Scientific Journal of Impact Factor (SJIF): 4.14
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406
rnational Journal of Advance Engineering and Research Development
Volume 3, Issue 5, May -2016

STUDY OF IMPROVED PERFORMANCE OF AERTAED AUTOCLAVE CONCRETE BLOCK USING GGBF

Mishra Manorama A[1], Tarak Vora [2] ,Manish Makwana [3]

Abstract:- *At present in India huge amount of Solid wastage is produced which generated high environmental in India. Many of researchers around the world are looking for the economic utilization and disposal of solid wastage. In India 41 million tonne of Ground Granulated Blast Furnace slag is produced due to the production of huge amount of Steel Production. However, the construction materials industries is most suitable way to mass consumption of the solid wastage. The utilization of Ground Granulated Blast Furnace slag to prepare Aerated Autoclave Concrete Block was studied. In this study the replace the Ground Granulated Blast Furnace slag with cement as various amount up to 70%. The Aerated Autoclave concrete block were prepare with a Dry Density of 580.77 Kg./ m^3 and Compressive strength 4.82 MPa. Increasing percentage of GGBF replace cement is also decreasing the Water Absorption and Drying Shrinkage capacities of the Aerated Autoclave Concrete Block.*

Keyword — Ground Granulate Blast Furnace Slag (GGBF), Drying Shrinkage, Compressive Strength, Water Absorption, Aerated Autoclave Concrete (AAC), Ultra Sonic Pulse velocity,

I. INTRODUCTION

Aerated Autoclave Concrete Block has been widely used in construction industries in India as masonry blocks, and wall panels. Aerated Autoclave concrete (AAC) Block offer design flexibility and substantial cost savings as a consequence of its lower unit weight. Aerated Autoclave concrete block (AAC) mixture of cement, gypsum, lime , soluble oil, caustic soda, Aluminum powder and Fly ash or fine Aggregate. Fine aggregate and fly ash was used as vice versa to each other. AAC block is highly porous and light weight material with excellent insulation ability.

The Aerated Autoclave concrete consisting the mainly two process once is Aeration and Autoclave. The Aeration process is due to the reaction between lime and aluminum powder. In the Aeration process the lime is react with aluminum powder to produce Tricalcium Hydrate and Hydrogen.

$2Al + 3Ca(OH)_2 + 6H_2o \rightarrow 3Cao\ Al_2O_3\ 6H_2O + H_2$

Aluminum powder + Hydrated Lime → Tricalcium Hydrate + Hydrogen

Autoclave is the process of producing high pressure and high temperature steam curing in the close vessel. The autoclave is long steel vessel consisting the temperature up to 180° to 200° and pressure up to 800 KPa to 1200 KPa. The result of the autoclaving in production the AAC block is ready to use in 24 hour for the construction.

Fig. 1 Showing The Autoclave vessel

The commercial AAC is normally producer with cement lime as calcareous materials, and fine aggregate or fly ash the siliceous materials. AAC was molded and cut into accurate dimensioned and cured in the an autoclave. Result of autoclaving under high pressure and high temperature was reduces drying shrinkage and water absorption of AAC block. To extend the range of raw materials and lower the production costs, several researchers have investigated the possibility of replacing the traditional raw materials of AAC by industrial waste, such as Ground Granulated Blast Furnace slag, air-cooled slag, coal bottom ash, copper tailing, natural zeolite, coal fly ash circulating fluidized bed combustion boiler, and Lead- zinc tailing.

II. PROPETIES OF INGREDIENT

A. *Cement:*-The cements used in this experimental works are ordinary Portland cement with 53 grade purchasing from the Hathi cement company. all properties of cement are tested by referring IS Specification for Ordinary Portland cement. cement

Table :- 1 Consist The Physical Properties of Cement.

PHYSICAL PROPERTIES OF CEMENT		
Sr. No.	Test Description	Results
1	Fineness of cement	1%
2	Specific Gravity	3.15
3	Standard Consistency of cement	30%
4	Setting time of cement Initial setting time Final Setting time	 135 Minutes 288 Minutes
5	Soundness test of cement	1.5mm

B. Ground Granulated Blast Furnace Slag:-

In experimental study the used Ground Granulated Blast Furnac slag is provided from the Stallion Energy PVT. LTD. from District Rajkot, Gujrat.

The Ground Granulated Blast Furnace Slag (GGBF) is bring from the pigmentation process of steel called blast furnace slag. This works at a temperature of about 1500° C and which are supply with combination of iron-ore, coke and limestone. Generally iron ore contain 60 to 70% of Iron and residual is slag. The normal production of Blast Furnace Slag is 300 to 400 kg. per tonne from the raw material of Pigmentation process of Iron. Generally silicon, calcium aluminum, magnesium and oxygen remains 95% or more in GGBF.

Table-2 Consist the Chemical Properties of GGBF

Chemical composition of GGBF	
Chemical Constituent	Percentage
Silica (SiO_2)	35.47
Calcium (CaO)	35.89
Magnesium (MgO)	8.06
Iron Oxide (Fe_2O_3)	2.41
Alumina (Al_2O_3)	14.27
Loss of ignition (LOI)	0.70
Insoluble Residues	0.52
Manganese oxide (MnO)	0.34
Alkalies	0.20
Sulphied Sulphar (SO_3)	1.58
Fineness (cm^2/gm)	3820

As Per Indian Slag Association (ISA) " In India he resent time annually total slag production is about 41 million tonnes and expected to reach to the 90 Million tonne in the year of 2020. As per Director of the National Council for cement and Building material " Approximately 30% of the raw material used in steel production turns to slag."

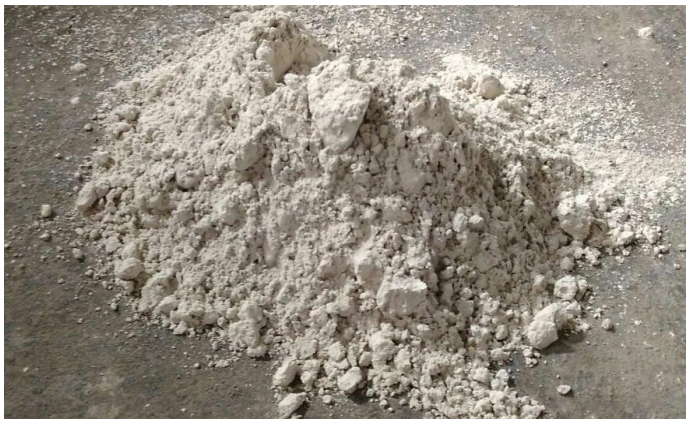


Fig.2 Ground Granulate Blast Furnace Slag

C. Lime:-

The lime shall satisfy the requirement for Class C lime Specified in IS : 712-19734.in experimental work used lime is hydrated lime.

D. Water:-

Water should be clean and free from injurious amounts of deleterious materials and quality fit for drinking water purpose. Water used in the production of AAC block should be free from the harmful matter usually which case effloresce in the building construction. Water should be meet the requirement of IS:- 456-2000.

E. *Fly ash:-*In experimental work used Fly ash is from the Wanakbori Thermal Power station, in Kheda Distric, Gujrat. The class F class fly ash should be used in production of AAC block.

F. *Aluminum Powder:-*

In the production of AAC block Aluminum powder is important raw material. For each cubic meter production of AAC block, 0.5 Kg Aluminum powder should be used. 65% purity of Aluminum powder is required for the production of AAC block.

G. *Gypsum:-*

Gypsum used in production of AAC block as retarder admixture. Gypsum is help to slow down the hydration process of AAC bock and its also helpful to increasing the strength of AAC block.

H. *Miscellaneous :-*

Other raw material should be used in the production of AAC block is as Caustic soda and Soluble oil. Both ingredient is important for the stable rising of the mixture of AAC block.

III. EXPERIMENTAL WORK

The aerated autoclave concrete production process is similarly as the light weight concrete. cement, lime, gypsum and flyash GGBF caustic soda and soluble oil mixed thoroughly as a slurry from. lastly in mixed slurry Aluminum powder should be added. The slurry should be poured in mould. In couple of hour the aeration process should be completed. During aeration process the casting mould is place at the temperature higher than the atmosphere temperature. In the Fresh mixed the lime and Aluminum powder reacted, result of this hydrogen gas form in the mixed slurry. In AAC block hydrogen gas produce porous structure.

Fig.3 Fresh mixture having aeration process

The fresh aerated mixture is then cut by the wire cutting. The size and shape of AAC block is automatically arrange . The horizontal and vertical cutting is due to the vertical and horizontal arrange wire. The cutting of AAC block is make too precisely. The size of AAC block is as per IS 2185 (Part -3)-1984.

Fig.4 wire cutting of fresh mixture of AAC block

Then cut block is loaded on the Autoclave. In the Autoclave the cut block should take up to 10 to 12 hour at pressure of 800 to 1200 KPa and Temperature up to 180˚C to 200˚C. strength of AAC block is increase with the increasing the time of the autoclaving of the AAC bock. Then the block should be removed from the autoclave and cooled its.

Fig.5 Stored Aerated Autoclave Concrete Block

In the experimental work cement is replace with the GGBF as the various percentage as, 10%, 30%, 50% and 70%. Mechanical properties and durability properties are determined by the conducted various test. The dry density test, compressive strength test is conducted for the determined the mechanical properties of the AAC block. Drying Density test, water absorption test, and Ultra Sonic Pulse Velocity test should conducted for the determined the Durability of the AAC block.

Mixture Composition of AAC block				
	GGBF 10%	**GGBF 30%**	**GGBF 50%**	**GGBF 70%**
CEMENT (%)	18	14	10	7
GYPSUM (%)	5	5	5	5
LIME (%)	15	15	15	15
FLYASH (%)	60	60	60	60
ALUMINUM (%)	0.08	0.08	0.08	0.08
CASTIC SODA (ml)	32	32	32	32
SOLUABLE SODA (Lit)	1.65	1.65	1.65	1.65

IV. TESTS ON AERATED AUTOCLAVE CONCRETE

As per IS CODE 2185 (part-3)- 1984 all test of the AAC block should be conducted. Compressive strength test for the mechanical properties of the AAC block. Dry Density test, Water Absorption test for the AAC block for the various properties. For the durability Ultra Sonic Pulse Velocity test and Drying Shrinkage test should be conducted.

A. Compressive strength test

The mechanical properties of AAC block was determined by the compressive strength of AAC bock. The compressive strength is test is as per IS 6441 (part-5)- 1972. The Compressive strength test is performed on the standard size of the block as 150mm x 150mm x 150mm at 28 days. The sample is placed in UTM (Universal testing Mechanic) perpendicular to the applied load.

B. Dry Density test

The Physical properties of AAC block is determined by the Dry density test as per ASTM-C1693. The sample is placed in oven at 100c to 110C at 24 hour. Then weight very accurately and measure the volume of the sample with the caliper gauge.

C. Ultra Sonic Pulse Velocity Test

Ultra Sonic Pulse Velocity test is per IS 13311 (Part-1)- 1992. The homogeneity of the AAC block is determined by the ultra sonic pulse velocity test.

D. Drying Shrinkage Test

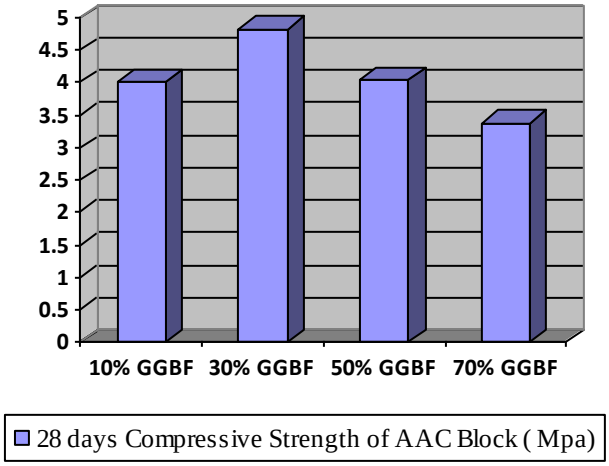
Drying Shrinkage test is as per IS 6441 (Part- 2)- 1972.to determined the durability of properties of the AAC block the drying shrinkage test is conducted.

V. RESULTS

A. Compressive strength test

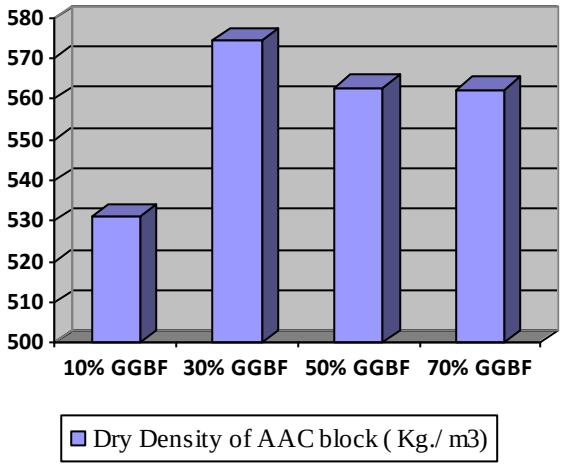
The results of 28 days compressive strength of AAC block having replacement of GGBF with cement. The increment in Compressive strength of AAC block having GGBF up to 30% with replacement of cement and then linearly decreasing of

compressive strength is linearly. Optimum compressive strength gain in AAC block is up to 4.82 MPa.



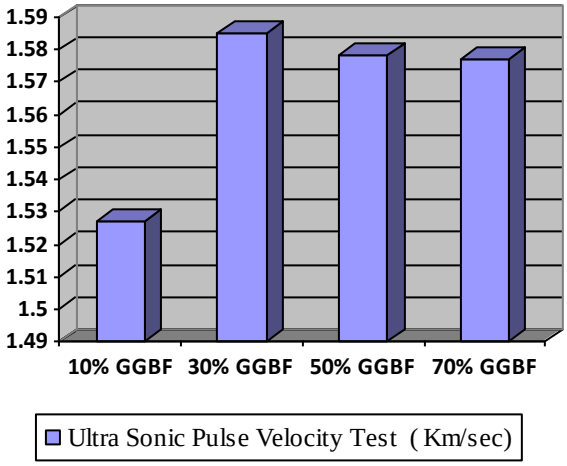
B. Dry Density Test

The Dry density of the AAC block having GGBF is as below.



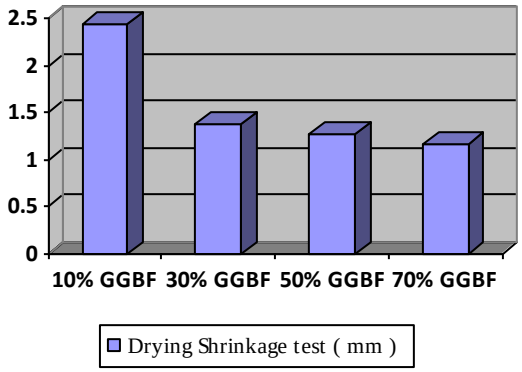
C. Ultra Sonic Pulse Velocity Test

The Porosity of AAC block having GGBF samples was determined by Ultra Sonic Pulse Velocity test. This test was based on the theory of ultra sound transfer inside the material. Solid materials transfer the sound faster than porous materials. Chart 3 indicated that UPV values of AAC block having GGBF.



D.Drying Shrinkage Test

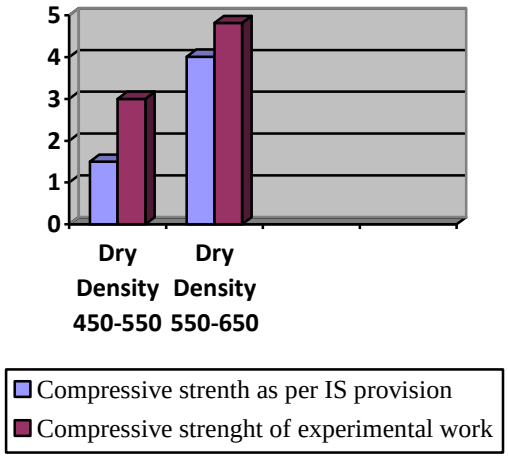
The results of drying shrinkage test of AAC block having GGBF is below. Increasing the percentage of GGBF in AAC block is decreasing the Drying Shrinkage value .



VI. CONCLUSION

The results show that AAC having GGBF Had dry density of 574.25 Kg./m^3 and compressive strength of 4.82 MPa was produced by the raw material composition of 30% of GGBF.

Compare with the IS 2185 (Part-3)- 1972 the dry density of AAC block is 550-650 Kg. / m^3 had compressive strength up to 4 MPa and the compressive strength of AAC block having GGBF is 4.82 MPa which is greater than IS provision. The result of Drying Shrinkage test is linearly decrease with increasing the percentage of GGBF in production of AAC block.



REFERENCES

[1] Dhiraj Agrawal.; Pawan Hinge.; U. P. Waghe.; and S.P. Raut.; "Utilization of Industrial waste in construction materal – review paper" International Journal of Innovative Research in Science, Engineering and Technology pp. 8390-8397, January 2014.

[2] Indian Minerals, 51 Editions, Government of India Ministry of Mines , Indian Bureau of mines , Year 2012,

[3] ACI Committee 233," ACI233R-95" Ground Granulated Blast Furnace Slag as a cementious Constituent in concrete,

[4] N. Narayanan, K. Ramamurthy," Structure and properties of aerated concrete: a review" Cement & Concrete Composites 22, pp- 321-329, 2000

[5] N.Y. Mostafa, "Influence of air-cooled slag on physicochemical properties of autoclaved aerated concrete "Cement and Concrete Research 35, pp-1349– 1357, 2005

[6] Xiao-yan Huang, Wen Ni, Wei-hua Cui, Zhong-jie Wang, Li-ping Zhu," Preparation of autoclaved aerated concrete using copper tailings and blast furnace slag"Construction and Building Material 27, PP-1-5, 2012

[7] H. Kurama, ,I.B. Topc¸u, C. Karakurt," Properties of the autoclaved aerated concrete produced from coal bottom ash" journal of materials processing technology 2 0 9 ,PP- 767–773, 2009

[8] Vinayak Awasare, Prof. M. V. Nagendra," ANALYSIS OF STRENGTH CHARACTERISTICS OF GGBS CONCRETE" International Journal of Advanced Engineering Technology,PP-82-84, 2014

[9] SOHANI N. JANI, DARSHAN S. SHAH," Analysis of microstructure and properties of aac block with its manufacturing process" JOURNAL OF INTERNATIONAL ACADEMIC RESEARCH FOR MULTIDISCIPLINARY, PP-278-285,2014

[10] Rostislav Drochytkaa, Jiri Zacha, Azra Korjenicb,, Jitka Hroudovaa," Improving the energy efficiency in buildings while reducing the waste using autoclaved aerated concrete made from power industry waste" Energy and Buildings 58,PP-319–323, 2013

[11] Franco Bisceglie , Elisa Gigante , Marco Bergonzoni "Utilization of waste Autoclaved Aerated Concrete as lighting material in the structure of a green roof" Construction and Building Materials 69,PP- 351–361 ,2014

[12] Yuanming Song , Chuanchuan Guo , Jueshi Qian , Tian Ding," Effect of the Ca-to-Si ratio on the properties of autoclaved aerated concrete containing coal fly ash from circulating fluidized bed combustion boiler" Construction and Building Materials 83, PP- 136–142, 2015

[13] Cenk Karakurt , Haldun Kurama , _Ilker Bekir Topcu," Utilization of natural zeolite in aerated concrete production" Cement & Concrete Composites 32,PP- 1–8,2010

[14] Watcharapong Wongkeo , Pailyn Thongsanitgarn , Kedsarin Pimraksa , Arnon Chaipanich," Compressive strength, flexural strength and thermal conductivity of autoclaved concrete block made using bottom ash as cement replacement materials" Materials and Design 35 ,PP- 434–439,2012

