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Preparation of Autoclaved Aerated Concrete (AAC) Block by using Aluminum Powder as Foaming Agent

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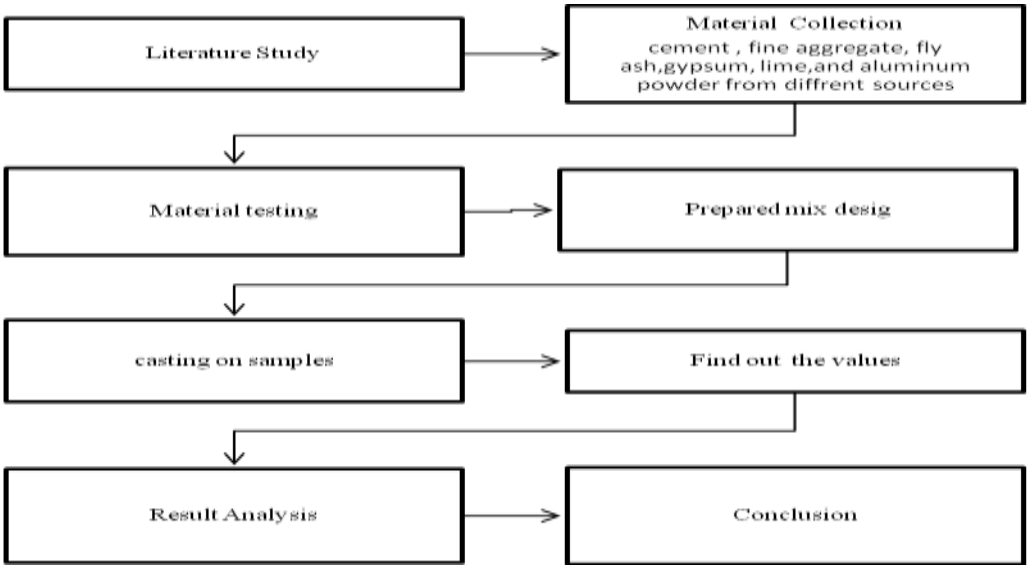
Abstract - *Autoclaved Aerated concrete is a lightweight concrete generally used to form concrete blocks. The paper presents the results of the investigation to achieve the comprehensive consumption of solid waste and reduce the costs of the project. In this study natural sand is partially replaced by fly ash and cement is partially replaced by lime. The mix proportion used 1:3 with a water-cement ratio of 0.6. In this research, the specimen is tested with and without lime. Gypsum is constantly used in the entire specimens. Different percentage of aluminum powder is used 0.02%, 0.05%, 0.075%, 0.1%, and 0.12% of total weight of concrete. Different properties of concrete such as compressive strength, water absorption, density were determined.*

Key Words: **Autoclaved Aerated Concrete, Fly Ash, Lime, Gypsum, Aluminum Powder.**

1. INTRODUCTION

Autoclaved Aerated concrete is a lightweight foaming concrete used to form precast concrete blocks. In this course, aggregate is not used only fine aggregate and lightweight foaming agents are used. Foamed concrete has high flowability, low self-weight, minimum use of aggregate, controlled low strength, and exceptional thermal insulation property. The density of foamed concrete has an extensive range from 1600 – 400 kg/m^3, with appropriate control in the prescribed amount of the foam. AAC has used both interior and exterior constructions. The mixture of cement, sand, lime, and water that was prolonged by the addition of aluminum powder to produce hydrogen gases in the cement slurry. If we want to reduce the size of blocks and increase the floor area without compromise strength, durability, the toughness of block polypropylene fibers are added to it.

2. METHODOLOGY:



3. MATERIAL USED:

3.1 Cement: In Aerated concrete cement is used as a binding material. In this research ordinary Portland cement (OPC) of grade 53 used of specific gravity 3.12, Initial setting time 38 mints and final setting time 544 mints and fineness 2.2%.

3.2 Lime:

Lime is obtained from limestone by calcination of lime in a lime kiln at a temperature of above 200 degrees Fahrenheit. Also known as quick lime or burnt lime with a specific gravity of 2.61.

3.3 Gypsum:

Gypsum is an evaporate material usually found in the earth's crust. It acts as a hardening retarder in ordinary Portland cement. 2.32 is the specific gravity of gypsum.

3.4 Fly ash:

It is a coal combusted product compost of fine particles by the use of fly ash workability significantly improved and also cost of the project reduced. In this research type c fly ash is used which contains 20% of lime and not more than 6% loss of ignition happened. The specific gravity of fly ash is 2.25.

3.5 Aluminum powder:

It is an expensive agent used as foaming added to concrete to create hydrogen bubbles. Hydrogen bubbles are created due to the reaction between calcium hydroxide, aluminum and water, and hydrogen gas which increase the volume of the blocks.

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

3.6 Fine aggregate:

Aggregate which passing through 4.75mm IS sieve. In this research local available fine aggregate is used of specific gravity 2.68.

3.7Water:

Water is a significant element that helps in the chemical reaction. Potable water of Ph 6.8-7.4 is used in this process.

4. MIX PROPOSITION:

Table I: Mix propitiation without lime

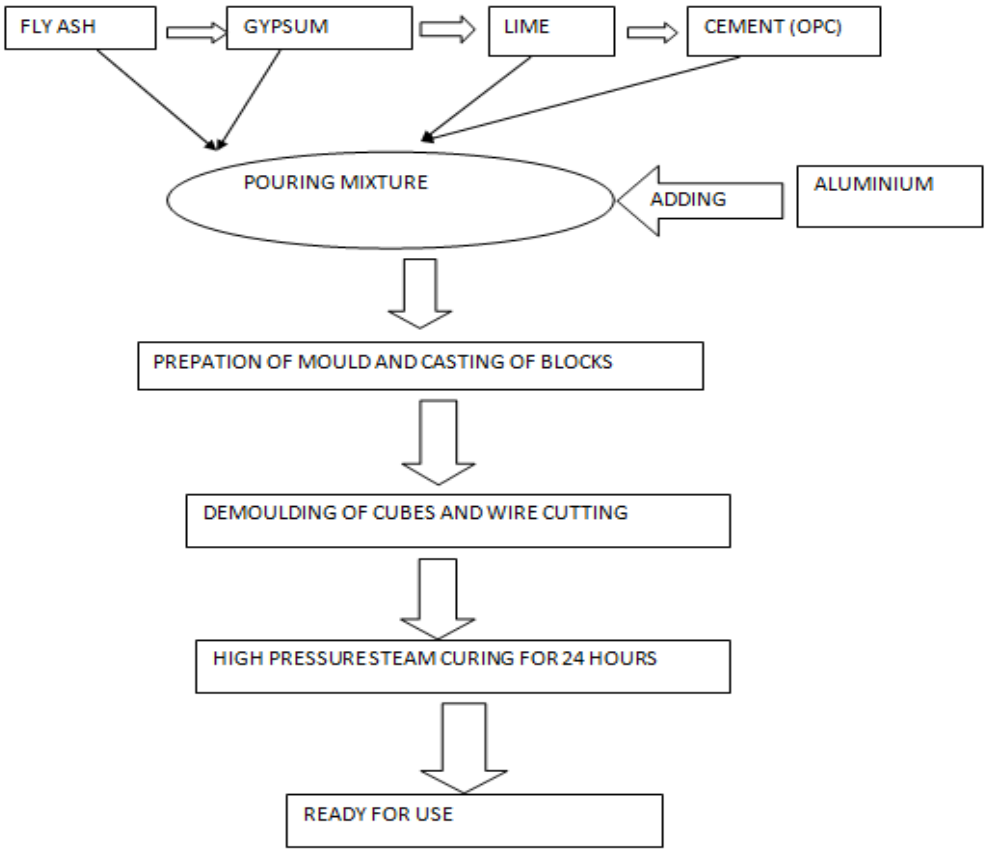
S.N0	cement	Fine aggregate	Fly ash	Aluminum powder(total percentage of dry material)	Gypsum
1	1	3	0	0.025	0.5
2	1	2.25	0.75	0.05	0.5
3	1	1.50	1.50	0.075	0.5
4	1	0.75	2.25	0.10	0.5
5	1	0	3	0.12	0.5

Table II: Mix propitiation with lime

S.N0	cement	Lime	Fine aggregate	Fly ash	Aluminum powder	Gypsum
1	1	0	3	0	0.025	0.5
2	0.9	0.1	2.25	0.75	0.05	0.5
3	0.8	0.2	1.50	1.50	0.075	0.5
4	0.7	0.3	0.75	2.25	0.10	0.5
5	0.6	0.4	0	3	0.12	0.5

5. MANUFACTURING PROCESS:

FLOWCHART OF MANUFACTURING AAC BLOCK:



6. RESULTS AND DISCUSSION:

6.1 Compressive strength:

The resistance of a material against a compressive force which tends to compress it. It is done after 24 hours of steam curing. Compressive strength is equal to the load/area. The size of cubes used for making cubes is $70.6mm^3$

Table III Compressive strength with and without lime

S.NO	Without lime **(N/mm²)**	With lime **(N/mm²)**
1	5.2	6.3
2	5.4	6.6
3	5.6	6.8
4	5.7	6.7
5	5.5	6.4

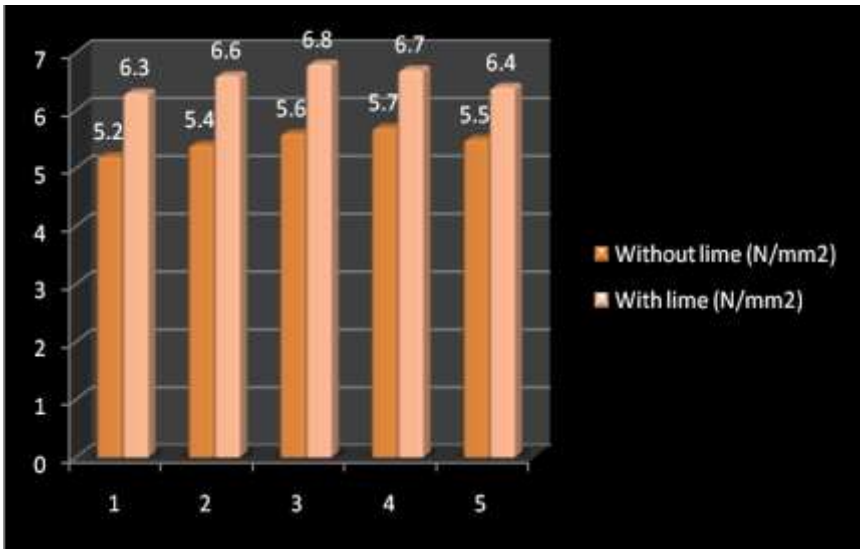


Figure 1 Compressive strength of aerated concrete with and without lime

6.2Water absorption test:

The main objective of this test is to measure the ability of a material to retain water to check its strength and quality of the material.

Table IV: percentage of Water absorption of the sample

S.NO	Without lime **percentage**	With lime **percentage**
1	17.8	17.21
2	16.4	16.10
3	15.98	15.31
4	16.12	15.86
5	17.6	16.81

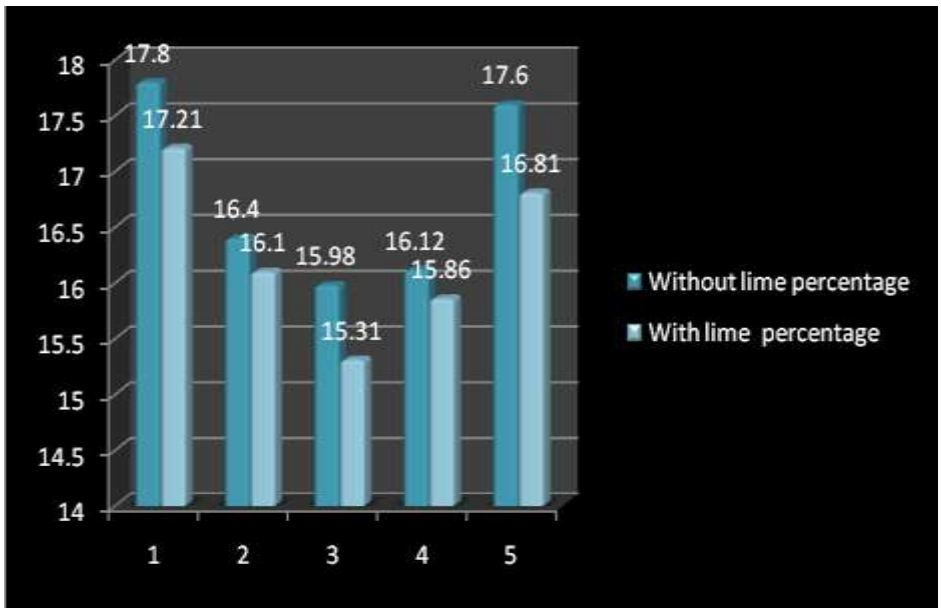


Figure 2: percentage of Water absorption of samples

6.3 Density Test:

Mass per unit volume of homogeneous material depends upon the type of material represent as mass/volume.

Table V: Density of samples

S.NO	Without lime **kg/m³**	With lime **kg/m³**
1	899.1	771.6
2	926.4	882.1
3	985.2	942.4
4	931.3	921.1
5	793.9	886.5

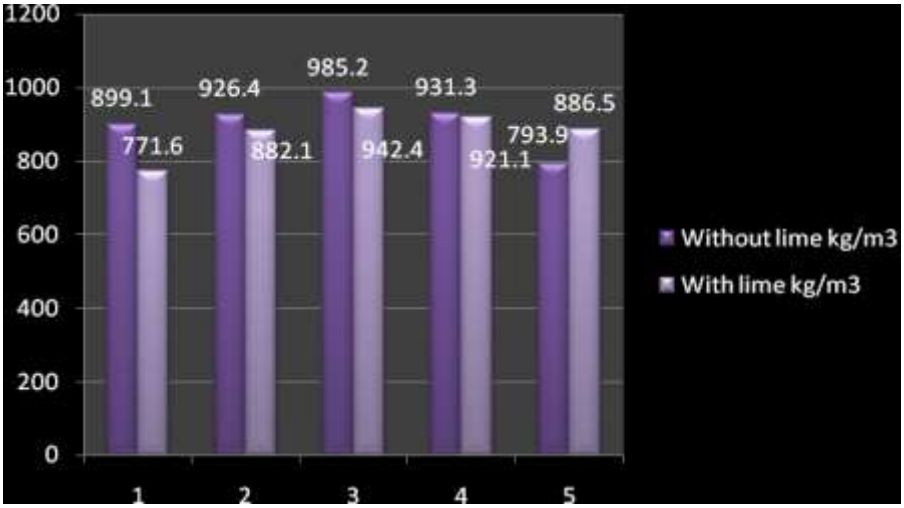


Figure 3: Density of samples

7. CONCLUSIONS:

- From the above results, it is shown that 0.075% of aluminum powder given better results in both conditions with and without the use of lime.
- In the above research, sand is partially replaced with fly ash and cement is partially replaced by lime .and gypsum is added at a constant rate of 0.5% which acts as a retarder.
- By the use of AAC cost of the project also reduced and the speed of the construction increased.
- AAC is mostly manufactured from no biodegradable materials which never decay nor attached to mold which helps us to keep the interior of mold clean and durable.
- AAC block is around 80% light weighted then red bricks which help us to decrease the self-weight of structural. In short AAC blocks are economical and good compressive strength.

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