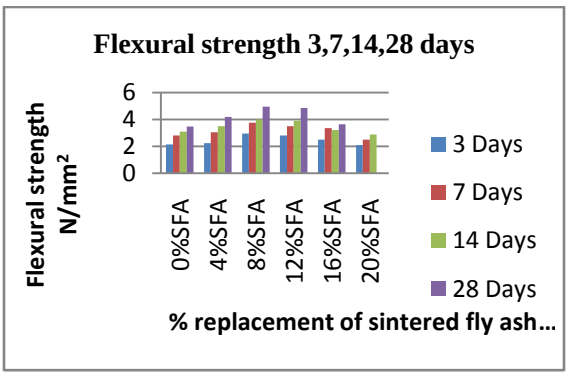


Flexural strength on 3daysFlexural strength on 7days





Flexural strength on 14 DaysFlexural strength on 28 Days



Flexural strength at variousages

CONCLUSION

The maximum compressive strength of 36.25 N/mm^2 is attained at 12% replacement of Sintered fly ash aggregate in concrete while the minimum strength of 26.68 N/mm^2 is attained at 20% replacement, At 16% replacement, increased the value 28.67/mm^{2,} and 12% increased the value 36.25N/mm^{2}the highest increased the value.The maximum flexural strength of 4.95 N/mm^2 was attained at 8% replacement, while the minimum strength of 2.75 N/mm^2 was attained at 20% replacement. To increase the speed of construction, enhance green construction environment we can use lightweight concrete. The possibility exists for the partial replacement of coarse aggregate with Sintered fly ash aggregate to produce in thermal power plants west material. Sintered fly ash is compatible with the cement. Use of sintered fly ash as coarse aggregate can reduce the cost of construction and it is useful in environmental point of view. At the same water cement ratio, by increasing cement content, the drying shrinkage increased and sorptivity decreased.

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