Survey on Utilization of Plastic Waste in Autoclave Aerated Concrete Block

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Abstract- At present, construction works, such as high-rise buildings or offices and residential houses, in many countries are growing very fast every year. The accumulation of heat and moisture in building wall plays an important role in its maintenance and energy conservation.AC block, an eco-friendly material, gives a prospective solution to building construction.
The usage of AC block reduces the cost of construction up to 20% as reduction of dead load of wall on beam. The use of AC block also reduces the requirement of materials up to 50%.Aerated concrete can produce a light weight, environmentally friendly, lower coefficient of thermal expansion, mould resistance, reduced dead weight and good sound insulation as a result of air voids within aerated concrete this block
Keywords: AC, light weight, Reduces, Eco-Friendly.

1. INTRODUCTION

Bricks remain one of the most important building materials in the country. Brick making is a traditional industry in India, generally confined to rural areas. It has directly or indirectly caused a series of environmental and health problems. At a local level, in the vicinity of a brick kiln, environmental pollution from brick-making operations is injurious to human health, animals and plant life. The environmental pollution from brickmaking operations contributes to the phenomena of global warming and climate change. Extreme weather may cause degradation of the brick surface due to frost damage. Various types of blocks can be used as an alternative to the red bricks, to reduce environmental pollution and global warming. Aerated Concrete blocks (AC) may be one of the solutions for brick replacement. AC is one of the eco – friendly product. AC is porous, non-toxic, reusable, renewable and recyclable. Aerated Concrete, also known as aircrete, is a lightweight, load-bearing, high insulating, durable building product, which is produced in a wide range of sizes and strengths. AC is produced out of a mix of quartz sand or pulverized fly ash, lime, cement, gypsum/anhydrite, water and aluminium and is hardened by steam-curing in autoclaves. Being aerated, it contains 50 - 60 % of air, leading to light weight and low thermal conductivity. AC is a lightweight, precast building material that simultaneously provides fire resistance, construction, economy and speed.

1.1 Introduction

Lightweight concrete is an important construction material nowadays, as it increases thermal insulation properties and also decreases the thermal load coming on the building. Light weight concrete is widely using all over the world due to its light weight, high strength, low thermal conductivity, low shrinkage, low absorption, high heat resistance and which possess sharp edges and corners

1.2 Characteristics of Aerated Concrete.

(i) Workability
Workability is measured using flow table. Workability of the cement paste or mortar is based on the flow. When the water to the solid ratio increases, flow or workability increases. Stiff pastes are not suitable for aerated concrete production
(ii) Density
Water cement ratio is a factor that effects on the amount of aeration and thus the density of concrete. If it consists of pozzolanic materials, Water solid ratio is to be considered instead of water cement ratio. The water cement ratio should not be much lower due to the insufficient aeration and should not be not much higher due to the rupture of voids. Thus the water cement ratio is taken on the basis of the consistency of the concrete; there is no any relevance to the selection of predetermined one.
(iii) Water absorption
Water absorption reduces with increase in the density of concrete. As per the study conducted by Muthukumar etal.(2017), For a constant density, the water absorption has reduced for the increase in curing temperature. A comparative density with minimum water absorption is obtained at a temperature of 90ºc

1.3 Test conducted on Masonry Walls

The mechanical properties of masonry walls evaluated by testing a small portion of wall that represents the entire system. Masonry walls are tested for compressive strength test, Flexural strength and Shear strength. Mainly the compressive strength. Because, the major load on the masonry wall is compressive or vertical loads. The performance of masonry walls is evaluated by using masonry prisms or masonry wallets. Conducted a study on the masonry prisms and wallets. Masonry prisms are the arrangement of masonry blocks with less than 3 courses. Masonry wallets are arrangement with 5 courses or more. He concludes that the prisms are a better representation of the actual masonry construction. An also determined that 3- course prism better represents masonry properties of the walls when compared to 2-course prisms After the masonry prism test, the strength calculated must be multiplied with a correction factor. The correction factor is determined according to the ratio of prism height to least lateral dimension of prism. Minimum length of the prism shall be 100mm. The load is applied perpendicular to the bed joints. These are specified under ASTMC 1314 or IS 1905:1987

Comp strength of clay brick block is higher than concrete blocks. Elastic modulus is higher for concrete blocks Due to the brittle nature of clay brick block, the masonry wall does not have higher strength [34]. Masonry prisms can be arranged in different configurations. But as a representative of the whole wall, we are generally arranging the blocks in the way that is given in the figure 2:

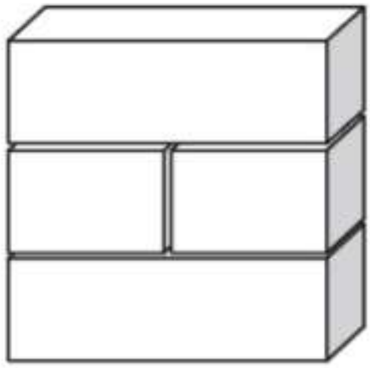

Figure 1.1: Masonry prism configuration

1.4 Problem Statement

At present, construction works, such as high-rise buildings or offices and residential houses, in many countries are growing very fast every year. The accumulation of heat and moisture in building wall plays an important role in its maintenance and energy conservation.AC block, an eco-friendly material, gives a prospective solution to building construction. The usage of AC block reduces the cost of construction up to 20% as reduction of dead load of wall on beam. The use of AC block also reduces the requirement of materials up to 50%.

1.5 Scope of project

To present an overview on the use and properties of autoclaved aerated concrete products. To prove that AC can be produced in small scale industries. It is light weight block and eco-friendly.

1.6 Objective

1- To compare the various properties AAC Block.
2- To find a compressive and flexural strength AAC blocks.

2. LITERATURE REVIEW

Johan Alexanderson [1] investigated the relations between structure and mechanical properties of autoclaved aerated concrete. Tests for fresh concrete and hardened concrete have been carried out. It is concluded that when the pores increases it decreased the compressive strength. Therefore increase in aluminium powder adversely affects the strength. N Narayanan and K Ramamurthy, the Microstructural investigations on bond and lime as follows . Hardened concrete parameters such as, the porosity and the pore estimate appropriation were examined. Shrinkage and compressive strength were measured. The response items had a place with the tobermorite gathering of calcium silicate hydrates and the term crystallinity was characterized as the level of 11.3 Å tobermorite out of the aggregate sum of calcium silicate hydrates. The shrinkage diminished with expanding crystallinity while the compressive strength expanded up to an ideal esteem. The strength additionally expanded with expanding measures of hydrates and with diminishing porosity. Different elements of the response items were demonstrated by thermal conduct and

Gunnar Bave [2] investigated on the aerated concrete towards the development of green building. The fabricate of aerated concrete offers the benefit of using promptly accessible crude materials, including certain mechanical waste that has been collected from industry. Aerated concrete is a material with high thermal protection against warmth and frosty consolidated with adequate strength for use in loadbearing structures up to 3-4 stories. Generation strategy requires a similarly low contribution of vitality. Aerated concrete decreases the vitality required for warming or cooling amid the life expectancy of a building. The mechanical parameters can be enhanced with the help of industrial wastes.

N Narayanan and K Ramamurthy [3] investigated the Structure and properties of aerated concrete. The properties of aerated concrete rely upon its microstructure (void ± paste framework) and arrangement, which are influenced by the kind of cover utilized, strategies for pore-development and curing. Albeit aerated concrete was at first imagined as a decent insulation material, there has been re-established enthusiasm for its basic attributes in perspective of its lighter weight, reserve funds in material and potential for expansive scale usage of squanders like pummelled fuel ash. The concentration of this paper is to group the examinations on the properties of aerated concrete as far as physical (microstructure, density), concoction, mechanical (compressive and tensile strengths, modulus of flexibility, drying shrinkage) and useful (warm insulation, dampness transport, strength, resistance and acoustic insulation) qualities.

N Narayanan and K Ramamurthy [4] investigated the microstructures of the aerated concrete. This investigation reports the examinations directed on the structure of bond based autoclaved aerated concrete (AAC) and non-AAC with sand or fly ash as the filler. The purposes behind changes in compressive strength and drying shrinkage are disclosed with reference to the adjustments in the microstructure. Compositional investigation was done utilizing XRD. It was observed that fly ash reacts inadequately to autoclaving. The paste± void interface in aerated concrete examined in connection to the paste± aggregate interface in ordinary concrete uncovered the presence of an interfacial change zone. From this we concluded that the microstructural changes, either because of compositional variety (sand/fly fiery remains as filler) or curing (moist curing/ autoclaving) altogether influences the properties of aerated concrete. Non-autoclaved aerated concrete experiences changes in structure with time though autoclaved items are for all intents and purposes stable. Autoclaving brings about higher strength as a result of the better crystallinity of the items framed. The proficiency of autoclaving is less when fly ash is available in the blend, the response items being inadequately crystalline

EP Kearsley et al. [5] investigated the porosity and permeability of foamed concrete. An examination has been embraced to explore the impacts, on the properties of frothed concrete, of supplanting extensive volumes of bond (up to 75% by weight) with both ordered and unclassified fly ash. This paper reports just on the aftereffects of porousness and porosity measured up to an age of one year on very much cured concretes. Porosity was observed to be needy for the most part on the dry density of the concrete and not on ash sort or substance. Penetrability was measured regarding water retention and water vapor porousness. The volume of water (in kg/m3) consumed by frothed concrete was around twice that of a proportional bond glue yet was free of volume of air entrained, ash sort or ash content. The water vapour penetrability expanded with expanding porosity and ash content.

A Laukaitis and B Fiks [6] investigated the Acoustical properties of aerated autoclaved concrete. Three most broadly utilized sorts of AAC are decided for the investigation: gas bond concrete, gas concrete with joined folio (Portland bond and lime), and froth bond concrete. The strategy and procedure of the materials' arrangement is exhibited in this work. The assessment of acoustic characteristics of AAC depends on the material's air porousness and porosity (i.e., ratio of the volume of the interconnected pores to the aggregate volume of pores). For this reason the estimations acquired by an acoustic interferometer are utilized. The consequences of the analysis demonstrate that relapse conditions for the AAC sorts, which density ranges from 250 to 500 kg/m3 , might be utilized to assess the materials' ordinary frequency ingestion coefficient esteems, which rely upon the air porousness and porosity. Results demonstrate that retention coefficient of not uniquely treated AAC is somewhat low. As indicated by the estimations got in an extraordinary reverberation room of 202 m 3 , a sound assimilation coefficient may increment up to 0.6, gave that openings of Helmholtz resonator's sort are made in the chunks of AAC gas bond concrete with joined cover

Cenk Karakurt et al. [7] Utilization of natural zeolite in aerated concrete production. In this study, natural zeolite (clinoptilolite) was utilized as a total and air pocket creating operator in autoclaved aerated concrete (AAC) creation. The smashed and crushed specimens were arranged into two diverse molecule sizes: 100 lm (fine-ZF) and 0.5–1 mm (coarse-ZC) before utilizing as a part of AAC blends. The impacts of molecule estimate, substitution sum (25%, half, 75% and 100% against quartz) and curing time on the AAC properties were tentatively examined. It was discovered that use of natural zeolite, particularly with a coarser molecule measure, has valuable impact on the physical and mechanical properties of AAC.

Watcharapong Wongkeo et al. [8] investigated Compressive strength, flexural strength and thermal conductivity of autoclaved concrete block made using bottom ash as cement replacement materials. The base slag (BA) from Mae Moh control plant, Lampang, Thailand was utilized as Portland cement replacement to create lightweight concrete (LWC) via autoclave aerated concrete strategy.

Md Azree Othuman Mydin [9] investigated the mechanical properties of foamed concrete exposed to high temperatures. This study reports the consequences of a trial and logical examination to research the mechanical properties of unstressed frothed concrete presented to high temperatures. Two densities of frothed concrete, 650 and 1000 kg/m3 , were made and tried with extra tests being performed on densities of 800, 1200 and 1400 kg/m3 for extra information. The trial comes about reliably showed that the misfortune in firmness for frothed concrete at hoisted temperatures happens overwhelmingly after around 90°C, paying little heed to density as water grows and vanishes from the permeable body. From an examination of the exploratory consequences of this exploration with various prescient models for typical strength concrete, this examination has discovered that the mechanical properties of frothed concrete can be anticipated utilizing the mechanical property models for ordinary weight concrete given that the mechanical properties of frothed concrete originate from Portland Cement .

Martin Keppert [10] Hygric, thermal and durability properties of autoclaved aerated concrete. The hydric and thermal properties of autoclaved aerated concrete (AAC) given in the producers rundowns incorporate for the most part only the thermal conductivity in dry state and nonspecific information for the particular warmth limit and water vapour dispersion resistance factor. Durability attributes are not recorded by any stretch of the imagination. This extraordinarily restrains any administration life appraisal investigations of AAC-based building envelope frameworks.

N Uddin et al. [11] investigated Design of hybrid fibre reinforced polymer (FRP)/autoclave aerated concrete (AAC) panels for structural applications. This part talks about outline for fibre reinforced polymer (FRP)/autoclaved aerated concrete (AAC) sandwich blocks/panels for basic applications. The part initially exhibits the limited component investigation (FE) of FRP/AAC blocks. The FE comes about are contrasted and the test comes about demonstrating adequate understanding. Next, explanatory models are introduced to foresee the deformation and strength of the panels. At last, outline diagrams have been produced to help in planning the floor and wall panels produced using FRP/AAC boards. Additionally, those panels have been contrasted with the financially utilized reinforced AAC boards exhibiting that FRP/AAC boards offer a generally practical answer for longer life cycle

M Vijayalakshmi et al. [12] investigated Strength and durability properties of concrete made with granite industry waste. Granite stones handling industry from Tamilnadu state produces huge amounts of non-biodegradable fine powder squanders and usage of that unsafe waste in concrete generation will prompt green condition and feasible concrete innovation. The fundamental target of this examination is to tentatively explore the appropriateness of rock powder (GP) squander as a substitute material for fine/common total in concrete creation. The trial parameter was level of stone powder substitution. Concrete blends were set up by 0%, 5%, 10%, 15%, 20% and 25% of fine/normal total substituted by GP squander. Different mechanical properties, for example, compressive strength, split rigidity, flexural strength; ultrasonic heartbeat speed (UPV) and versatile modulus were assessed.

Rostislav Drochytka et al. [13] investigated improving the energy efficiency in buildings while reducing the waste using autoclaved aerated concrete made from power industry waste. Creation of Autoclaved Aerated Concrete (AAC) from control industry squander soot speaks to a dynamic innovation for preparing of mechanical waste in another type of building material with great qualities. In spite of these positive perspectives, the offer of soot concrete in the building business is less prevalent.

Atthakorn Thongtha et al. [14] made an Investigation of the compressive strength, time lags and decrement factors of AAC-lightweight concrete containing sugar sediment waste. Sugar silt squander was fused into the crude material blend for the creation of Autoclaved Aerated Concrete, and was shown by broad testing to give more noteworthy compressive strength than ordinary materials, and an expanded time slack. Likewise, the utilization of this generally squander material was shown to be exceptionally helpful both financially and earth. Sugar residue is a waste result of the sugar refining industry in Thailand, and is accessible in immense amounts.

She Wei et al. [15] investigated using the ultrasonic wave transmission method to study the setting behaviour of foamed concrete. The aim of this study is to examine the likelihood of utilizing ultrasonic wave transmission strategy to ponder the setting conduct of frothed concretes (FC), and relate ultrasonic wave parameters to frothed concrete setting times. To begin with, Anderson and Hampton's hypothesis was utilized to break down wave engendering and weakening in pyroclastic media containing significant air bubbles portrayed by 3D X-beam registered tomography (XCT). At that point, the compressional (P) waves were utilized to consequently and persistently measure the FC glues with various plastic density (300, 500, 800 and 1000 kg/m3) and diverse fly ash substance (20%, 40% and 60% by weight of concrete).

3. RESEARCH METHODOLOGY

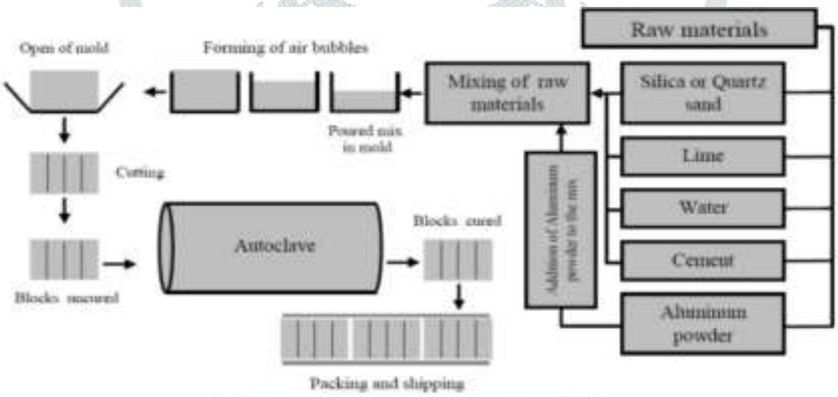

Figure 3.1: Process of Autoclaved aerated concrete block production

A. Ordinary Portland cement (Opc)

Ordinary Portland Cement (OPC) is the most common cement used in general concrete construction when there is no exposure to sulphates in the soil or groundwater. Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. The OPC was classified into three grades namely, 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested.

B. Fly Ash:

Fly ash is one of the naturally-occurring products from the coal combustion process and is a material that is nearly the same as volcanic ash. When coal is burned in today's modern electric generating plants, combustion temperatures reach approximately 2800°F. The non-combustible minerals that naturally occur from burning coal form bottom ash and fly ash. Fly ash is the material that is carried off with the flue gases, where it is collected and can be stored in silos for testing and beneficial use. Fly ash can be classified into classes. Class F fly ash normally produced by burning anthracite or bituminous coal. Usually it has less than 5% of CaO. Class C fly ash normally produced by burning lignite or sub-bituminous coal. Usually it have CaO content in excess of 10%.

C. Lime:

Lime is a calcium-containing inorganic material in which carbonates, oxides, and hydroxides predominate. It is also the name of the natural mineral (native lime) CaO which occurs as a product of coal seam fires and in altered limestone xenoliths in volcanic eject. The word "lime" originates with its earliest use as building mortar and has the sense of sticking or adhering. These materials are still used in large quantities as building and engineering materials the rock and minerals from which these materials are derived, typically limestone or chalk, are composed primarily of calcium carbonate. "Burning" converts them into the highly caustic material "quicklime".

D. Water:

Water is an important constituent of concrete. It chemically reacts with cement to produce the desired properties of concrete. Mixing water is the quantity of water that comes in contact with cement, impacts slump of concrete and is used to determine the water to cementations ratio of the concrete mixture. Strength and durability of concrete is controlled to a larger extent by its w/c .The quality of mixing water used in concrete has important effects on fresh concrete properties such as setting time and workability it also has important effects on the strength and durability of hardened concrete.

G .Plaster Of Paris:

Plaster is a building material used for the protective and decorative coating of walls and ceilings and for moulding and casting decorative elements. In English plaster usually means a material used for the interiors of buildings. The most common types of plaster mainly contain gypsum, lime, or cement but all work in a similar way. The plaster is manufactured as a dry powder and is mixed with water to form a stiff but workable paste immediately before it is applied to the surface. The reaction with water liberates heat through crystallization and the hydrated plaster then hardens.

H. Sand: Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica, usually in the form of quartz.

I. Aluminium Powder:

Aluminium powder is usually used to obtain autoclaved aerated concrete by a chemical reaction generating a gas in fresh mortar; it contains a large number of gas bubbles. When aluminium is added to the mixing ingredients by 0.2%-0.5% to the dry density of cement . The Aluminium powder can be classified into three types: atomized, flake and granules. In case of an atomized particle, its length, width and thickness are all of approximately the same order where the length or width of a flake particle maybe several hundred times it thickness. Aluminium powder in the AAC industry is often made from foil scrap and exists of microscopic flake-shaped aluminium particles.

Fig 3.2 Aluminium Powder

J. Plastic Waste

Plastic have many good characteristics which include versatility, light-ness, hardness, and resistant to chemicals, water and impact. It makes up much of the street side litter in urban and rural areas. It is rapidly filling up landfills as choking water bodies.

Fig 3.3 Methodology

K. Raw Material Preparation:

Fly ash is mixed with water to form fly ash slurry. Lime powder required for AC production is obtained either by crushing limestone to fine powder. 53-grade Ordinary Portland Cement from reputed manufacturer is required for manufacturing AC blocks. Gypsum is easily available in the market and is used in powder form Aluminium powder/paste is easily available from various manufacturers.

L. Dosing and Mixing:

After raw material preparation, next step of AC blocks manufacturing process is dosing and mixing. Process of dosing and mixing defines the quality of final products. Maintaining ratio of all ingredients as per the selected recipe is critical to ensure consistent quality of production. The fly ash and cement is mixed in dry state thoroughly after that recipe material is mixed the lime is mixed with slurry and then aluminium powder is mixed with water and then slurry is prepared and moulded.

Casting: AAC blocks manufacturing process involves casting, rising and pre-curing. Before casting, moulds are coated with a thin layer of oil. This is done in order to ensure that green cake does not stick to moulds. While slurry is mixed and poured into greased moulds, Aluminium reacts with Calcium Hydroxide and water to form Hydrogen. Millions of tiny Hydrogen bubbles are released due to this reaction. This leads to formation of tiny unconnected cells causing slurry mix to expand. Such expansion may be twice its original volume. This process is very similar to rising of idli or dhokla dough. It must be noted that bubbles generated during AC blocks manufacturing process are unconnected. Bubble size is usually 2- 5mm. These cells are the reason behind light weight and insulating properties of AC blocks. Once rising process is over, green-cake is allowed to settle and cure for some time. This ensures cutting strength required for wire cutting.

M. Demoulding:

In earlier casting we have seen how slurry is cast in moulds and allowed to rise and gain strength during procuring. Once green cake has achieved strength, it is ready to be demoulded. In industries they generally use machines to separate the mould or invert the mould upside down to remove the block from the mould.

N. Curing:

For this block normal water curing cannot be done has it will increase the weight of the block by filling up the pores in the block so to increase the strength of the block in short period of time and also to reduce the block weight steaming curing is done. Generally curing is done to reduce the heat induced inside the concrete and to increase the strength of concrete.

CONCLUSION

Autoclave Aerated concrete Block is turning into a pattern during a unique concrete. It's a lot more useful because of the self-healing capacity of its compared to the traditional concrete with break fixing. AAC concrete is a novel as well as earth friendly approach. Calcium carbonate precipitate of the germs greatly gets better the sturdiness of concrete by filling the voids. By utilizing AAC concrete the fix as well as rehabilitation expense of concrete framework could be lowered. By the literatures it's expected the longevity of the germs is a lot more compared to the lifetime on the construction. This's an extremely handy technique. This particular development is going to provide longevity on the concrete framework by lessening the permeability because of the precipitation of calcite by the germs via bio mineralization operation. Though the specifics associated with the financial issue of AAC concrete need to be nevertheless to discover away. **The good results will be founded by the substitution of Glass & Plastic waste i.e. 7.5%, 10%.** To find the force of concrete, the concrete evaluated for the test of compression force of high strength concrete in which the replacement of material Glass & Plastic waste testing 7days, 28days. In every trail mix of our AAC concrete mix will be tested by compressive, flexural Test. The Compressive Strength increases with the use of Glass & Plastic waste material. The maximum strength achieved in concrete having 7.5% Glass, 10% Plastic waste i.e., Mix 3.the strength increased 2.3% as compare to CC. The Flexural-Strength(force) also shows the enhancing in AAC concrete strength with the presence of Glass & Plastic waste , The maximum strength achieved in concrete having 10% Glass, 12% Plastic waste i.e., Mix4.the strength increased 1.6% as compare with the normal concrete. Hence for an above experimental research has concluded that cement with Glass 10% & Plastic Waste 12% partial replacement gives an optimum good result of forces and also helps in the strength & durability improvement properties of high strength concrete.

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