STUDY ON MYCEILUM BRICKS

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ABSTRACT:
-There is an increased need to find sustainable building materials for the construction industry as we are growing through global warming, eradication of natural resources, fossil fuels. We need building materials that consumes less energy in their life cycle process. One of the contemporary and most budding are the mycelium brick. A mycelium brick is an organic brick that is found from organic waste and the mycelium of fungus. . the outgrowth of Mycelium are the thin root-like fibers from fungi which run underneath the ground, when dried it can be consumed as a super strong, water, mould , fire-resistant building material .it will grows at room temperature. It feeds on natural local feedstock like husk wheat, corn stock, etc., and it can be naturally developed into a fibrous hardened block of Mycelium material. intergrating such natural organism behavior as innovations in architecture and design will provide a new approach to composite materials, moving towards a more imperishable future. These fibers are transferred into the layer,let it to grow for few days. Its fibers are further condensed into a mould to form a brick. This brick is burnt to get a strong green building material called Mycelium brick.it has more compressive strength then concrte brick,which is quite good point for converting for myseillum bricks
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KEYWORDS:- Mycelium bricks, Mycelium fungus, Termite,fire,water,resitant,rigid than oridinary concrte bricks,root like fibre grows on room temperature

1. INTRODUCTION:-

Production of construction materials consumes energy and pollutes water,air,land.Due to high requirement of energy leads to manufacture the highest levels of insulation, higher density Amaterials,advanced technologies to utilize. Building insulation takes an major role in devolping thermal comfort, health,pollution and reduces the heating and cooling energy consumptions,emissions of carbon. Insulation materials is produced by fossil fuelbased ,minedmaterials.To find alternative way to go ecofriedly. The rapid growth of global population have been resulted in increasing food demand, growing agricultural output, give ways to the initation of agricultural by-products and its wastes such as sugarcane bagasse,straw, rice husks,stover, cotton stalk . We have chosen three species of

basidiomycete fungi and used those to grow mycelium bricks on straw waste.The fibrous growth of filamentous fungi (mycelium) had attracted commercial concerns over the past decade as a new form of low energy bio-fabrication, waste recycling.Mycelium binds through a network of hyphal micro-filaments during a organic process ready to be utilizesupply low-value materials, higher-value materials with little or no commercial value. Mycelium-derived materials has many advantages than traditional synthetic materials including their cost-effective, density,energyexpenditure,in addition to their environment-friendly and energy saving,carbon footprint. The ongoing application of mycelium materials, primarily stemming from their natural foam-like mechanical properties, high water absorption. These limitations make advanced research and development of these materials necessary applications, such as insulation, flooring, door cores, panelling, cabinetry and other furnishings.

Figure 1.

2. FUNGI SPECIES AND GROWING PROCESS

A.VITAL INFORMATION ABOUT THE FUNGI

The realm of Fungi is a diverse kingdom, with parts of the phylum Basidiomycota.It include mushrooms,puffballs,stinkhorns,rusts,smuts. Basidiomycetes has been studied as promoter of wood decay. Basidiomycota is basically filamentous fungi composed of hyphae. In the past, most research have focused on clarifying the mechanisms of lignocelluloses degradation both in an ecologically and harmful effects of fungi in wooden buildings.

3. MATERIALS:-

The binder for the brick is produced from mycelium. The materials used for the mycelium arerice and sugarcane bagasse. The matrix that the mycelium binds are the underneath Rice bran(RB), saw dust(SD), and coconut husk (CD). A control specimen, clay (C) brick has produced, which are also a common building materials. The RB design mix consists of a ratio of 5:2:1 by mass

for C:RB:CH with 350 mL water put on to the mix. The SD mix consist a ratio of 5:3:1 by mass C:SD:CH with 450 mL of water put on to this mix. The C mix was red brick production with varying water to attain a workable mix. Sugarcane baggase ingredients were economically available, while the RB and CH were purchased from local farms ,factories and SD was brought from lumber wastes. In addition, paper, two (2) plastic containers, and airtight wrappers were also gathered. The steel brick mold which has the dimensions of 200 mm length × 90 mm width × 60 mm height. The mold consists of 4 bricks. After setting it with 33 days of incubation, a laboratory oven (kept at 110◦ to 115 ◦C for not less than 24 h) is used for drying and it prohibit futher growth of the myceillum

FIGURE .2 HYPAE

FIGURE 3

Clay (C) and Coco Husk (CH) retained as the constant ingredient to the substrate in the four design mixe with agricultural wastes. Sugar Cane Molasses (SCM) is make used to act as the mycelium in serum form to the researchers to safe handle later add the mycelium to the substrate mixes. RB was take on as a substrate material with the intention of getting a rapid growth in material and acted as an additional filler material and stabilizer to the substrate. Hardwood Sawdust (SD) is economically available waste material produced from wood workshops and construction sites which were sieved to smaller particles.Coco husk is collected from coconut farm. In mix design, CH is used as an extra substrate for mycelium nutrients for growth.

(a) (b)

Figure.4. mycelium substrate production.(b)brick mold.

4. PROCESSING:-

The methodology starts with the accession of the mycelium fungi from underneath a bamboo shoot. One kg of rice in a plastic container. The first main substrate buried below the soil near the bamboo shoot. The container was left under the bamboo shoot for five days. This is the basic step to allow the substrate to hold the fungal tissue. After few days,the mycelium will be separated by the researchers from the rice substrate. After the separation the mycelium has mixed with 1 L of sugarcane molasses (SCM) which are stored in a 1.5 L PET bottle.Then there will be a inoculation period of five (5) days in constant room temperature, before it is ushe brick production as a mycelium serum.

FIGURE.5

TABLE 1

Specimen Mix Designation	Ratio by Mass	Added Water (ml)	Mycelium Serum	Number of Specimen for Each Test	Number of Specimen for Flexural Test
Rice Husk Bricks (RB)	5:3:1	350	Without	4	4
Rice Husk with Mycelium Bricks (RBM)	5:3:1	350	With	4	4
Sawdust Bricks (SD)	5:3:1	450	Without	4	4
Sawdust with Mycelium Bricks (SDM)	5:3:1	450	With	4	4
Clay Bricks (C)	5:3:3	Variable	Without	4	4
Clay with Mycelium Bricks (CM)	5:3:3	Variable	With	4	4

The researchers ordered the substrate design mix depends on material availability and from the waste substrate used for mycelium growth. Mass are taken for the basis of design mix ratio. Sieve no. 150 µm are used to achieve the particle size of Saw dust,coconut husk.. Water taken in all substrate mixes are distilled water. The agricultural wastes are mixed to form the substrate manually ..Mycelium serum of 1 tblespoon for one kilogram of ingredients will be using for the mycelium serum-substrate ratio. After mixing, the mycelium bricks are placed in mold and stored inside a room with constant temperature and no sunlight at a for a period of 25 days incubation. . During incubation period, the weight of the bricks specimens will be recorded daily til all the mechanical tests are performed. After that, the mycelium bricks are oven-dried for 1 day in order to stop the growth of the mycelium in the bricks. The temperature ranges used in the oven for drying the SD,RB, SDM,RBM bricks is 110 to 115 ◦C, while oven-fired bricks for C , CM observes a minimum temperature of 900 ◦C and maximum of 1100 ◦C.Additional four days were allowed to so that the brick get harden oven dried.another for were for the curing period.total no of production of bricks from the the initial stage is about 34 days. . Compressive test and flexural test will be taken place after the production of the bricks after 34 days. The universal testing machine (UTM) will being used to administer mechanical tests.

FIGURE.6

5. WEIGHT AGAINST AGE:-

The weights of the specimens for compressive test at the 34th day are noted regularly and graphed against the number of days. The weight of the mycelium bricks is always higher than the non-mycelium bricks,it denotes that the additional weight is the presence of mycelium. Since it is hard to find out the mycelium content inside the brick. CM bricks has the highest weight, continued by C, RBM, RB, SDM, and SD. The moderate difference of weight between CM and C bricks is 12.25 g, while SDM and SD bricks sustain the highest difference at 57 g. Finally,the difference between RBM and RB bricks is 29.75 g. Clay bricks makes less estimated mycelium content, while SD bricks gives the highest mycelium content.

6. COMPRESSIVE STRENGTH:-

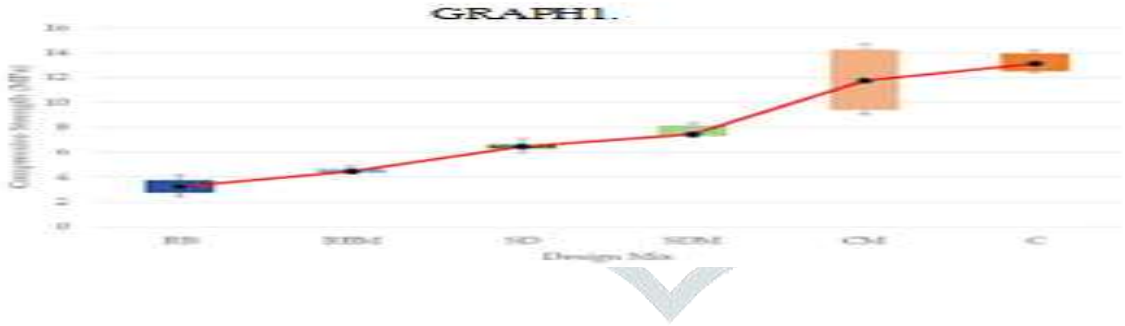
The strength test results of the mycelium-induced bricks and traditional bricks were obtained. Four specimens of each design mix are tested for compressive test. From the test, all the mycelium-induced brick specimens attained the 3.5 MPa minimum compressive strength for masonry bricks., The majority average values of compressive strength for bricks without mycelium attained the minimum requirement with the exception of the RB specimens. The highest compressive strength test results are seen in the C and CM design mixes. In the results, they found that there is a 38.5% increase in compressive strength from RB to RBM mixes. For the SD to SDM mixes, there is an increase of 31.0% in compressive strength. The presence of mycelium can be a reason to be the prevailing substance that caused the increase in strength of the bricks. It acts as bio-composite binder or fibrous-binding material or stabilizer which increased the capacity of the mycelium-induced bricks. The mycelium-induced bricks are appeared to be more ductile as compared to the regular mix bricks without mycelium. It can be seen specifically in the RBM and SDM bricks particles did not entirely collapse or had been crushed, and it remained intact with very less cracks after the test. Figure shows ,the box and whisker plots of the six design mixes of the specimens compressive strength results. Its from top to bottom, the supreme value as the top whisker, first four mix as the top of box, median as the circle, third quartile as the bottom of box, and the least value as bottom whisker. The design mixes are organized left to right from minimum to utmost median. It could be detected in the figure that the difference of SDM,RBM RB, SD is small (less than 2 MPa) compared to CM and C. The greatest difference is seen in CM, in the meantime there were minimal mycelium present, an average of 12.25 g at 34 days, leading to few and unreliable mycelium fiber networks present in attaining cohesive and improved compressive results.

FIGURE.7

7. FLEXURAL STRENGTH:-

The usual values of total midpoint displacement and flexural strength. Four specimens are tested for each design mixes. The equation for the flexural strength of the brick specimen The self-regulating load variable P is gained during the flexural strength test at failure. The brick dimensions per specimen are measured and used in the totaling for flexural strength. SDM specimens are found to have the flexural strength value at 0.473 MPa, though its average maximum midpoint displacement is at 2.937 mm. It attained developed displacement than the brick without mycelium, due to the fibers. RBM gained the highest force as related to the other specimen mix designs with mycelium. Its verified that the growth of mycelium is active in rice bran as substrate.

GRAPH1.



8. WATER ABSORPTION TEST:-

Two bricks one of each merge (Hemp and Aspen) are used. Water Absorption test in masonry is to verify its moisture content and durability. It is used to fix the rate of absorption of water by the Mycelium brick, by measuring the rise in the mass of the specimen. In masonry, it is projected to determine the defenselessness of an unsaturated concrete to the saturation of water. In research, we drenched two bricks (one Hemp and one Aspen blend) in a plastic bucket full of water and set a weight on top of it to avoid the bricks from floating upwards due to buoyancy. The bricks weight are recorded before and after soaking into water. At the end the bricks soaked were cast-off and mixed the soil in the garden .We soaked Brick A4, Aspen blend, grown and Brick H1, Hemp blend, deformed mechanically after being tested under the UTM for Compression test.

FIGURE.8

9. BENEFITS:-

The progression of producing with mycelium brings a huge saving in consuming fossilfuels. The vital energy for fabrication is small and there is a massive reduction in construction waste. The product is 100 percent decomposable and can be used as soil. Bio fabrication is a carbon neutral building.It can eradicate artificial insulation in walls, use of particle board and other non load bearing structures. Mycelium bricks can be termite proofing.The result is a mushroom brick that can be 200,000 times softer than steel, 10,000 times less rigid than traditional housing brick, but capable of holding 50 cars.When they placed together in a few hours, the material joins together. The growth will be stopped when the specimen is dried, generated rigid material which can be polished and painted. The mycelium bricks is bullet proof and absorb carbon dioxide, making them a workable material for the construction of our upcoming buildings.

FIGURE.9

10. APPLICATIONS OFMYCELIUM

- For Interior construction will be used as an interior featurewall.
- Low-costHousingstructuresexploitlocalmaterialsandcheaplabor.Nospecialexpertiseequipmentare needed. So Mycelium are be used as an excellent substitute material for low cost housing.(Even so, the living conditions,safety of people living inside sstructures over a certain duration of time needs to be examinedfurther).
- Computational Design and Fabrication Mycelium blocks can becustomized
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FIGURE.10

11. CONCLUSION:

Mycelium is a growing material, its one of the most hopeful future industries in the world. Mycelium could bring a huge change in construction industry and transform the commerce because of its maintainable design practices. The making of bio-composite mycelium bricks as maintainable construction building materials using agricultural waste. There are six design mixes consisting of rice bran (with and without mycelium), sawdust (with and without mycelium), and pure clay (with or without mycelium). Based on Indian Standard IS1077, all the brick design mixes with mycelium touched an acceptable average compressive strength result. the minimum requirement of 3.5 MPa. SDM ,RBM attained a higher compressive strength, compared to their non-mycelium equals with an impressive increase of 38.5% and 31.0%, respectively. The accumulation of mycelium in the flexural test improves the ductility of the brick specimens by making fewer cracks. The mycelium contented at 34 days of age increases from the design mixesSDM, CM, RBM. It displayed that when the mycelium content increases, the dimensional change increases. A presence of fiber seen in the stereoscopic microscope, which showed the natural fibers from mycelium acted as a binder to the building material. The cost of making of a single Mycelium brick is lesser than the conventional masonrybrick.

Conventional bricks use non-renewable resources at the end of their cycle release the hazardous pollutants Mycelium is a cradle to cradle method, the materials used for its industrial process could be recycled or taken back to Mother Nature a circular life cycle.

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