EFFECTS OF BIODEGRADABLE MATERIALS ON CONCRETE PROPERTIES

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Abstract - This study aims to characterize the concrete block produced by the addition of the two natural waste materials i.e. sugarcane bagasse powder and egg shell powder. Disposing off these waste materials is a very challenging task and sometimes the sugarcane bagasse is a hazard to the environment also. The sugarcane bagasse, the egg shells and the jute fibers were collected locally from the cities of Mysore and Mandya, respectively. These raw materials collected i.e., the sugarcane bagasse and the egg shells were powdered and bought into the considerable form and checked for the basic materials testing like Specific gravity, Sieve analysis, Test for Bulk density, Test for Moisture content were done and the mix design was prepared; On the flow the concrete blocks were casted, cured for straight 28 days and the blocks were brought into the testing and the compression of the specimen was done and the natural raw materials were proven to be effective. In general, the overexploitation of natural sand has harmed many ecosystems, including soil and water, and disrupted the balance of life.

Key Words – Sugarcane bagasse powder(SCBP), Eggshell powder (ESP), jute fiber (JF).

1. INTRODUCTION

In order to enhance the qualities of concrete, several researchers employed various materials. These materials may be used in lieu of, in addition to, or as a replacement for fine aggregate in concrete. Natural sand is an appropriate resource for this purpose and is frequently used as a fine aggregate in the manufacture of mortar and concrete Eco-friendly behaviour is intentional living. The goal is to avoid interacting in a way that harms the environment. Natural sand has been overused in recent years, harming a number of ecosystems, including soil and water. To preserve the environment and recycle resources, it is essential to look for substitutes for natural sandstone. To reduce the use of natural resources, some waste kinds and other biodegradable products, such as sugarcane bagasse, eggshell powder, and jute fibre, can be recycled for renewable uses.

The accumulation of organic waste is one of the most serious problems facing in the developing countries. Getting rid of the wastes by dumping them in the waste land or burning and this effect negatively the environment. Moreover, these wastes attract a lot of insects when it is dumped and also effect the nature when it is burnt which produces harmful gasses which thread the public health and cause many diseases. The project intend is to merge the organic waste into construction industry and turn it into a useful cheap building material. In an attempt to reduce the initial costs of building material, sugarcane bagasse powder (SGP), eggshell powder (ESP) and Jute fiber as reinforcement materialis used as an additive in the structural cement blocks (bricks). In this present study, these materials are used as a partial replacement in fine aggregate as filler form and reinforcement form, and properties like compression strength and density test were determined.

2.Objectives

- Realising sustainability, minimising environmental consequences, and achieving progress in the direction of environmentally friendly recycled materials.
- The major objective is to decrease the use of sand and increase the use of biodegradable materials.
- Influence on the compression strengths of concrete blocks constructed with various material ratios.
- Comparison between conventional concrete blocks with concrete blocks made from jute fibre, sugarcane bagasse powder, and eggshell powder.
- To determine the optimum ratio for the materials.

3. MATERIALS

Cement: A binder, or substance that can bind other materials together and set and solidify, is something like cement, which is used in building. The two most crucial forms of cement are employed in the creation of mortar for masonry work and concrete, which combines cement with aggregate to create a study building material.

Fine aggregate: River sand is replaced by manufactured sand (M-Sand) for making concrete. Crushing hard granite stone yields manufactured sand. The crushed sand is graded, rinsed, and shaped into a cubical form with grounded edges for use in building. M-Sand is manufactured sand with a particle size of less than 4.75mm. An alternative to river sand is manufactured sand.

Coarse aggregate: Concrete requires aggregates, which are inert granular materials like sand, gravel, or crushed stone, in addition to water and Portland cement. Aggregates must be free of absorbed chemicals, clay coatings, and other fine contaminants that might cause concrete to degrade in order to make a suitable concrete mix.

Sugarcane bagasse powder : Sugarcane bagasse powder has been explored as a potential building material due to its renewable and sustainable nature. Bagasse is the fibrous residue that remains after sugarcane stalks are crushed to extract juice for sugar production.

Egg shell powder: A poultry waste with a chemical makeup that is almost identical to limestone is calcium-rich egg shell. Utilising eggshell waste in lieu of natural lime to substitute cement in concrete can reduce the amount of cement used, preserve natural lime, and reduce waste.

Jute fiber: Natural fibres are plentiful and inexpensive in jute. So, one of the key strategies for the advancement of concrete technology may be the coupling of jute fibre with concrete. The purpose of this study is to compare the findings with plain concrete blocks while examining the mechanical characteristics of jute fibre reinforced concrete with various combinations of fibre volume and length

4. RESULTS OF BASIC MATERIAL TESTING

Test on cement:

1. Fineness of cement is **4.0%**. according to IS 12269–1987 the fineness of cement should be<10%
2. Specific gravity of cement is **3.02**

Test on fine aggregate:

1. Specific gravity of fine aggregate is **2.65**, according to IS: 383-1970 Specific gravity of fine aggregates should be between 2.6 to 2.75
2. Sieve Analysis test on fine aggregates: fineness modulus is **3.22**

Test on Coarse aggregate:

1. Specific gravity of coarse aggregate is **2.71**, according to IS:383-1970 Specific gravity should be 2.7-2.9.
2. Average moisture content of sand sample is **1.37**, according to IS: 2386 part 3

Test on Eggshell powder:

1. Specific gravity of eggshell powder is **0.98.** As per IS: 4031-part 6 specific gravity of eggshell powder is 0.98.

5. MIX PROPORTION

1. Grade designation: 1: 6 ratio IS 2185: 2005 Masonry Solid Blocks
2. Type of cement: OPC 53 grade (JSW)
3. Max. nominal size of aggregate : 10mm
4. Exposure condition placing : Moderate
5. Degree of supervision: Good
6. Type of aggregate: Crushed angular aggregate
7. Type of Bio degradable materials : Sugarcane Bagasse Powder (SCBP), Eggshell Powder (ESP), Jute fiber of 2cm length (JF).

As per INDIAN STANDARD SPECIFICATION FOR CONCRETE MASONRY UNITS

PART 1 HOLLOW AND CONCRETE BLOCKS [IS: 2185 Part 1- 1979]

Mix Design 6.1.1 & 6.1.2

All of the materials are prepared and double-checked before The concrete mix used for blocks shall not be richer than one part by volume of cement to 6 parts by volume of combined aggregates before mixing.

Concrete blocks are frequently built using cement-sand mixtures in the ratios of 1:3, 1:6, or 1:9, with aggregates or often made of 1:6 concrete. **And aggregate no larger than 10 mm.**

In case of hand-moulded block where compaction is done manually, concrete mix should be sufficiently consistent to enable demoulding immediately after casting. The consistent to enable demoulding immediately after casting. The consistency of the mix to be friable, while too much water causes difficulty in the immediate withdrawal of the mould.

being considered for combining. The mixture has six different ingredients: CA, FA, sugarcane bagasse, eggshell powder, jute fibre, and water. Concrete is mixed using a machine called a mixer. All the ingredients are added one by one to the mixer, together with the calculated amount of water, to create the mixture. First, 10% and 20% of the fine aggregate are partially replaced with sugarcane bagasse powder, which is gradually added to the concrete and punched by a machine.

The concrete blocks casted with partial replacement of fine aggregate by 10 and 20% was failed. The blocks which was casted collapse before 24 hours itself, the blocks were not able to lift because 10 and 20% replacement was high. Then we decided to reduce the replacement ratio of the materials within 10%. And replaced with 3% 6% and 9% was done. The blocks of size 400*200*150mm size is casted.

The fig 1 shows the punching machine used for preparation of the concrete blocks.

Fig 1 Punching Machine used to prepare blocks.

The concrete is poured into the mould and filled properly and then aloud the machine to punch concrete into blocks. The blocks after casting is given in the fig 2 Concrete blocks after punching by the machine.

Fig 2 Concrete blocks after casting.

Concrete blocks are allowed to cure for a full day at room temperature. The specimens are then maintained for 28 days to undergo ambient curing. The strength of concrete will also be affected by the curing temperature. Concrete undergoes chemical reactions that lead to the polymerization process, which kicks off the curing phase. After that, the specimens are cured at room temperature.

RESULT:

Compression strength of blocks (SCBP).

Replacement of material	Compression strength
0%	25.51
3% SCBP	28.13
6% SCBP	27.76
9% SCBP	27.48

Table 1 Compression strength of the blocks. (SCBP)

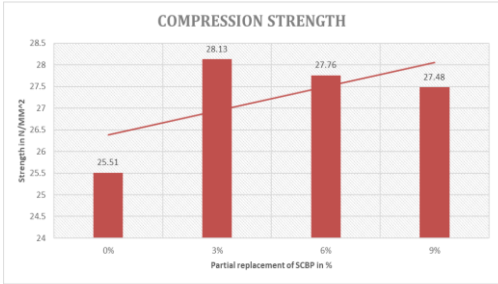

Fig 3 Compression strength of the blocks. (SCBP)

Compression strength of blocks (ESP).

Replacement of material	Compression strength
0%	25.51
3% ESP	29.21
6% ESP	28.35
9% ESP	28.31

Table 2 Compression strength of the blocks (ESP).

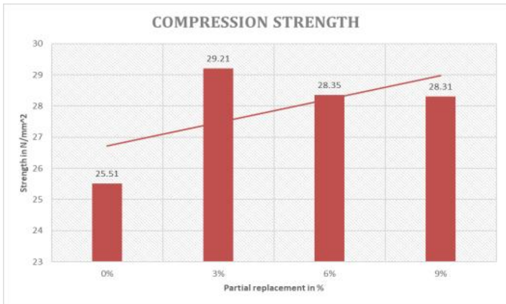

Fig 4 Compression strength of the blocks (ESP).

Compression strength of blocks (SCBP+ESP).

Replacement of material	Compression strength
0%	25.51
3% (SCBP+ESP)	29.69
6% (SCBP+ESP)	28.01
9% (SCBP+ESP)	27.99

Table 3 Compression strength of the blocks (SCBP+ESP)

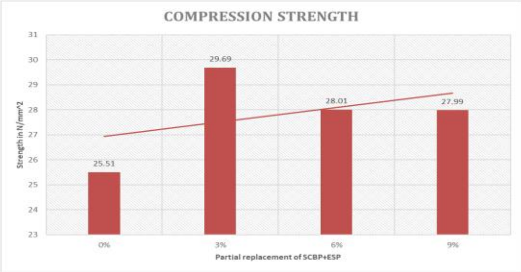

Fig 5 Compression strength of the blocks (SCBP+ESP)

Compression strength of blocks (JF)

Material added	Compression strength
JF 1% of length 2cm.	30.64
JF 2% of length 2cm.	29.84

Table 4 Compression strength of the blocks (JF)

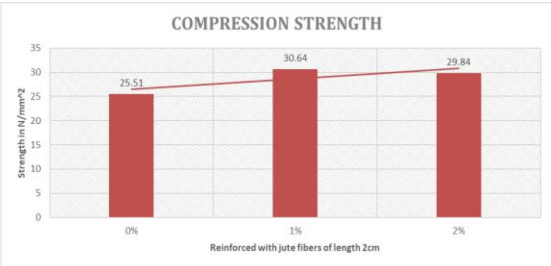

Fig 6 Compression strength of the blocks (JF)

6. RESULTS AND DISCUSSION

Compression test on concrete block

The strength of the SCBP blocks increased 2 to 4% more than the conventional blocks when the strength characteristics of the SCBP partly replacement blocks were compared to the strength properties of the conventional blocks. As a result of using biodegradable materials, these blocks can be considered green blocks in accordance with the project's fundamental premise. We can decrease the impact on natural resources by utilising these blocks instead of natural or mined sand. According to the results of the blocks' overall compression tests, we can observe that the strength of the blocks has not decreased relative to conventional blocks and actually increased to different extents in all concrete blocks that have used biodegradable components. By looking through the results, we could move on to using green concrete blocks then regular concrete blocks.

By doing this, we can lower the rate at which natural resources are used and protect them. Additionally, waste goods may be recycled to create affordable, usable building materials.

Density test on concrete blocks

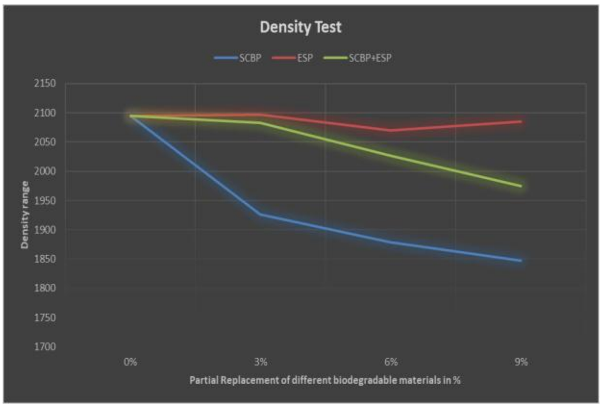

Fig 7 Density test

In the density test, the blocks' weights are lowered by 3–4% of all other blocks partially replaced with biodegradable materials when compared to conventional blocks. According to IS code 2185.1.2005, these blocks met the requirements for being usable building materials.

The SCBP, ESP, (SCBP+EGP), & jute fiber has the compression strength of concrete blocks with partial replacement of fine aggregate by Biodegradable materials (SCBP, ESP, and reinforced with jute fibers) at 28 days. The compression strength of the concrete is increased for all percentage of mixes up to 4-8%.

So we can replace this blocks to the conventional blocks due to its strength properties. By making use of these blocks, we may somewhat limit exploitation and sand consumption. Waste materials can also be utilized.

Discussion

The concrete blocks' compression strength is assessed after 28 days of curing. Two blocks of the test are conducted with varied amoun ts of partial substitution of biodegradable components. There have been four distinct block types examined. First, fine aggregate is replaced in part with SCBP. The second involves replacing fine aggregate with ESP in part. In the third phase, fine aggregate is partially replaced by SCBP and ESP.

Finally, a length of 2 cm of jute fibre in amounts of 1 and 2% is put to the concrete blocks. The blocks are cast, allowed to cure for 28 days, and then they are available for inspection. When the strength characteristics of the SCBP partially replacement blocks were compared to the strength properties the conventional blocks, the strength of the blocks rose 2 to 4% more than the conventional blocks.

According to the main tenet of the project, these blocks qualify as "green blocks" because they were made from biodegradable materials. By using these blocks in place of natural or mined sand, we may lessen the impact on the environment.

According to the findings of the blocks' comprehensive compression testing, we can see that the strength of the blocks has not reduced in comparison to conventional blocks and has actually grown to varying degrees in all concrete blocks made with biodegradable components.

We might proceed to utilise green concrete blocks rather than conventional concrete blocks by checking at the outcomes. By doing this, we can slow down the rate of resource usage and save the environment.

Waste products can also be repurposed to make cheap, useful building materials.

According to the density test, the weights of the blocks are reduced by 3-4% when compared to traditional blocks, with all other blocks having biodegradable components substituted to some extent.

These blocks complied with the standards for being useable construction materials as defined by IS code 2185.1.2005.

The compressive strength of concrete blocks with partial replacement of fine aggregate by biodegradable materials (SCBP, ESP, and reinforced with jute fibres) at 28 days is depicted graphically in Fig. 4.1 SCBP, ESP, (SCBP+EGP), and & jute fibre. For all percentages of mixtures up to 4-8%, the concrete's compressive strength is enhanced.

As a result of this block's strong characteristics, we may replace traditional blocks with it.

Table 2 of the IS code 2185 (Part 1) physical requirements The year 2005 highlights the dependability and suitability of concrete blocks as a building material.

We can considerably reduce exploitation and sand usage by using these blocks. Materials from waste can also be used.

CONCLUSION

The concrete blocks that were cast with more than 15% partial replacement failed. SCBP utilisation is hence down to less than 15%.

The high replacement ratio of sugarcane bagasse powder decreased the compression strength of blocks, whereas the low replacement ratios enhanced the compression strength. With a partial substitution of 3% of SCBP, ESP, and SCBP+ESP compared to ordinary concrete blocks, the compressive strength of the blocks increased to 3-4% of the typical strength of concrete at 28 days. The limited use of the Sugarcane bagasse powder less then 20% gives good strength. The strength of the concrete blocks replaced with eggshell powder 3% and 6% was increased to 3 to 4%. The high replacement of eggshell powder may cause effect on workability. Addition of both SCBP and EP will also give good strength for the concrete blocks, 3-4% more then conventional concrete blocks which achieves good result. Jute fibres are added to concrete blocks in lengths of 2 cm in proportions of 1 and 2%, the fibres act as reinforcing material in the blocks and, when the blocks were tested, the compression strength was improved to 3-8%.Due to its capabilities as reinforcement, fibre blocks helps to reduce the occurrence of fractures in constructions. As per the IS code reference these blocks can be used for the construction of load bearing walls. We may use this block in place of conventional blocks due to its great features.

SCOPE OF FUTURE STUDY

Further by replacing sugarcane bagasse powder, eggshell powder in different ratio like 5%, 10% and 15%.Adding of jute fiber with different ratio of SCBP and ESP may give good strength.

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