OPEN ACCESS
International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-6, March 2020

Behaviour of Autoclaved Aerated Concrete Blocks using Alkali-Resistant Glass Fibre as Additive.

Anayatullah Bhat, Zishan Raza Khan

Abstract: ***Autoclaved aerated concrete (AAC) blocks are the lightweight and green concrete blocks that are composed of cement, fly ash, lime, gypsum and aluminium powder. Depending on its density AAC consists of up to 80% of air by volume. Due to their low density and lightweight Autoclaved aerated concrete blocks exhibit so many favourable physical properties that these have got attention from all around the globe. Due to these enhanced properties Autoclaved aerated concrete blocks are extensively used as masonry units in all types of construction. On one hand AAC blocks have no comparison with other types of masonry units in terms of physical properties but on other hand AAC blocks are found to have low compressive strength relatively. In this study an attempt has been made to study the influence of Alkali-Resistant Glass Fibre additive on the physical and mechanical properties of Autoclaved aerated concrete blocks. Four sets of samples were cast and named as A, B, C and D with the fibre additive contents as 0%, 0.1%, 0.2% and 0.3% respectively (by dry weight of all the ingredients).Each sample set consisted of three specimens and the average value of the three samples were taken. For example, the average value of the three specimens- A_1, A_2, and A_3 was taken as A and so on. Fibre additive influenced the aeration process of Autoclaved aerated concrete by increasing the rising/aeration time by 8%. The investigated fibre additive increases the compressive strength by 0%, 10%, 24% and 13.8% respectively to the added fibre contents of 0%, 0.1%, 0.2%, and 0.3% respectively. The optimal content of Alkali-Resistant Glass Fibre additive to be added for obtaining the highest compressive strength is 0.2%. Further investigations have shown a slight variation in density (about 0.2%) between the normal and modified Autoclaved aerated concrete blocks.***

Keywords: ***Autoclaved aerated concrete (AAC) Blocks, Compressive strength, Glass fibre, Alkali-resistant, Aerated concrete, Aluminium powder, Mechanical properties, Lightweight concrete blocks.***

I. INTRODUCTION

The performance of every structure whether it is a wall-bearing or a framed one is governed by various properties like- strength, fire resistance, thermal resistance, resistance to earthquakes, pest resistance, etc. One of the major components of any structure that decides its fate is the blocks used for its construction. So, to build a good performing structure in terms of the above-mentioned properties one needs to pay great attention while choosing the right blocks for the construction. One of the fastest emerging building materials for the good performance of structures is Autoclaved aerated concrete. Autoclaved aerated concrete is a lightweight, excellent thermal insulating, fire-resistant, pest-resistant, energy-efficient, environment-friendly and sustainable material [1-5]. Autoclaved aerated concrete material was first developed in Sweden in 1920. It has become one of the most used building materials in Europe and is growing rapidly all around the globe. AAC blocks offer great opportunities to enhance the building quality and reducing the expenses at the same time. Due to its excellent properties, AAC blocks are used in almost every type of structures, for example in commercial buildings, residential apartments, government housing colonies, industrial buildings, and warehouses [6].

AAC blocks are manufactured from cement, fly ash, lime, gypsum and aluminium powder. Aluminium powder is used as an aeration agent. Aluminium powder reacts with the lime (Calcium Hydroxide) to form micro air bubbles due to the formation of the hydrogen. This causes the concrete to rise in the mound and cause an increase in the overall volume of concrete and provide AAC with a strong uniform cellular structure. The process ends after the blocks are steam cured in Autoclave at a temperature ranging from 180°C-200°C and pressure ranging from 12 bars (1200 KPa)-14 bars (1400KPa) for about 10-12 hours, further strengthening the AAC blocks.

Due to the porous structure of AAC blocks, the density is quite low ranging from 500-650 Kg/m^3, making it a very lightweight building material and provides phenomenal properties to the AAC blocks. Because of lightweight, low density, high thermal insulation, high resistance to fire, good appearance, flexibility in sizes, ease in workability, less mortar and plaster consumption, AAC blocks are most extensively used as masonry units in construction. Undoubtedly AAC blocks have so many positive physical properties that have sought attention from all over the world but there are few drawbacks as well, those include low compressive and flexural strength. Attempts have been made by researchers to enhance the mechanical properties of the AAC blocks [7,8]. Some of them did not see any noticeable changes while others saw the mechanical properties were enhanced but the other properties got altered [9,10].For example, using polypropylene fibre as additive enhances the mechanical properties of AAC but it also increases the water absorption of AAC [9].

Manuscript received on February 10, 2020.
Revised Manuscript received on February 20, 2020.
Manuscript published on March 30, 2020.

* Correspondence Author
Anayatullah Bhat*, M. Tech student, Department of Civil Engineering, Integral University, Lucknow, India. Email: bhatanayat1@gmail.com
Zishan Raza Khan, Associate Professor, Department of Civil Engineering, Integral University, Lucknow, India. Email: zishanrk@iul.ac.in

There are a large number of fibres that have the properties good enough to bring about the positive changes in the mechanical properties of Autoclaved aerated concrete blocks, for example, carbon fibre, polypropylene fibre, basalt fibre, alkali-resistant glass fibre, Kevlar fibre, aramid fibre and other fibres have been used in the concrete to enhance the mechanical properties. Since Autoclaved aerated concrete blocks are cured at high temperature (180^oC-200^oC) and pressure (12 bars to 14 bars), a thorough study of the above-mentioned fibres was done in terms of the physical and mechanical properties to find their suitability.

Autoclaved aerated concrete blocks are well known for their affordable and economical costs and thus the cost factor has also been kept in mind. Alkali-resistant glass fibre was found to meet the requirements because of its physical properties, mechanical properties, and low cost. Keeping all the above factors in mind attempts have been made to study the various properties of AAC blocks such as compressive strength, density,and moisture content using Alkali-resistant Glass Fibre as additive.

II. METHODOLOGY

A. Materials Used

(1) Cement: Cement is used as a binder to bind up all the ingredients of the Autoclaved aerated concrete blocks. The ordinary Portland cement of grade 43 confirming to IS:8112-2013 (second edition) has been used to make the samples of Autoclaved aerated concrete blocks. The specific gravity of the cement used is 3.15.

Table 1: Chemical Composition of Ordinary Portland Cement.

Compound	Percentage
CaO	64
SiO_2	23
Al_2O_3	4
Fe_2O_3	2
MgO	2
Na_2O	0.6
K_2O	0.4

(2) Fly Ash: Fly ash is a heterogeneous by-product material that is produced during the combustion process of coal used in thermal power stations. It is a fine grey coloured powder having spherical glassy particles that rise with the flue gases and collected from by the electrostatic precipitators and hence the name fly ash. As fly ash contains pozzolanic materials that react with lime to form cementitious materials. Thus, Fly ash is used in concrete, mines, landfills, dams and the manufacturing of blocks. Fly ash has been classified into Grade I and Grade II by IS 3812 (Part1) (2013) and into Class C and Class f by American Society for Testing and Materials (ASTM C618). Generally, Type C fly ash is used in the manufacture of Autoclaved Aerated Concrete Blocks and so is in our case. The Fly Ash used for the manufacturing of the Autoclaved aerated concrete (AAC) Blocks at the plant (including the project specimen) is supplied by NTPC Unchahar, Rai Bareilly, Uttar Pradesh.

Table 2: Chemical Composition of Fly Ash.

Compound	Percentage
SiO_2	40
Al_2O_3	17
Fe_2O_3	6
CaO	24
MgO	5
SO_3	3

(3) Lime: Lime is one of the oldest binding materials that is used in the construction in one way or the other. It is obtained by the calcination of the naturally occurring Limestone. Calcium carbonate ($CaCO_3$), when treated with the heat up to the temperature of 1100^oC (Calcination), gives Quick lime (CaO) and carbon dioxide (CO_2). Quick lime is used in powder form for the manufacturing of autoclaved aerated concrete (AAC) blocks.

(4) Gypsum: It is used in the powder form as a retarder to increase the setting time of the concrete to avoid rapid hardening and to allow the time for Casting. It is easily available in the local market in powder form.

(5) Aluminium Powder: Aluminium powder is used as an expansion or aeration agent. It reacts with the lime (Calcium Hydroxide) to form micro air bubbles that cause 4-5 times increase in the volume of the concrete. It is used in very small amounts of 0.06 % to 0.08% of the total weight of the concrete.

$$2Al + 3Ca(OH)_2 + 6H_2O = 3\,CaO.Al_2O_3 + 3H_2$$

Aluminium powder+ Calcium hydroxide =
Tri-Calcium hydrate + Hydrogen[5]. (1)

(6) Alkali Resistant Glass Fibre: Glass Fibre is a material consisting of large numbers of extremely fine fibres of glass that are used to enhance the mechanical properties of the concrete. Alkali resistant glass fibres are similar to normal glass fibres, the only difference is that it contains zirconium in addition to other components. The AR Glass fibres used are purchased from Excellence Corporation, Mumbai-400079.

Table 3: Characteristics of Ar. Glass Fibre used.

Property	Value
Specific Gravity	2.68
Tensile Strength	1700 MPa
Youngs Modulus	72 GPa
Softening Temperature	860^oC
Length of Filaments	12 mm
Diameter of Filaments	14 microns
Dispersion for 12 mm long fibres	200 million filaments per Kg.

B. Manufacturing Process

(1) Preparation of the Raw Materials –

The whole process of the manufacturing of the AAC Blocks starts with the preparation of the raw materials. The details about the raw materials and their preparation are given as follows-

- **Fly Ash Slurry:** Fly ash and water are mixed in a cylindrical well-shaped tank called as a slurry tank. The mixing is carried out by means of an agitator, rotating at the rate of about 10 RPM. The ingredients are mixed in proportions such that the specific gravity of the slurry lies between 1.4–1.5 (Though it is different for different manufacturing plants but lies in the mentioned range). The slurry is transported by means of a pump to the slurry chamber that lies at the top elevation of the Batching Unit.
- **Cement-LimeMixture:** Cement and lime are poured in the funnel-shaped separate chambers from where these are carried by means of a belt conveyor to the second chamber of the Batching unit lying adjacent to the Slurry chamber.
- **Gypsum:** Gypsum in powder form is easily available in the market and is kept ready in the batching unit to be mixed up with the ingredients during the mixing process in the required amount.
- **Aluminium Powder:** Aluminium powder is used as an expansion agent and has been purchased from MMP Industries Ltd., Nagpur-4410001, Maharashtra, India. Aluminium powder is kept ready to be mixed up with the mixture in the range of 0.06 % to 0.08 % of the total weight of the dry ingredients.
- **Alkali-resistant Glass Fibre:** Ar. Glass fibre is used in this study as an additive. Four sets of samples were manufactured adding different proportions of the alkali-resistant glass fibre at the percentages by weight of the dry ingredients as- 0%, 0.1%, 0.2%, and 0.3%.

(2) Dosing and Mixing-

The proportions of the ingredients used for the manufacturing of the Autoclaved aerated concrete (AAC) blocks in this study are as follows-

- Fly Ash- 74%
- Cement- 16%
- Lime- 8%
- Gypsum 2%
- Aluminium Powder- 0.08%

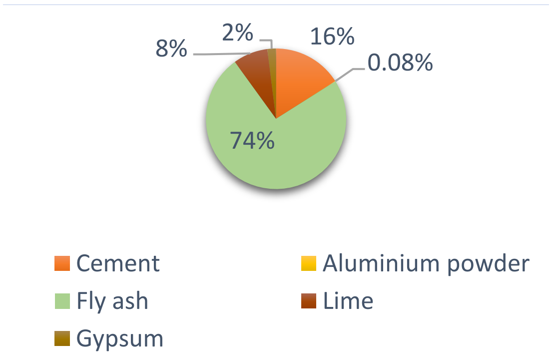

Figure-1: Mix proportions of AAC

Firstly, the Slurry is poured in the mixer chamber in the above proportion followed by the pouring of the cement-lime mixture. The mixing is done by means of the agitator rotating at the rate of 10-20 RPM. Then Gypsum is added in the required proportion and the ingredients are mixed for about 3-5 minutes. During the process of mixing, the temperature is maintained at about 40°C-45°C to allow the necessary chemical reactions to take place. The temperature is maintained by means of the steam taken from the boiler through a tube. The temperature is either monitored by automatic batching machine or by a laser thermometer. Lastly, the Aluminium powder is added and mixed for a small interval of time of about 30 to 35 seconds. This time interval is kept short to avoid the expansion of the mixture in the mixer.

Table 4: Mix proportions for the samples (by the percentage of the dry weight of ingredients).

Sample	Cement (%)	Fly ash (%)	Lime (%)	Gypsum (%)	Aluminium (%)	Ar Glass Fibre (%)
A	16	74	8	2	0.08	0
B	16	74	8	2	0.08	0.1
C	16	74	8	2	0.08	0.2
D	16	74	8	2	0.08	0.3

(3) Casting and Rising-

After the mix of the ingredients is ready, without waiting it is poured in the moulds. The moulds are of various sizes and capacities. To carry out this study the moulds used were of One Cubic metre of capacity with the following dimensions-

- Length of mould- 2.13 m
- Width of mould- 0.68 m
- Height mould- 0.75 m

Before casting, the moulds are coated with a thin layer of oil (usually the engine oils collected from the service stations of vehicles). The aim of applying the oil is to avoid the sticking of the concrete with the mould. After the application of the oil, the concrete is poured in the moulds up to the half of the height of the mould. After the poring, the aluminium powder starts reacting with the calcium hydroxide and the concrete start rising in the mould like a cake. The process of the rising takes about 2-3 hours to rise up to the top of the mould and a green cake is formed.

(4) Demoulding and Cutting-

Once the green cake attains the cutting strength it is lifted with the help of a crane for demoulding operation by means of a demoulding machine. The demoulding machine is operated by an operator who checks for the hardness of the cake at regular intervals.

When demoulding is completed the Green cake is moved forward for the cutting operation. The cutting process is completed in three stages. In the first stage, the cake is cut vertically to make the length 650 mm. In the second stage, the cake is cut horizontally height wise into three pieces each of 240 mm in width. In the third and last stage, the cake is cut to a height of 150 mm. The length of the blocks is fixed as 650 mm while the width and the height are variable and can be adjusted in a certain range as per the requirements of the project.

(5) Autoclaving or Steam Curing-

After the completion of the cutting operation, the blocks are sent into a closed vessel called Autoclave for steam curing. The blocks are then cured with steam into Autoclave for 10-12 hours at a temperature of about 180°C-200°C and pressure of about 12 bar (1200 KPa) to 14 bar (1400 KPa). The curing is done into three stages. In the first stage, the pressure is gradually increased up to 4 (400KPa) bars for 4 hours. In the second stage, the pressure is increased to 12 (1200KPa) bars and kept on hold for about 6 hours. In the last stage, the pressure is gradually decreased to avoid the cracks due to the sudden cooling of the concrete. The pressure and temperature in the Autoclave are maintained by means of steam generated by Steam Generation chamber/Boiler.

C. Experimental Program

(1)Compressive Strength Test-

The compressive strength test of the specimen has been done as per IS:6441 (Part 5)-1972 [11]. Four sets of samples (A, B, C, and D) were made with Alkali-resistant Glass fibre proportions as- 0%, 0.1%, 0.2%, and 0.3% of the dry weight of the ingredients respectively. Each set consisted of 3 cubes of the dimensions 150x150x150 (mm). The cubes are cut from the AAC blocks with the help of the cutter and the surfaces of cubes were made smooth by sand papers. The cubes were tested for compressive strength with the help of a Compression Testing Machine by placing the cubes between the plates and applying the load along the direction of the rise of the concrete at the rate of 0.5-2 kgf/cm^2 in such a way that failure occurs within 30 seconds[12]. The average value of compressive strength of the 3 cubes for each set was calculated, recorded and shown in the table-6.

Figure-2: Compression test of the cube specimen of AAC.

(2) Dry Density and Moisture content Test-

These tests have been done as per IS:6441 (Part1)-1972. The samples were prepared by cutting out the blocks of AAC. Four sets of samples were prepared of the said concentrations of Ar. Glass fibre. Each set consisted of 3 specimen of size 50x100x200 (mm). Firstly, the specimens were measured accurately and the volume of each sample was recorded as V m^3). The weight of each sample was recorded as W_1 Kgand then specimens were kept in the oven for 24 hours at the temperature of 105°C. After 24 hours the specimens were removed from the oven and weighed again immediately and the weight was recorded as W_2 Kg.

Dry Density = $(W_1 – W_2)/V$ (Kg/m^3)[13] (2)

Moisture content = ((W1 – W2)/W2) x 100 (%)[13] (3)

III. RESULTS AND DISCUSSION

A. Influence on Aeration and cutting Process

Aeration in the AAC is caused by the reaction between aluminium and lime, and is the cause of the increased volume or reduced density of the AAC. The aeration process was analyzed bycalculating the volume of the concrete in moulds at regular time intervals to see the influence of the fibre additive on the aeration and the results are depicted with the help of graph in figure-3.

Table 5: Analysis of the Aeration (Rising) process of Autoclaved Aerated Concrete in moulds upon treatment with different Alkali-resistant Glass fibre content.

S. No.	Time (in minutes)	Volume of mould attained by the concrete (in %)			
		Sample A	Sample B	Sample C	Sample D
01	0	60	60	60	60
02	05	84	83	82.8	82.6
03	10	96	84	94	93.8
04	15	98	95.3	95.1	95
05	20	98.7	97.4	97	96.8
06	25	100	98.7	98.6	98.6
07	30	100	100	100	100

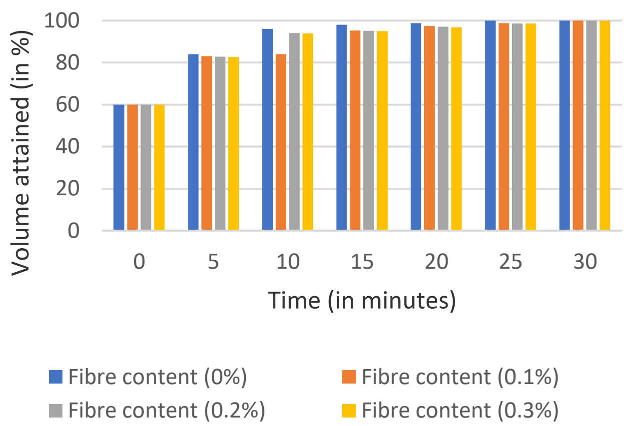

Figure-3: Influence of Alkali-Resistant Glass Fibre on the Aeration process of AAC.

This is clear from the figure-3 that there was only a slight effect seen on the aeration due to the fibre additive. The untreated AAC reaches its 100 % aeration in 25 minutes while the modified AAC reaches its 100% aeration in 27 minutes. So, the modified AAC takes 8% extra time to complete the aeration process. This may be caused because of the high specific gravity of the fibre additive than the AAC. No difficulty was seen in the rising of the modified autoclaved aerated concrete and showed almost the same relation with the time as shown by the untreated autoclaved aerated concrete.

Retrieval Number: F8478038620/2020©BEIESP
DOI:10.35940/ijrte.F8478.038620
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-6, March 2020

Figure-4: Analysis of aeration process of Autoclaved aerated concrete.

The investigations have shown that the fibres were uniformly distributed in the AAC blocks in all directions. A strong bond was observed between the fibres and the paste resulting in the enhanced mechanical properties.

We have observed that with lower fibre additive proportions there are no issues in wire cutting process but as the proportions of fibre additive increases, problems start occurring in the cutting process. This may be due to the large length of the fibre used (12 mm). We recommend the usage of small length fibre additive for future reference to avoid the problems in wire cutting.

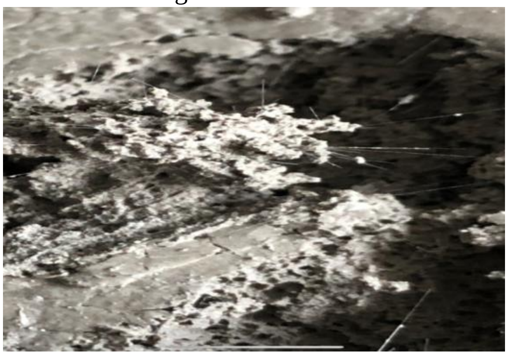

Figure-5: Microstructure of modified AAC showing strong bond formation and uniform distribution of fibres.

B. Influence of Alkali-Resistant Glass Fibre on Properties of AAC.

The investigations have shown that the Ar. Glass Fibre additive increase the compressive strength of Autoclaved aerated concrete blocks by 10%, 24% and 13.8% with respect to the fibre additive content of 0.1%, 0.2% and 0.3%. The optimal content of Alkali-Resistant Glass Fibre additive to be added for obtaining the highest compressive strength was found to be 0.2%. Formation of strong bond between fibres and the paste was observed as shown in figure-5. The fibres act as the reinforcement and enhance the mechanical properties to great extent.

Table 6: Properties of AAC Blocks at different fibre content.

Sample Code	Ar. Fibre content (in %)	Density (Kg/m^3)	Moisture content (%)	Compressive Strength (MPa)	
				3 Days	7 Days
A	0	555	19.7	2.3	2.9
B	0.1	565	20.8	2.5	3.2
C	0.2	566	19.5	2.8	3.6
D	0.3	566	20.9	2.5	3.3

A slight increase (about 0.2%) in the density of normal untreated and modified AAC Blocks was observed. The dry density of the samples A, B, C, and D were found to be 555 kg/m^3, 565 kg/m^2, 566 kg/m^3, and 566 kg/m^3 respectively.

The investigations have further shown that the moisture content of Autoclaved aerated concrete (AAC) blocks was not influenced so much by the various content of Alkali-resistant glass fibre additive. The moisture content was observed to lie in the range from 19.5% to 20.9%.

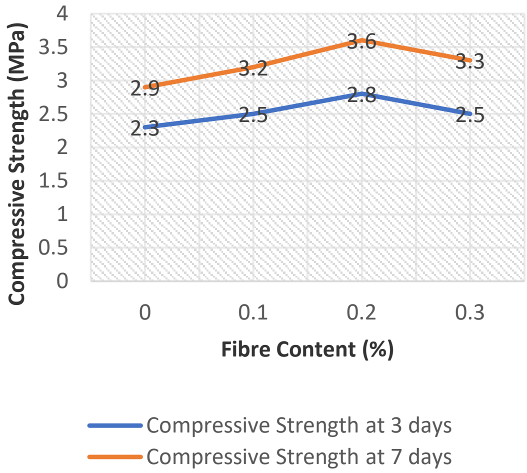

Figure-6: Relationship between the compressive strength of AAC specimens and content of Alkali-Resistant Glass Fibre additive.

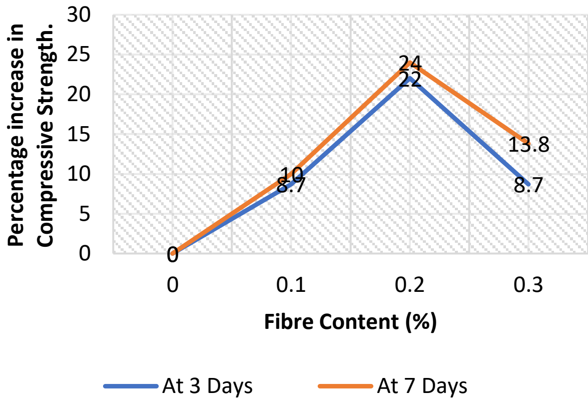

Figure-7: Relationship between the fibre content and the percentage increase in compressive strength.

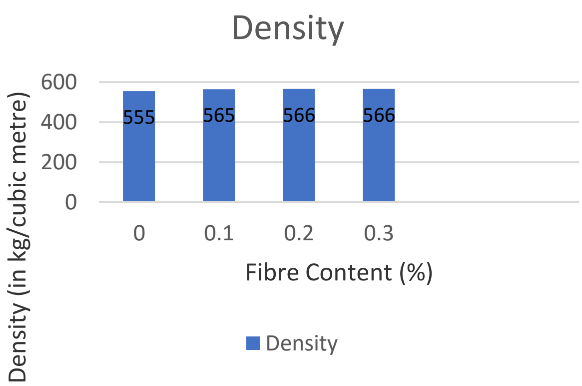

Figure-8: Relationship between the Dry Density of AAC specimens and content of Alkali-Resistant Glass Fibre additive.

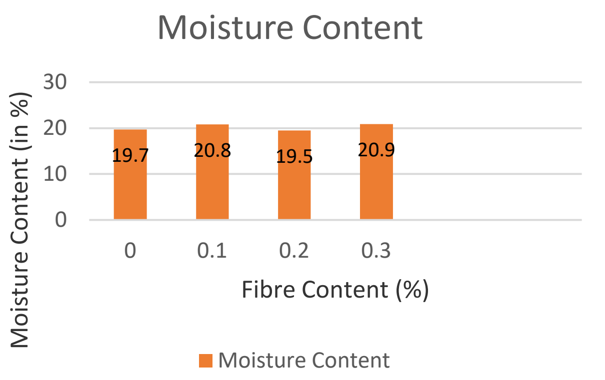

Figure-9: Relationship between the Moisture Content of AAC specimens and content of Alkali-Resistant Glass Fibre additive.

IV. CONCLUSION

The following conclusions have been drawn from the experimental study of the Autoclaved aerated concrete blocks:

1) Alkali-resistant Glass Fibre additive was observed to be uniformly distributed in all directions.
2) Strong bond was observed to form between the fibre additives and the paste.
3) Alkali-resistant Glass Fibre additive influenced the aeration/rising process of the AAC slightly by increasing the aeration time by 8%.
4) Alkali-Resistant Glass Fibre additive increases the compressive strength of Autoclaved aerated concrete blocks by 10%, 24% and 13.8% with respect to the fibre additive content of 0.1%, 0.2% and 0.3% respectively.
5) The optimal content of Alkali-Resistant Glass Fibre additive to be added for obtaining the highest compressive strength was found to be 0.2%.
6) A slight increase (about 0.2%) in the density of normal untreated and modified AAC Blocks was observed. The dry density of the samples A, B, C, and D were found to be 555 kg/m^3, 565 kg/m^2, 566 kg/m^3, and 566 kg/m^3 respectively.
7) The moisture content of Autoclaved aerated concrete (AAC) blocks was not influenced so much by the various content of Alkali-resistant glass fibre additive. The moisture content was observed to lie in the range from 19.5% to 20.9%.

REFERENCES

1. Hamad, A. J. (2014). Properties and application of Aerated Lightweight Concrete. Material Production, 2(2), 152-157. doi:10.12720
2. Kurweti, A. (2017). Comparative Analysis on AAC, CLC and Fly Ash Concrete Blocks. International Journal of Engineering Development and Research, 5(2), 1924-1931.
3. Jain, S. K. (2018). An Overview of Advantages and Disadvantages of Autoclave Aerated Concrete. Advanced Structures, Materials and Methodology in Civil Engineering, 35-39. Retrieved from http://www.researchgate.net/publication/329013600
4. Avadhoot Bhosale, N. P. (2019). Experimental Investigation of Autoclaved Aerated Concrete Masonry. American Society Civil Engineering, 1-11. doi:10.1061/(ASCE)MT.1943-5533.0002762.
5. Wahane, A. (2017). Manufacturing Process of AAC Block. International Journal of Advanced Research in Science and Technology, 06(02), 4-7. Retrieved from www.ijarse.com.
6. Nitin Kumar, D. O. (2017). Application of AAC Blocks in Residential Buildings. International Journal of Engineering Sciences and Research Technology, 6(3), 281-284. doi:10.5281/zenodo.400936
7. Bonakdar, A. (2013). Physical and Mechanical Characterization of Fibre-Reinforced Aerated Concrete (FRAC). Cement & Concrete Composites doi:http://dx.doi.org/10.1016/j.cemconcomp.2013.03.006.
8. Gulam Rizwan Gulam Firoz, R. (2019). Comparative Analysis of G+10 RCC Building with AAC Blocks and Conventional Blocks. International Journal of Research and Technology (IRJET), 6(4), 2430-2435. Retrieved from http://www.irjet.net
9. Amit Sahu, P. A. (2017). Aerated Concrete Blocks Using Polypropylene Fiber. International Journal for Research in Applied Science and Engineering Technology, 5(Xii), 1516-1520. Retrieved from www.ijraset.com
10. Zuhtu Oner Pehlivanli, I. U. (2016). The Effect of Different Fibre Reinforcement on the Thermal and Mechanical Properties of Autoclaved Aerated Concrete. Construction and Building Materials, 112. doi:http://dx.doi.org/10.1016/j/conbuildmat.2016.02.22
11. IS:2185 (Part 3) (1984) Specification for Concrete Masonary Units AAC Blocks (First Revision). New Delhi-110002: Bureau of Indian Standards.
12. IS:6441 (Part 5) 1972 Methods of Test for Autoclaved Cellular Concrete Products. New Delhi-110002: Bureau of Indian Standards
13. IS:6441 (Part 1) 1972 Methods of Test for Autoclaved Cellular Concrete Products. New Delhi-110002: Bureau of Indian Standards
14. Jagadish Vengala, S. K. (2019). Performance of Autoclaved Aerated Concrete Blocks under varying Temperatures. International Journal of Recent Technology and Engineering (IJRTE), 7(6C2), 615-619.
15. IS: 8112 (2013) Ordinary Portland Cement,43 Grade-Specification (Second Revision). New Delhi-110002: Bureauof Indian Standards.
16. IS:269 (1989) Specification for Ordinary and Low Heat Portland Cement (Third Revision). New Delhi-110002: Bureauof Indian Standards.
17. IS:712 (1984) Specificationfor Building Limes (Second Revision). New Delhi-110002: Bureau of Indian Standards.
18. Rongsheng Xu, T. H. (2019). Utilizing Wood Fibre Produced with Wood Waste to Reinforce Autoclaved Aerated Concrete. Construction and Building Materials, 243-249. doi:10.1016/j.conbuildmat:2019.03.030
19. Xiaoling Qu, X. z. (2017). Previous and Present Investigations on the Components, Microstructure and main Properties of Autoclaved aerated Concrete- A Review. Construction and Building Materials, 505-516. doi:10.1016/j.conbuildmat.2016.12.208.
20. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

AUTHORS PROFILE

Anayatullah Bhatis currently pursuing M. Tech in Structural Engineering from the Department of Civil Engineering, Integral University, Lucknow, Uttar Pradesh-226026, India. He has completed B. Tech (with Hons.) in Civil Engineering in 2018 from the same institution.

Zishan Raza Khan is working as Associate Professor in Department of Civil Engineering, Integral University, Lucknow, Uttar Pradesh-226026, India. He has experience of more than 10 years in teaching and research and has published more than 14 papersin various journals.