Experimental Study On Light Weight Foamed Concrete In Comporting Glass Fibres

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ABSTRACT:

Waste disposal is currently one of the most difficult tasks for the majority of engineers. As a result, an alternative has been discovered: solid concrete blocks made from waste materials like expanded polystyrene, or EPS. This has lessened the environmental and financial effects of quarrying and processing. The use of lightweight foamed concrete offers many benefits over other materials like steel and wood, such as cost savings, quick compaction, and ease of application. In this study, we used Expanded Polystyrene Beads (EPS) to investigate Cellular Light Weight Concrete (CLC). CLC has been around from the beginning of time and is not a new innovation. Cement, fly ash (class F), manufactured sand (M-Sand), ground granulated blast furnace slag (GGBS), and polypropylene fibers have all been utilized. In this study, hardened blocks with EPS beads were subjected to tests for thermal conductivity, compressive strength, and water quality. Fly ash and GGBS decreased water demand by lowering hydration and carbon footprint, which decreased shrinkage. However, they also decreased the blocks' compressive strength by about 25–45%. Concrete with a density of less than 1800 kg/m3 is commonly referred to as lightweight concrete. The utilization of Expanded Polystyrene (EPS) beads in lightweight concrete is the main topic of this study. Lightweight foamed concrete (LFC) is a low-density concrete that has many applications. However, its strength should also be decreased because it weighs about half as much as regular concrete. Therefore, earlier studies used both natural and synthetic short fibers to improve LFC performance. Porosity, water absorption, UPV, split tensile strength, flexural strength, compressive strength, and drying shrinkage were among the characteristics identified. Fiberglass netting enhances drying shrinkage, flexural, compressive, tensile, and UPV strengths in addition to controlling cracks. Compared to traditional concrete, it is lighter. Lightweight foamed concrete is now commonly used in several nations. Expanded lightweight particles in this kind of concrete increase the mixture's volume. The various uses and benefits of the lcw are demonstrated in this study.

Keywords: Glass Fibres, foaming agent, (GGBS),lightweight aggregates, water, recycled materials, fly ash, compressive strength, thermal insulation, density reduction, eco- friendly concrete.

1. Introduction

An incredible human creation, light weight concrete (LWC) is utilized in many different construction-related industries. Frames and its numerous vital applications include floors, curtain walls, shell roofs, folded plates, bridges, offshore oil platforms, and precast. Its strength is 27–33% less than that of an average LWC. The three types of concrete are heavy, normal weight, and light weight three varieties of concrete that are separated based on their respective weights. These are the compositions. Heavy: 3100–3900 kg/m Typical: 2300–2500 kg/m Light: 1900 kg/m. There are several ways to make lightweight blocks, but the most popular is to make a lightweight material by adding air to it. Coarse aggregates are replaced when air is added to any building. As a result, as it dries, lightweight material will form. Cellular concrete is the term used to describe this kind of concrete. In the modern world, the need for lightweight blocks is increasing daily. The main benefit of lightweight blocks is that they contribute to the creation of inexpensive and elegant constructions by reducing the size of the foundation as the load on it decreases. Aggregate made of polystyrene beads is frequently utilized. Lightweight Concrete is suitable for structural uses like floors and frames since it has acceptable strength values. Pumice, diatomite, volcanic cinders, and other materials are examples of natural lightweight aggregates; clay, expanded shale, fly ash that has been sintered and expanded polystyrene are examples of manmade lightweight aggregates. Portland cement, cement-pozzolana, and lime-pozzolana are combined to create cellular concrete, a lightweight product with a homogenous cell structure created by the use of a foaming agent. By using a foam generator to create foam, the density of lightweight concrete can be decreased. Fly ash and GGBS are the main components of CLC. In India, this kind of block is appropriate for partitioning and load-bearing small building projects.One of the most widely utilized building materials on the planet is concrete. Cement, water, coarse aggregate, and fine aggregate are the essential ingredients of this composite material. In addition to these resources, fly ash, crushed granulated blast furnace slag, and other waste byproducts, expanded polystyrene, etc. can be used to make concrete. Both the environmental effect and the expenses associated with quarrying, processing, and shipping are decreased when such materials are used in building. Hollow blocks were created to reduce the dead weight of the construction since they have a higher compressive strength than conventional bricks. Consequently, lightweight concrete blocks have been developed to lower the DL of the construction. In this work, a substance known as EPS (Expanded Polystyrene) is used in of both coarse and small particles to reduce the concrete's weight. EPS's specific gravity is significantly lower (0.057) than that of fine aggregate (3.5). Concrete's weight decreases further as a result of the cellular voids that EPS causes in the material. To ensure that the strength and permeability parameters are unaffected, the EPS beads will further occupy these voids. The amount of air that the foaming agent introduces has an impact on lightweight foamed concrete.

2. Methodology

2.1 Material Selection & Prepration

The necessary materials are Manufactured sand, or cement, fly ash, expanded polystyrene fibers of polypropylene, GGBS (ground granulated blast furnace slag), or EPS Benzoyl alcohol, an OPC of 53 grade, is utilized as a water foaming agent. Cement has a specific gravity of 3.16 and is tested in accordance with IS guidelines. River sand can be replaced with sand that has been formed by shattering and utilizing strong granite stone as fine aggregate. Nowadays, there is a huge

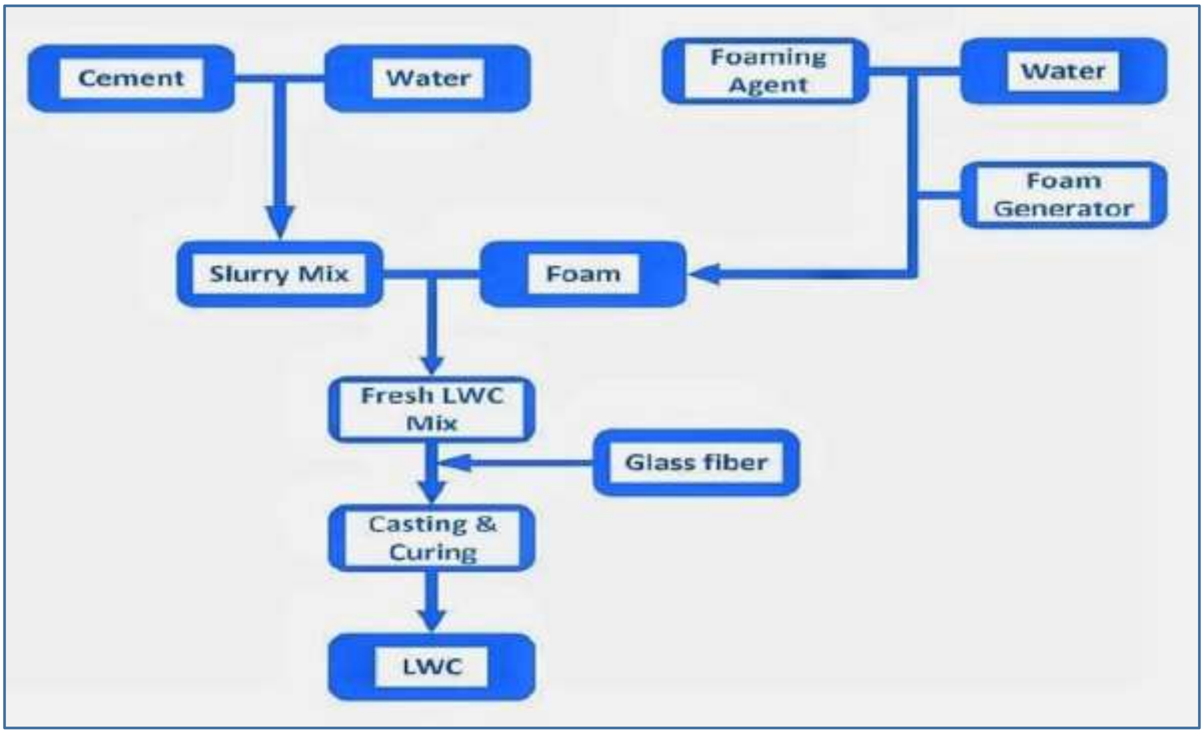


Fig:1- Concrete Meaking Process

Fig:2 - Mould Setup

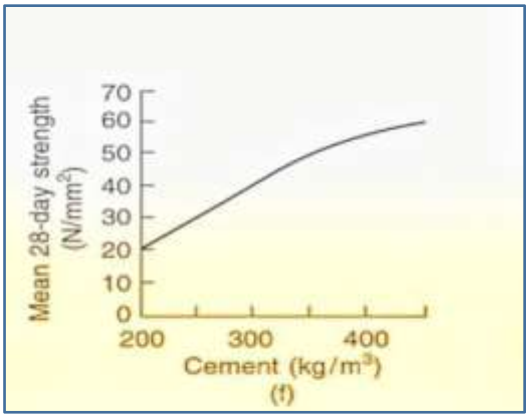
Fig:3 - Mixing Process

2.2 Material Calculation

Mold volume: 150 x 150 x 150 mm = 0.00348 mm3. The table below lists the quantities for each mold. 40 milliliters of foaming agent thoroughly combined with one liter of water is the foaming agent. Before the concrete is put inside the molds, they are lubricated with oil to stop the concrete from sticking to the mold. The concrete is then compacted into three layers by pounding each layer 25 times with a tamping rod. Following compacting, the extra concrete is scraped off, and a trowel is used to level the surface.

2.3 Mixing Design

In this investigation, 549 kg/m³ and 1149 kg/m³ LFC densities were produced. the mix ratios for the densities that were tested and those that were manufactured. The cement-to-sand ratio was maintained at 1:1.6, and the water-to-cement ratio of 0.46 was selected because it offered adequate workability.



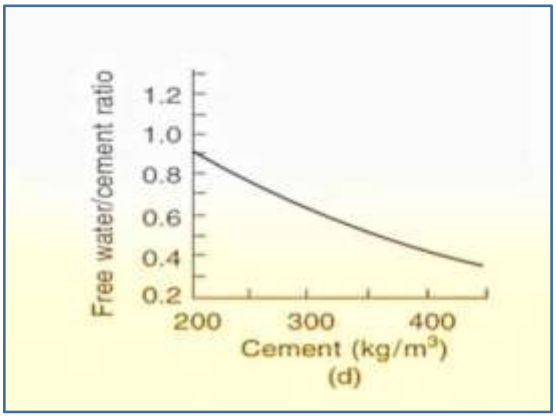


Fig:4 - Mean 28 -day Strength **Fig:5 - Water Cement Ratio**

- **Table 1**
- **Comparative analysis of the properties of lightweight concrete and conventional concrete.**

Sr. No	Study Parameters	Lightweight Concrete	Conventional Concrete
1.	Oven dry density	300 - 1999	2000 – 2400 kg/m^3
2.	Cube Strength	1.1 – 59 MPa	14 – 99 MPa
3.	Thermal Conductivities	0.4 – 0.99-1 W/mK	2.7 – 2.8 W/mK

2.4 Testing Methods

A density of 1000 kg/m3 was used. In order to achieve workability and other attributes, research was done to determine how much fly ash and GGBS should be added. Batching is carried out using manual mixing and weight batching in accordance with the blended proportions. Fly ash and GGBS are first thoroughly mixed and cured with cement. Sand is then added and dried once more to ensure adequate mixing.

a) Tensile Test

The split tensile strength of the air-dried LWC specimens was 7–9% of the corresponding compressive strength. The split tensile strength of LWC built with foam and expanded clay aggregate shows that the percentage of air voids rises as the foam value increases while the strength and density properties significantly decrease.

Additionally, a direct correlation between compressive strength characteristics and tensile strength was found. Higher ductility and flexural strength characteristics have been demonstrated by LWC constructed using produced aggregate. Compared to water curing and wet curing, LWC made with OPBC has a lower tensile strength performance after air drying. The splitting tensile strength in the damp curing state is 5–7% of the compressive strength.

b) Flexural Strength

When coconut shell (CS) was substituted for natural coarse aggregate (NCA), a stiffness criteria was lowered but the ductility factor was raised. Additionally, it was found that the flexural behavior of conventional concrete was the same when up to 50% of NCA was replaced with CS aggregate [15]. The flexural strength performance of Styrofoam aggregate with 15% NCA replacement was superior.

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➢ **Table 2**

Age of Concrete	**Flexural Strength (MPa)**	**% of 28-days strength**
7 days	2.1 - 3.7 MPa	68 – 72%
14 days	2.9 – 4.7 MPa	77 – 91%
28 days	3.6 – 6.2 MPa	99.15%

c) Compressive Strength Test

Fig:6 – Test In CTM Machine

Fig:7 – LWFC After Testing Table 2

Sr.No	**Compressive Strength Test**	**N/mm^2**
1	7 – days Strength	7.1
2	14 – days Strength	12.88
3	28 – days Strength	15.77

3. Result and data analysis

Concrete was put through four tests: heat, compressive strength, slump, and water demand. The water content decreased when fly ash and GGBS were introduced in small amounts, and it increased when the amount of manufactured sand increased. In addition to testing the consistency (flowability) of fresh concrete, the slump cone test is used to assess the concrete's workability. Details of the water demand and decline obtained are shown in

Mix ID	Fibre (%)	Density (kg/m³)	Compressive Strength (MPa)	Tensile Strength (MPa)
M1	0	1500	15.2	1.3
M2	0.6	1660	16.8	1.7
M3	1.1	1600	20.8	2.2
M4	1.6	1650	19.2	2.1

4. Conclusions:

Due to its affordability, lightweight cement has become more and more popular in the upcoming years properties. Furthermore, lightweight aggregate is a remarkable substitute for the typical (heavy weight) aggregate employed in Indian marketplaces since it can be used to load-bearing, non-load-bearing, and cast-in-place buildings. The Indian market has a huge need for LWC, and new regulations ought to be put into practice to promote increased use. They are very helpful in various purposes. with a density of 1000 kg/m3, EPS aggregate concrete has less compressive strength than traditional hollow blocks but more than clay bricks. Cement is substituted with fly ash GGBS by roughly 29.1%, hence lowering the density, shrinkage, and water content. Compressive strength is lost despite decreased density and shrinking. The results indicate that lightweight blocks should only be used in non- structural building because of their low weight and low thermal. With a lower density and weight than traditional concrete, lightweight concrete is a contemporary and practical building material. Its application lessens a structure's overall load, which lessens the strain on the foundation and may also result in decreased construction costs. This kind of concrete has good sound and thermal insulation qualities, which improves building occupant comfort. When the right mix design and curing procedures are followed, it can nevertheless provide sufficient strength even though its flexural and compressive strengths are marginally lower than those of regular concrete. To sum up, lightweight concrete is ideal for construction projects where weight reduction is crucial, precast structures, and high-rise buildings. Because it frequently makes use of lightweight and occasionally recycled materials.

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