Density of Concrete With Sintered Fly Ash Aggregate

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Abstract

Amount of sintered fly ash aggregate which is and yet to be generated in the coming years highlights the necessity of developing new methods of the ,Nowadays concrete is considered as one of the most important and widely used materials in construction industry. The use of cost effective construction materials has accelerated in recent time due to the increase in the demand of light weight concrete for mass applications. This necessitates the complete replacement or partial replacement of concrete constituents to bring down the escalating construction costs.

Keywords: Sintered Fly Ash Aggregate, OPC 43 Grade, Strength.

I. INTRODUCTION

The increasing demand for iron and steel products, primarily driven by booming markets, substantially affects costs for raw materials, scrap, logistics, and energy. Steadily rising prices and intense competition among steelmakers has sharply reduced profits. To successfully produce under extreme cost pressure, all sinter plant operators must keep their plants running at peak performance while minimizing consumption of electric energy and solid fuel.

The main overall goal of sinter plant operators is to achieve a high output of uniform sinter quality at low operational costs. As the main component in the blast-furnace burden, the production of high-quality sinter is crucial for assuring high, stable furnace productivity with a low consumption of reductants. Sinter quality begins with the proper selection and mixing of the raw materials. The chemical properties must be stabilized by an automatic adaptation of the raw material mix, which means that plant operators need an advanced system with the ability to quickly react to process fluctuations and aberrant situations like an inhomogeneous mixture, poor surface ignition, and incomplete burn-through of mixed materials.

A. Materials Used

The following materials were used for preparing the test specimens

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

II. EXPERIMENTAL PROGRAM

A. 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: The Ordinary Portland cement was classification into three grades, namey 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested as per IS 4031-1988. If the 28 days strength is not less than 33N/mm^2, it is called 33 grade cement, and not less than 43 N/mm^2, and 53 N/mm^2, it is called 43 grade and 53 grade cement. The cement used was fresh i.e., used within three month of manufacture .The properties of cement are determined as per the IS 8112–1989 and result are physical property was given below:

Table - 1
Properties of Cement

S.N	*Physical Properties*	*Test results*
1.	*Fineness modulus*	*7.09*
2.	*Specific Gravity*	*2.52*
3.	*Water Absorption (%)*	*0.16*

- 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 - 2
Properties of Fine Aggregates

S.N	*Physical Property*	*Test Result*
1.	*Fineness modulus*	*2.32*
2.	*Specific Gravity*	*2.46*
3.	*Bulk Density(kg/m^3)*	*1590*
4.	*Water Absorption (%)*	*0.72*

- 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 - 3
Properties of Coarse Aggregates

S.N	*Physical Property*	*Test Result*
1.	*Maximum Size (mm)*	*20*
2.	*Fineness modulus*	*7.22*
3.	*Specific Gravity*	*2.66*
4.	*Bulk Density(gm/cc)*	*1.4-1.6*
5.	*Water Absorption (%)*	*0.18*
6.	*Aggregate Crushing Value*	*15.65%*
7.	*Aggregate Impact Value*	*12.34%*

- 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 - 4
Properties of Sintered Fly Ash Aggregates

S.N	*Properties of Sintered Fly ash Aggregates*	*Values*
1.	*Fines modules*	*6.21*
2.	*Bulk density(kg/m^3)*	*645-755*
3.	*Sizes produced(mm)*	*4.70 -10.0*
4.	*Water absorption (%)*	*0.17*

III. RESULTS AND DISCUSSIONS

A. Density:

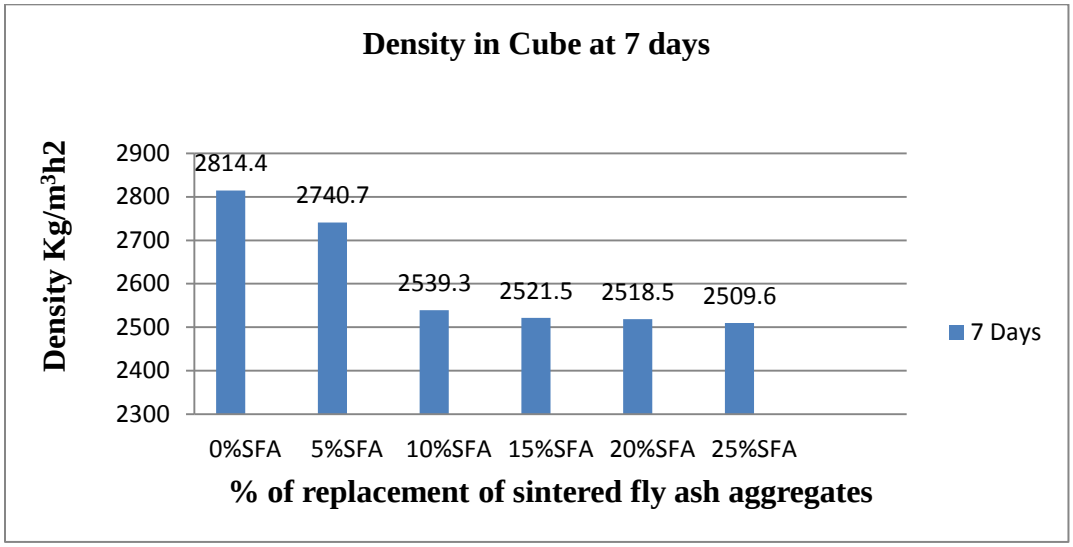
Density of sintered fly ash aggregate decreases with the ratio of replacement . Density is defined as mass per unit volume that means how much amount of mixture concrete, is per cubic meter volume.

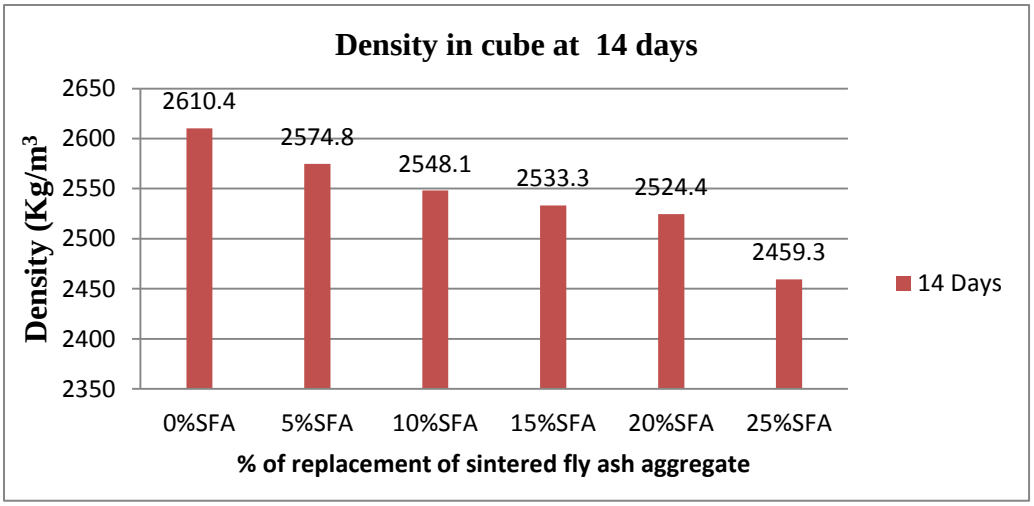
$$\text{Density} = \frac{Mass}{Volume}$$

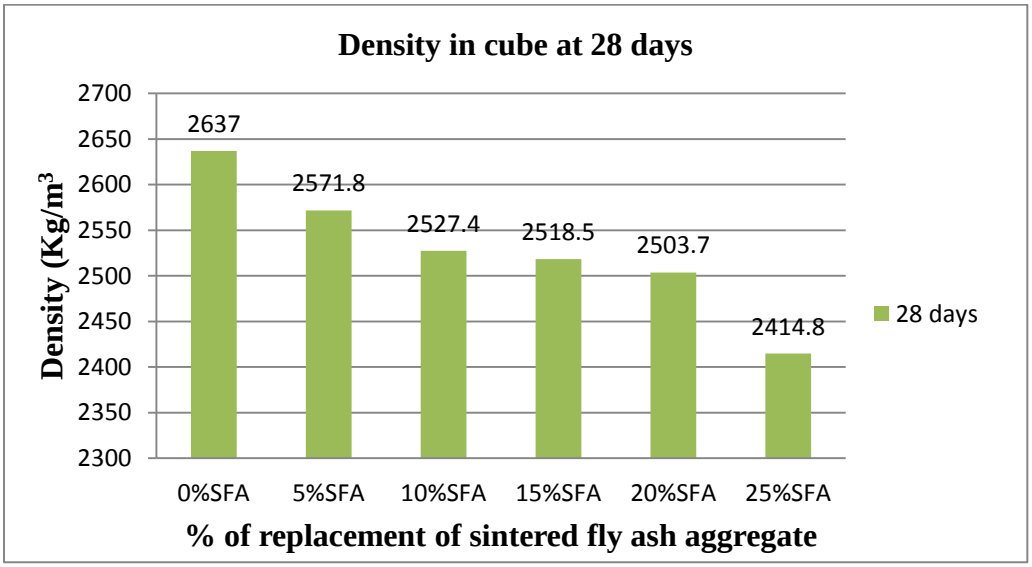
Where mass is in Kg and volume in cubic meter.

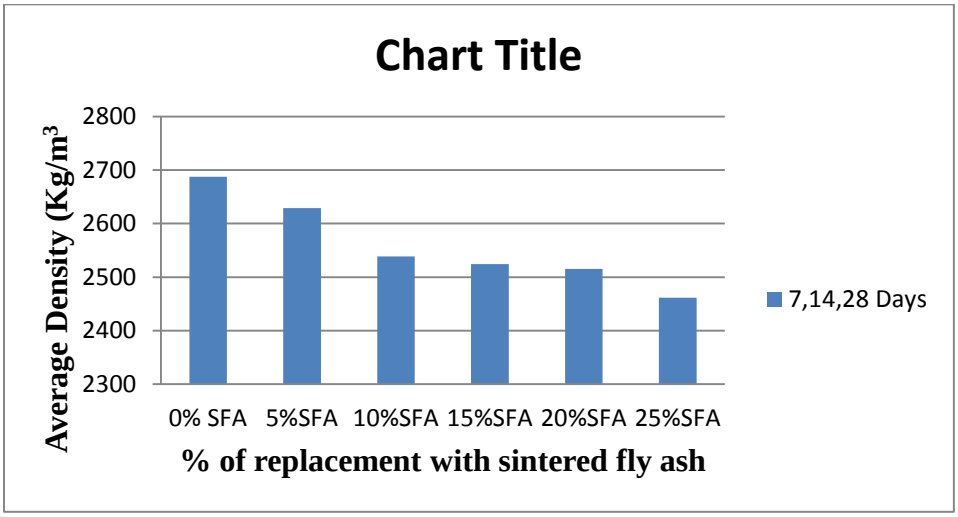
Table
Density of Sintered Fly Ash Aggregates Cube (Kg/mm^2)

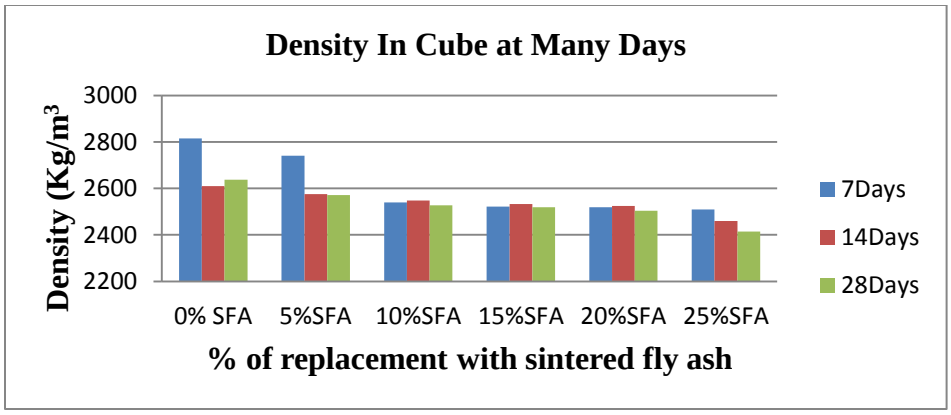
Days	*0% SFA*	*5%SFA*	*10%SFA*	*15%SFA*	*20%SFA*	*25%SFA*
7	*2814.4*	*2740.7*	*2539.3*	*2521.5*	*2518.5*	*2509.6*
14	*2610.4*	*2574.8*	*2548.1*	*2533.3*	*2524.4*	*2459.3*
28	*2637.0*	*2571.8*	*2527.4*	*2518.5*	*2503.7*	*2414.8*
Average	*2687.3*	*2629.1*	*2538.3*	*2524.4*	*2515.5*	*2461.2*





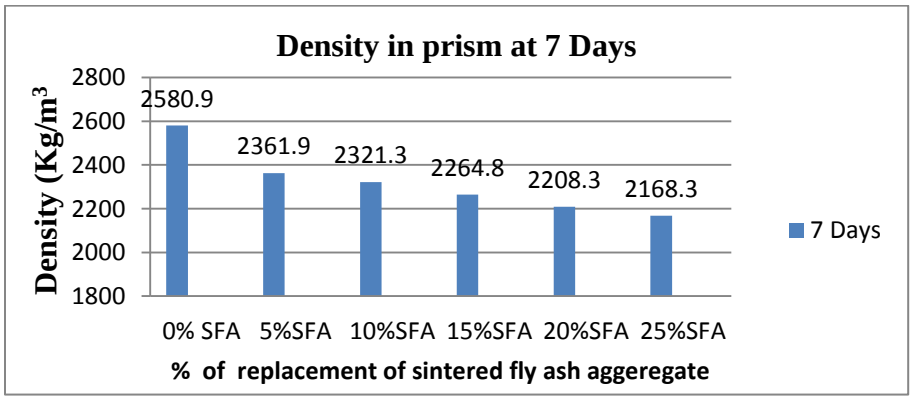


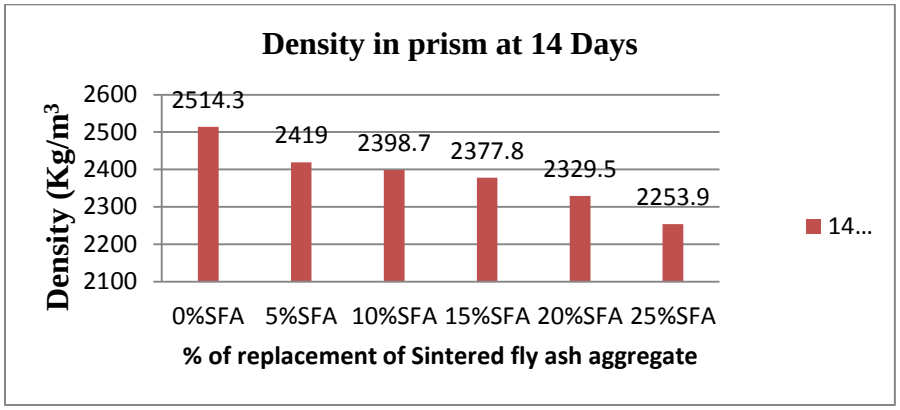


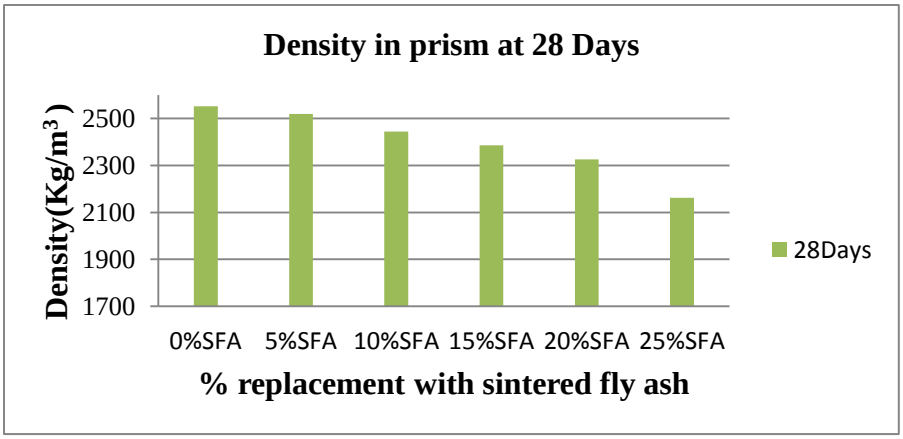


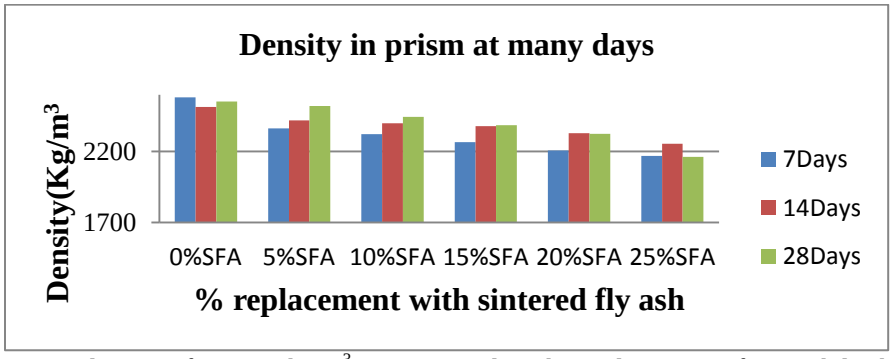
For cube the maximum density of 2814.4 kg/m^3 was attained at the replacement of 0% while the minimum. Density of 2414.8 kg/m^3 was attained at 25% replacement.

Days	*0%SFA*	*5%SFA*	*10%SFA*	*15%SFA*	*20%SFA*	*25%SFA*
7	*2580.9*	*2361.9*	*2321.3*	*2264.8*	*2208.3*	*2168.3*
14	*2514.3*	*2419*	*2398.7*	*2377.8*	*2329.5*	*2253.9*
28	*2552.4*	*2519.5*	*2444.4*	*2385.4*	*2325.1*	*2161.9*
Average	*2549.1*	*2433.5*	*2388.1*	*2342.7*	*2287.6*	*2194.7*









For prisms that maximum density of 2580.9 kg/m^3 was attained at the replacement of 0% while the minimum density of 2161.9 kg/m^3 was attained at 25 % replacement.

IV. CONCLUSION

The maximum density in cub in 2814.4 Kg/m^3 attained at 0% replacement of Sintered fly ash aggregate in concrete while the minimum strength of 2414.8 Kg/m^3 is attained at 25% replacement. And average maximum density 2687.3 Kg/m^3 attained at 0% SFA, and minimum average density in cube 2461.2 Kg/m^3. 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 plant west materials.

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