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Building the Future with Earth – Herbarium CSEB as a Modern Self-Insulative, Eco-Friendly Material

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ABSTRACT

Many types of analysis were undertaken in sustainability and passive energy, Reduction in Carbon emission and cost-effective style in summer cooling, it's like rather than the usage of AC these days because of climate weather modification even this year and in coming years I needed to visualize whether or not the CSEB material is actually replacing AC system for a sustainable future. the rise of a movement against non-eco-friendly practices nowadays has woke up us to adapt to and incorporate practices that are pro-earth. we've got realized that the smaller steps taken nowadays, have a larger impact on our tomorrow. green practices within the housing industry will contribute towards a more robust and greener tomorrow. Construction using CSEBs is one in every of the various ways in which we are able to resort cut back the negative impact on mother earth. In this study, the effect of bulk viscosity and cement content on the thermal conductivity of cement- stabilized earth block CSEB is delved . Experimental results show that thermal conductivity increases with bulk viscosity. Changing the cement content slightly changes the thermal conductivity of CSEB at a specific bulk viscosity. No clear direct relationship was observed between thermal conductivity and cement content in CSEB. still, the CSEB compressive strength increased significantly with cement addition. Also, the compressive strength of CSEB increases as the cement content increases. CSEB shows pledge in earthen structures due to its increased compressive strength and reduced thermal conductivity.

Keyword: Eco-friendly, Herbarium CSEB, Effective thermal comfort, Indoor thermal conductivity, passive material making, Herbs – Henna, Traditional techniques, Adobe earth blocks, Natural material.

INTRODUCTION

In the growing energy and ecological problems, the thermal comfort of building materials is an important issue, and modern construction is paying more attention to the thermal performance of buildings than in the past. It draws attention. As a building fabric, brick has amazing 'thermal conductivity'. 'Thermal conductivity' depends on the density and moisture content of the fabric. Therefore, the estimated heat conduction cost can be determined using experimental and theoretical strategies. Bricks made of press-stabilized soil showed better thermal conductivity compared to bricks made of fired clay. My analysis ison how this property adobe/compressed stabilised earth block material reduces indoor heat transmission from the wall (cseb) and the way to form comfort inside using adobe material i.e., to bring less Thermal conduction out of my new combination mixtures added to CSEB. They consist of dry mineral soil, non-expanding clay, aggregate and 'Portland cement'. CSEB is an 'environmentally friendly alternative to the clay bricks currently used in most residential buildings in India'. These presses can produce regular blocks of different types and sizes that are denser, stronger, more waterproof and safer than regular adobe. many styles since then machines and many laboratories are specialized and It is delicate to determine the foundation of a building. Many countries in South

America, Asia and South Asia as well as several countries on the continent use this technology heavily. Wet or stabilized soil for compacted earth blocks is lightly moistened and poured into a steel press where compaction by manual or motorized presses can be compacted into a variety of shapes and sizes. Compression ground blocks can be stabilized or unsterilized. However, in most cases it is stabilized with cement or lime. So, these days I prefer to call it a compression stabilized ground blocks.

1.1 GENERAL CSEB STUDY

Compression Stabilized Earth Block (CSEB) is made from local soil mixed/stabilized with a small amount of cement (up to 5%), sand and water. Made from local soil, they offer a sustainable alternative to fired clay bricks/cement blocks. These blocks are pressed in a press (manual or electric) and cured for 28 days to achieve the desired compressive strength. Auroville developed a machine "Auram Press 3000" for the production of these blocks and offers 80 different blocks in 18 different shapes. Blocks can be solid, hollow, round or custom, depending on the application. These blocks can also be used to create columns, floors and roofs. The fertile topsoil is removed and the deeper soil is mined as the main raw material for block production. Depending on the characteristics of the local soil, the building mixture is prepared from local soil, cement, sand and water, which are then poured into molds through a press to obtain blocks of the required strength for each application.

CSEB can be made anywhere in India using Auram press 3000. Not all soil types are available for his CSEB. Before producing bricks/blocks, a soil survey must be carried out. Currently operating in 38 countries around the world, and more than 13,000 of employees in 92 countries are trained in earthwork by Auroville. This is a fair measure of the environmental impact of a building material or system. The initial embodied energy of CSEB is generally lower than that of other building materials. CSEB is an eco-friendly product that does not require calcination and requires only 4 weeks of cement stabilization period. Reduce manual and ground transportation and production.

1.2 MATERIAL BACKGROUND STUDY - CSEB BLOCKS HISTORY

The first attempts to compress earth blocks were made in Europe in the 19th century. Designer He Francois Quantero created small blocks of broken soil and used a pole to compact the moist soil into the shape of a small, low tree that could be manipulated by foot. In the 1950s, the main steel produced in the world was his hand press, and he was a breeze. This was the result of Colombia's public housing development research program to improve hand-formed and sun-dried bricks. CSEB is a tough material with an average dry compressive strength of 7.5 MPa and up to 09 MPa for Auroville. Wet compressive strength 03-04 MPa - after 24 hours of soaking.

The selection of a suitable soil stabilizer for a soil block depends on the volume and structure of the soil. Cement is preferred for linen flooring and provides fast and high strength. Lime is used more often in silty soils, but it still takes time to harden and form strong blocks. Benefits of CSEB includes

Inexpensive, Energy efficient Structural strength, First class form

Non-toxic, Biodegradable

Acoustic, Flame retardant and Insect resistant aesthetic and Adaptable reduction of deforestation social responsibility to support plant growth.

1.3 GENERAL STUDY ON 2-HYDROXY-1,4-NAPHTHOQUINONE (LAWSONE) - HENNA.

"Naphthoquinones " is a natural color in nature and has important biological functions. 'Lawsone (2-hydroxy-1,4-naphthoquinone)' and its synthetic products, especially nitrogen-containing derivatives, have antibacterial, antifungal, antibacterial, medicinal Pesticides, disinfectants and other activities, 'insecticidal' effect. Its pharmacological properties and mechanism of action relate to "oxidation/reduction and acid/base", which can be modified by adding modifiers to the "1,4-naphthoquinone ring". For this reason, "naphthoquinone and its derivatives" have always been the target of many studies. Lawson also wants to absorb "ultraviolet rays."

Henna has natural cooling properties. People used to make a paste from dried and crushed henna leaves and dipped their palms and soles into it to relieve the scorching heat. This helped the people of the desert. Henna also called mehndi has been considered an art since ancient times. Over time its prevalence has taken many forms. Over 9000 years ago, it emerged in the culturally rich heritage of India, Pakistan, UAE, Africa and the Middle East. For centuries, henna has been used to regulate body temperature. Henna was used by people to awaken them spiritually, as it was believed to make them more aware of the earth's energies.

1.4 NEED FOR THE STUDY

To identify & give out a solution for the reduction of indoor heat gain in a building by achieving thermal comfort with holistic living during all the season at tropical
Zone. To test which combination with CSEB could be more stable and also bring out a solution for the reduction of indoor heat gain in a building by achieving thermal comfort with holistic living during summer season at tropical Zone.

Major concern was additional awareness of how the human body experiences atmospheric conditions, such as air temperature, humidity, wind and radiation. The study was introduced to review regarding different sustainably strong material, and additionally bound techniques accustomed to attain the passive style. This research is on how does this sustainable adobe/compressed stabilised earth block material reduce indoor heat transmittance from wall (cseb) and how to make comfort indoor using adobe material, parallelly to analyse the surface temperature of all directions and natural lighting with variations in building, and wind flow at each direction indoors.
The research was to bring in Calmness and mindfulness of public with senses like Sound, more of visual comfort indoor and outdoor with the material. Create awareness of inexperienced infrastructure and domestically available materials. Minimizing space between human and nature i.e, more of landscaping or gardening, farming inside the building to tackle the additional heat gain along with
the CSEB material.
This press could get regular blocks in form and size, denser, stronger and additional water resistant safe than the normal adobe. Since then, more forms of machines were designed and plenty of laboratories got specialised and delicate to spot the soils for buildings.

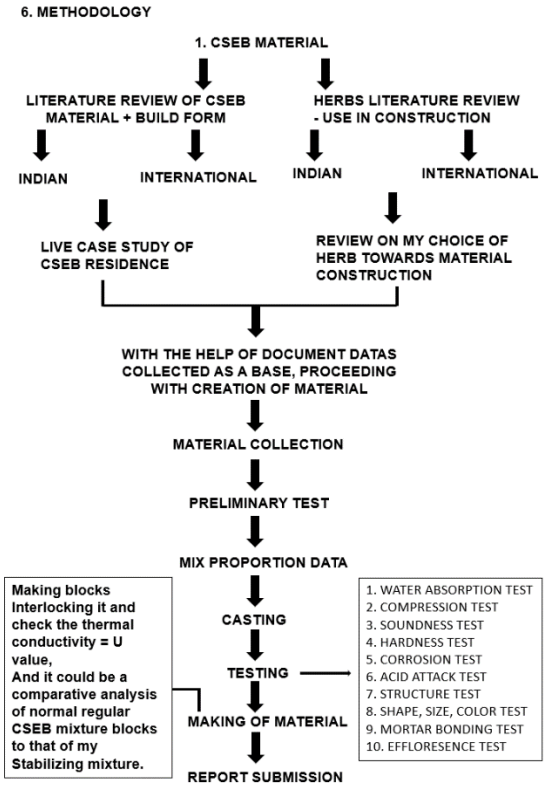
1.5 FACTORS CONCERNING CSEB SUSTAINABILITY AND ENVIRONMENTAL FRIENDLINESS OF CSEB

The soil will be natural and the best soil has been mined locally or not transported over long distances. CSEB emits 12.5 times more carbon than the country's baked brick. CSEB has 10.7 times the country's brick-firing energy. It is an electrical and electronic product. Labor costs for CSEB production range from a quarter to a fortieth of the total cost. This encourages inner development.

1.6 SOIL QUALITY & STABILIZATION FOR CSEB & COST EFFICIENCY

Not all soils are suitable for underground work, especially CSEB. It is important to remember that vegetative soil and organic soil should not be used and the characteristics of different soils are important to obtain the required properties. After a short training session some basic tests can be done. Cement stability is better for sandy soils. Lime stability is better for clay soil. The choice of stabilizer depends on the quality of the ground and the requirements of Clause. Cement will be suitable for sandy ground and will increase
strength more. Lime is better for clay, but
takes longer to harden and form a block. CSEB is generally less expensive than
fired brick and stonework.

2.0 METHOD



Firstly, I searched for the sustainable materials which are locally available., which proceeded with the Traditional old adobe-built houses under vernacular architecture, and then I checked how adobe blocks could be further bought up into this generation as a modern and beneficial material, found that already CSEB is doing good at thermal comfort of people who live inside and so I proceeded with my research on introducing herbs in CSEB.

2.1 MATERIAL STUDY

SOIL SAMPLES

There are 56-60 different sub soils in India which is been identified and kept at Auroville.

Fig. SOIL SAMPLES IN INDIA

There are 182-190 different types of sub soils in India which is been identified and kept at Auroville.

Fig. SOIL SAMPLES AROUND WORLD

2.2 BHARATHI CEMENT PPC

Portland Pozzolana Cement (PPC) is a premium composite cement made from the highest quality limestone using a new generation technology from Germany in accordance with international standards. Cement is produced by grinding high-quality clinker into high-quality highly reactive silica (HRS). It is collected in an electrostatic precipitator (ESP) and contains high quality gypsum.

Hydration of mixed cement

Ordinary Portland cement + water → C-S-H gel + Ca (OH)2 (alkali)
Highly reactive silica (HRS) + alkali → secondary gelation

Refinement occurs, making the concrete more impermeable to sulphate and chloride attack. This increases the durability of concrete structures.

2.3 FLY ASH

Silicon Oxides, Aluminum Alloy, Calcium Oxides, Magnesium, Potassium, Magnesium, Titanium, Sulphur.

These are also seen to a lesser extent. Used as a mineral aggregate in asphalt, fly ash is classified as either Class C or Class F based on its chemical composition.
Class C ash is generally derived from subbituminous coal and is composed primarily of calcium sulfate aluminum glass, quartz, tricalcium aluminate and free lime (CaO).
Class C ash is often referred to as high calcium ash because it typically contains up to 20% CaO.
Class F ash is typically derived from bituminous and anthracite coals and is composed primarily of aluminosilicate glasses, including quartz, mullite and magnetite. Class F or low calcium ash contains less than 10% CaO.

Fly ash in concrete makes good use of Portal cement hydration products. Both the calcium hydroxide solution and the alkali hydroxide solution released into the porous system of the paste mix with the fly ash particles to form cementitious media. The heat generated by hydration of the portal cement is the key factor initiating the fly ash reaction. When ash-bearing concrete is fully cured, ash-bearing reaction products occupy the interstices between hydrated cement particles, further reducing the permeability of concrete to water and harsh chemicals. The slower reaction time of many fly ash compared to Portland cement limits the extent of early heating and detrimental early heating of large structures. Proper dosing of the fly ash mixture provides concrete properties that cannot be achieved with Portland cement alone. Fly ash is also a cheaper alternative to Portland cement in some countries. fly ash is often referred to as an environmentally friendly material because it is a by-product with low energy content, which is an indicator of the amount of energy used to process and transport construction materials. On the other hand, Portland cement is, which requires a lot of heat to process, so it has a very high energy.

fly ash has less moisture than Portland cement, making it easier to use in cold climates.

Various scheduled occurrences.
Cold resistance.
High strength can be obtained depending on the application.
Can be used as an admixture.
Considered a non-shrinking material.
Generates thick concrete with smooth surfaces and sharp details.
Great opportunity to operate.
Reduces cracking, permeability and bleeding issues. Reduces heat of hydration.
Allows lower water-to-cement ratios with comparable slump values compared to non-fly ash mixes

2.4 LIMESTONE COMPOSITION

Chemical Composition - Lime is made from natural limestone by firing the quicklime in a kiln until only calcium oxide remains. Next, make slaked lime by mixing quicklime with a little water. It can be mixed with cement or used as a mortar with
water. Lime gradually absorbs carbon dioxide and hardens, turning back into limestone over time. Cement contains a highly reactive siliceous compound that hardens rapidly when mixed with water.

Physical strength - Lime hardens more slowly than cement mortar, which makes it easier to work with. Lime is less brittle and less prone to cracking; cracks can absorb carbon dioxide and heal within an hour. Cement sets very quickly, but can be too strong for some applications. B. Used to discard old bricks.
Once the structure is cured, the cement can also break and eventually cure.

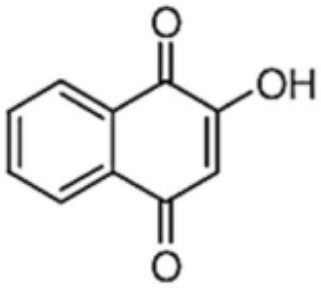
Lime is a calcium-containing mineral containing oxides and hydroxides, usually calcium oxide
and/or calcium hydroxide. It is also the name of
calcia, a product of coal seam fires, and
altered limestone xenoliths from volcanic eruptions. The word lime comes from its original use as mortar, meaning sticky or sticky. This material is also widely used in building materials, engineering materials, chemical products, confectionery and other materials.

The many uses of lemon work and lemon-derived products date back to prehistoric times in the old and new world. Lime, together with ferrous sulfate, is widely used in wastewater treatment. The rocks and minerals from which these chemicals are derived are usually
limestone or chalk, usually calcium carbonate. They can be cut, crushed or crushed and chemically modified. These minerals are burned (calcined) in the lime kiln, the highly abrasive quicklime is converted to calcium oxide of quicklime or quicklime, and then to which is less abrasive but still very alkaline.

Add water to slaked lime or hydrate. Lime is calcium hydroxide, Ca(OH)2) and the process is called slaked lime. When the time appears in the context of agriculture, it usually refers to the lime farm, which is the residual crushed limestone rather than the product of the lime kiln. Otherwise, it is usually slaked lime, as the most dangerous form is often called quicklime.

2.5 CHEMICAL COMPOSITION OF HENNA

Henna sheets contain a chemical
called Lawsone or 1-Hydroxy
Naphthoquinone, many phenolic
glycosides, coumarins, conoids, xanthones, beta-sitosterol glucosides, luteolin, resins, tannins, 0-from fats. Contains 7 glucoside extracts. Other compounds extracted from leaves include
gallic acid, 1,4-
naphthoquinone, laxanthone, acacetin-7-0-glucoside, and some alkaloids.



HNQ

Fig. CHEMICAL FORMULA OF HENNA

Phenol is found in small amounts in cosmetics, paints, varnishes, adhesives, varnishes, polishes, and solvents. A maximum of 2.5% is allowed for EU consumers and a maximum of 1% for soaps and shampoos. It is also found in bacon, smoked fish, and desserts.

Resins are commonly used as adhesives, coatings, or household products that require a permanent bond. For structures made of glued timber, for example. This resin is also widely used for decorating self-leveling floors and construction surfaces where the material can be used.

Gallic acid is a well-known antioxidant and major polyphenol secondary metabolite. Gallic acid is a very important antioxidant known as an Ayurvedic herb. In addition to its phytochemical effects, gallic acid is also used in leather tanning, ink dyes, and papermaking.

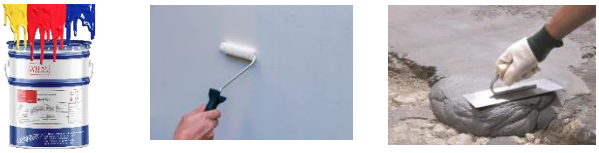


Fig. HENNA POSSIBLE COMPOSITION USES

3. MIX ELEMENTS AND PRELIMINARY TEST RESULTS

PROBLEM STATEMENT

How to reduce indoor heat transmittance from wall (exterior-interior) and how to make less thermal conductivity using adobe CSEB material along with mixture of henna paste, tamarind juice/pulp.

PROBLEM SIGNIFICANCE

Reduction of internal transmittance/heat from the outdoor surface to that of indoor.

3.1 MIXTURE COMPONENTS FOR CREATING MY MATERIAL

Mehandi or the Henna leaves are typically best-known to several folks for its usage for aesthetic purpose, however it really additionally incorporates a main property of cooling result individuals normally apply these leaves mix to chill their whole body temperature therefore i thought why not attempt it with CSEB in order that we might attain a lot of thermal comfort within a residence/building being a herb that additionally adds up strength to the material together with lemon/tamarind juice, fly ash, sand, clay, opc/ppc etc

3.2 PRELIMINARY TEST OF HENNA

XRD test was carried out as preliminary test and the peak at °2Θ starts from position 12 indicates good position as peak ranges starts from 4-35.

Fig. 3.1 MIX COMPONENTS

3.2 PRELIMINARY TEST OF HENNA

XRD test was carried out as preliminary test and the peak at °2Θ starts from position 12 indicates good position as peak ranges starts from 4-35.

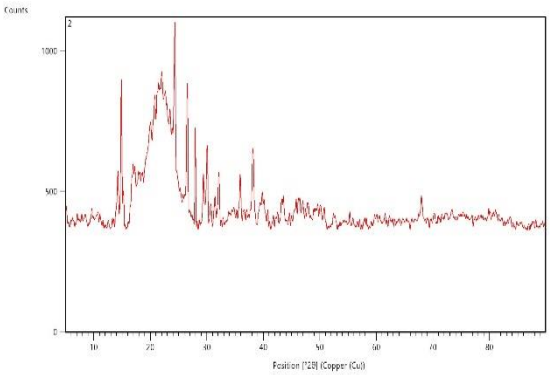


Fig. 3.2 PRELIMINARY TEST OF HENNA

3.3 PRELIMINARY TEST OF HENNA + CITRIC ACID (LEMON JUICE)

Derived the crystalline chemical structure formed and bonding of the samples.

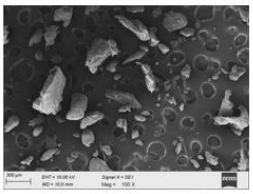


Fig. 3.3 STRUCTURE 1

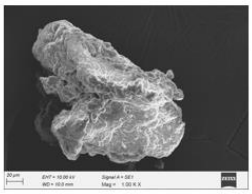


Fig. 3.4 STRUCTURE 2

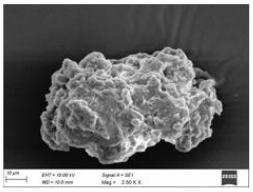


Fig. 3.5 STRUCTURE 3

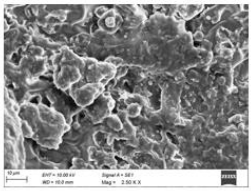


Fig. 3.6 STRUCTURE 4

Specific Gravity

90 micron Fineness test

Initial setting time

Final setting time

Fig. 3.7 XRD MACHINE

3.4 CASTING OF HERBARIUM CSEB

These steps were used while casting the mix design of HERBARIUM CSEB

#01 Detailed Literature review was done.

#02 Material selections were made on the basis of previous documentation analysis.

#03 Characterization of the materials was done as per requirement.

Specific Gravity

90 micron Fineness test

Specific Gravity

Specific Gravity

Initial setting time

Final setting time





Specific Gravity Initial setting time Final setting time



Final setting time Initial setting time 90 micron Fineness test


Specific Gravity 90 micron Fineness test

Fig. Characterization of Lime

#04 Mix design formulations for the HERBARIUM CSEB blocks based on documentation and practical work code of practice.

	CLAY	SAND	FLYASH	HENNA	PPC	LIME
TRIAL - 1	25%	65%	4%	1%	3%	
TRIAL - 2	20%	70%	2%	5%	3%	
TRIAL - 3	30%	60%	4%	6%		
TRIAL - 4	20%	68%	2%	5%	5%	
TRIAL - 5	20%	68%	2%	5%		5%
TRIAL - 6	25%	51%	2%	12%	10%	
TRIAL - 7	25%	51%	2%	12%		10%

TABLE 3.1 – MIX PROPORTIONS




Fig. CLASSIFICATION OF BRICKS

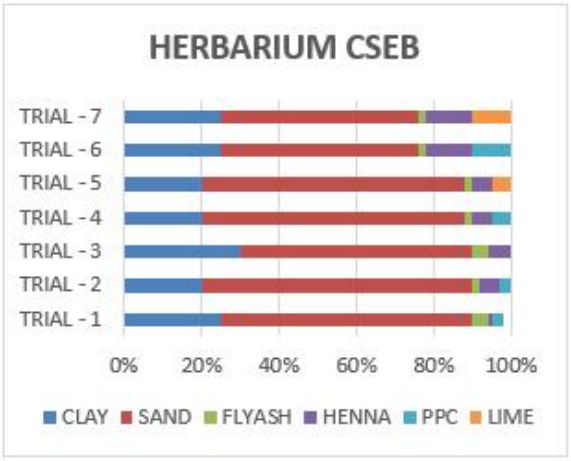


Fig. MIX RATIO %

#05 Casting of HERBARIUM CSEB blocks manual press for multiple Trials.




#06 Direct sun dry curing was done with sprinkling of water with water tubes of needful amount.


#07 Compression strength of HERBARIUM CSEB manual press blocks.

EXPERIMENTALTESTS EVALUATION

4.1 COMPRESSIVE STRENGTH TESTS ON HERBARIUM CSEB

A compressive strength test will estimate the endurance and strength of HERBARIUM CSEB brick. The brick is directed to a compressive load to state the maximum load at which the HERBARIUM CSEB brick will fail or break physically. This test has the salient role in estimating the physical validity of the block.

The standard IS Code 1725-1984 Each lot had 6 bricks, 3 of which were tested for compressive strength on the Compression Tester. The sample was placed in the CTM with the flat side horizontal and the dry sand-filled side up in the CTM, the placed between two 3 mm thick 3-ply sheets of plywood, the It was carefully centered between the plates of the tester. Load was applied axially in uniform rate of "15 N/mm (150 kg/cm²) per minute" until failure occurred and the max. load at failure was recorded. The load in failure was the max. load at which sample did not further increase the tester index value.

Compositions	BRICK SIZE [mm]	WEIGHT [kg]
HB CSEB-1 (T-1)	240 X 115 X 90	4.7
HB CSEB-1 (T-2)	241 X 115 X 90	4.8
HB CSEB-1 (T-3)	242 X 115 X 90	4.73
HB CSEB-1 (T-4)	243 X 115 X 90	4.98
HB CSEB-2 (T-5)	244 X 115 X 90	5.2
HB CSEB-3 (T-6)	245 X 115 X 90	4.79
HB CSEB-4 (T-7)	246 X 115 X 90	5

TABLE 4.1 – COMPOSITION SIZE & MASS OF ALL TRIALS

All 7 trials specimen shares the same dimension which is 240x115x90mm but has difference in it's density/ weight. The change in weight depends on the amount of Henna herb and PPC or Lime's is added to the soil. All seven specimens are compared on the same grounds of compressive strength. High capacity automatic compressive strength machine was used to determine the compression strength. The images of CTM used are shown below.

Fig. 4.2 MATERIAL CTM TESTING

After the HERBARIUM CSEB brick specimens were subjected to compression strength test, the following results were observed and noted. Also, a comparative model has been obtained with other conventional bricks, From the observation of strengths it can be noticed that the usage of Lime brick takes time for setting but gives a great result than cement also it is helpful for natural cooling, to reduce the U value. So, the result of Trial 4,5 are good but Excellence goes for Trial 6,7. Now, this acquired result must be compared with other conventional bricks and hence the results were compared with Hollow block, Sand lime brick, Fly ash brick, Sun dried brick Wire cut brick.

INFERENCE

COMPRESSIVE STRENGTH N/mm2	
HB CSEB-1 (T-1)	2.74
HB CSEB-1 (T-2)	3.47
HB CSEB-1 (T-3)	2.61
HB CSEB-1 (T-4)	4
HB CSEB-2 (T-5)	5.5
HB CSEB-3 (T-6)	6.5
HB CSEB-4 (T-7)	7

Totally 7 trial mixes were been carried out. It was observed that in trial 6 & 7 i.e, trial -6 (cement-henna), trial-7 (lime-henna) the compressive strength of trial 6 was best than trial 7 in 21 days of test but as lime takes time for setting it was observed that at 32nd day test the compressive strength of lime was high than trial 6. Hence it was proved that henna has good strong bonding in trial 7 as lime acts as a very good stabilizer.

4.2 WATER ABSORPTION TESTS ON HERBARIUM CSEB BLOCKS

A water absorption test is conducted to compute the durability and endurance of bricks to weather the climatic instabilities. The water absorption test is performed by immersing the bricks in cold water for 24hrs and observing the mass change,

Bricks are sun dried 4-5 days prior to the test.
Measure the weight of the brick W1.
Immerse the brick in cold water for 24 hours with the temperature range of 25-30 degree Celsius.
Now weigh the brick W2.
Water absorption % formula,

Absorption % = (W2-W1/W2) X 100

After the HERBARIUM CSEB brick specimens were subjected to Water absorption test, the following results were observed and noted. Also, a comparative model has been obtained with other conventional bricks,

WATER ABSORPTION %	
HB CSEB-1 (T-1)	12.6
HB CSEB-1 (T-2)	10.6
HB CSEB-1 (T-3)	-100
HB CSEB-1 (T-4)	10.6
HB CSEB-2 (T-5)	12.6
HB CSEB-3 (T-6)	14.4
HB CSEB-4 (T-7)	16.4

INFERENCE

Totally 7 trial mixes were been carried out. It was observed that except the trial 3, all other trials had the standard percentage of water absorption, but at initial stages i.e, in first 3 trials the compressive strength after water absorption was very low but later trials were carried out trial 4-7 and found that the stable/ standard wet strength to be 4.4 N/mm2 in trial 7, and in trial 6 it was 3.5 N/mm2. Hence, somehow, we achieved the dry and wet strength as per needful standards.

4.3 THERMAL ANALYSIS ON HERBARIUM CSEB BLOCKS

Thermal investigations are required to be performed in the HERBARIUM CSEB bricks to assess various and different thermal parameters and the thermal stability of bricks. The thermal investigations owe importance as the salient aim of the research is to reduce "the conductivity" value hence research is taken out for cement vs lime for the thermal physiographical analysis.

DSC – differential scanning calorimetry
Estimation of difference in the physical property with temperature change.

TGA – thermo-gravimetric analysis
To determine the stability of the material thermally.

TCA- thermal conductivity analysis
To evaluate the thermal conductivity, R-value, U-value.

DSC (International Organization for Standardization, 2014)

Differential scanning calorimetry is a thermal analysis scanning technique wherein the powdered sample is placed in an Alumina (Al2O3) crucible and is heated in step incremental quantum of temperature. The powdered sample is heated at at a rate of "30 °C/min or 35 °C/min or 40°C/min." The incremental temperature is chosen based on the type of the sample and the material behavior. Upon increasing the temperature, when the melting point of the material is reached, there arises a quantum of heat release or heat absorption based on whether the reaction is exothermic or endothermic. This behavior is recorded and the melting

S. No	Sample	Thermal conductivity W/m² K
1	S -1 {10-30°C}	0.175286
2	S - 2 {10-30°C}	0.130875
3	S – 3 {10-30°C}	0.193701
4	S -4 {10-30°C}	0.115545

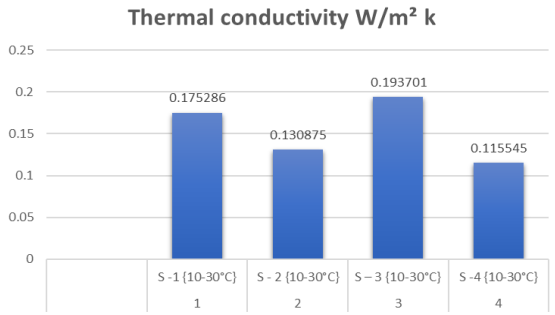
behavior of the material is observed. The Differential Scanning Calorimetry analysis is often coupled with Thermo-gravimetric Analysis. The thermogravimetric analysis estimates the mass loss incurred by the sample when there is a temperature rise.

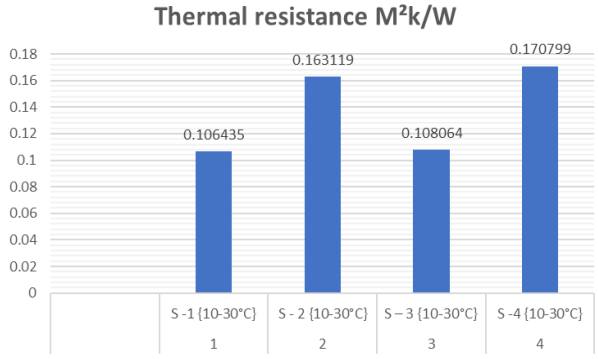
TCA (American Society for Testing Materials. 2017)
Thermal conductivity analysis (TCA) utilizes the solid form of the sample and heats one end, and observes the temperature rise in the other end of the sample. With the temperature difference being known and the amount of heat input known

provided, the thermal conductivity of the sample is estimated by using Fourier's law of heat conduction which implicates, R-Value and U-value of the material.

S. No	Sample	Thermal resistance M²k/W
1	S -1 {10-30°C}	0.106435
2	S - 2 {10-30°C}	0.163119
3	S – 3 {10-30°C}	0.108064
4	S -4 {10-30°C}	0.170799

S. No	Sample	Thermal Transmittance u-value [BTU]
1	S -1 {10-30°C}	2.087867
2	S - 2 {10-30°C}	1.362331
3	S – 3 {10-30°C}	2.056394
4	S -4 {10-30°C}	1.301074

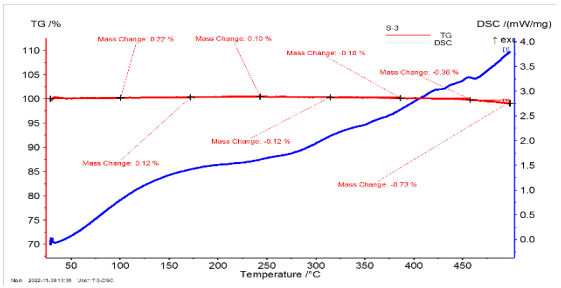


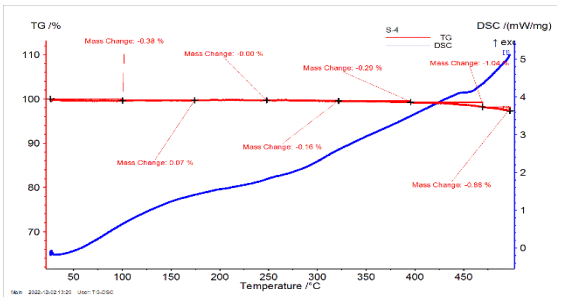


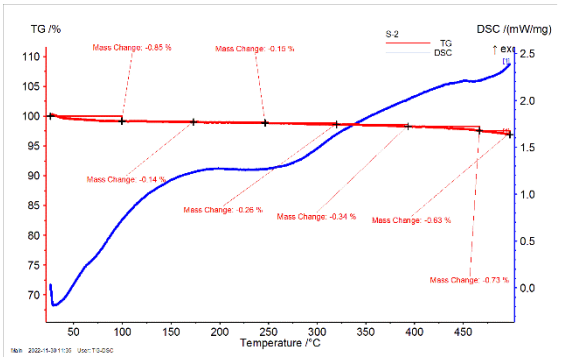
The thermal conductivity, U-Value, and R-Value of the specimen have been experimentally determined using Heat Flow Meter (HFM) method at a temperature of 30°C - 50°C . A known quantum of heat energy is passed through the specimen and the temperature change is recorded. The following observations have been recorded in

From the experimental test results, the following observations can be asserted.

1. Considering the thermal conductivity of the HERBARIUM CSEB bricks, the thermal conductivity of all 7 specimens of bricks is lower and this finds perfect applicability for thermal insulation.
2. Moreover, a lesser value of Thermal transmittance is observed (U — value). The thermal transmittance values for all the samples are moreover similar or even more good than other cseb versions of bricks. The values of the thermal transmittance and the Thermal Resistance — R-Value of the brick) are highly satisfiable concerning the applicability of the HERBARIUM CSEB brick.
The Differential Scanning Calorimetry Analysis coupled with Thermo-Gravimetric Analysis yield a validating result for the composite brick case. The following results indicate the thermal behavior of the specimen,







INFERENCE:

It was being observed that the thermal gravimetry TGA was stable at all points of the test, from normal room temperature 27°c to 600°c there was no major slope found . Hence, it is proved that my material is stable Trial 3,6,7 but out of all 3 the trial 7 is the best stable one as it can be seen which is the Lime and henna together .

Considering the DSC test analysis for the 3 trials , it can be seen that when the material is heated the heat absorbed per unit mass of the material remains constant up to exactly the needful degree which is material is stable it increases crystallization along with the time but no major failure or not even very peak melting point seen, hence it has a heat resistivity property and not fully melting both endothermic 250°c and exothermic 110°c also glass transition at 77-°c.

It was observed in TCA that the trials with Lime showed lesser thermal conductivity than the cement added trials still, trials 4&6 i.e, henna with cement showed good thermal result than other CSEB cement blocks, Hence, the final values of TCA trial 4,5,6,&7 gave the good and expected results as per my research.

4.4 FIRE RESISTIVITY ANALYSIS ON HERBARIUM CSEB BLOCKS

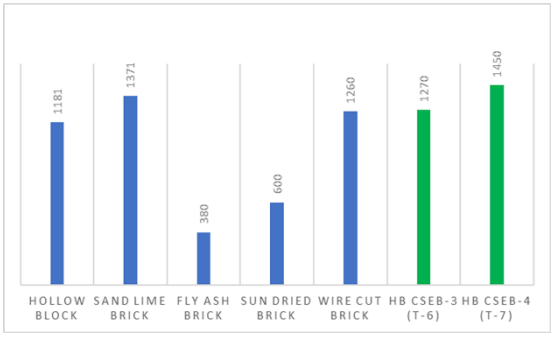
Muffle furnaces are available with different maximum temperatures. The maximum temperature depends on the type of heating element used in the construction. The heating elements with maximum temperatures in the range of 1000°C to 1200°C.

Heating elements: Imported Brick resistance wire heating elements are used in the muffle furnace at 1100°C. On the other hand, a high temperature muffle furnace at 1000°C uses “silicon carbide rods and MoSi2 (molybdenum disilicate)” at 600°C and 1800°C. Heating Zone: The heating zone is the most important part of the muffle furnace.

INFERENCE

Totally 7 trial mixes were been carried out. It was observed that in trial 6 & 7 i.e, trial -6 (cement-henna), trial-7 (lime-henna) the heat, fire resistance of the blocks were good the test was carried out at 600°C for 1 hr. and 4hrs and the mass of the brick was weighed, and the same process was carried out for 1100°C

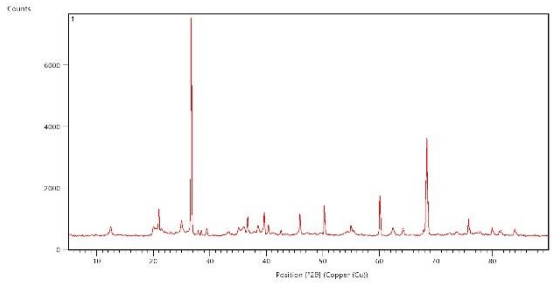
And the result were observed to be stable at the 1hr slot for both the trials there were minor mass changes but while checked for 4 hours it was seen that the material was still in a stable condition mass was reduced to some extent, in comparison to other bricks this blocks were stable, as Henna has best acidic attack and fire resistant capacity.

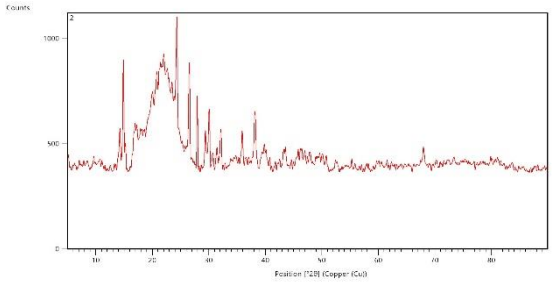


4.5 ELEMENTAL PRESENT ANALYSIS ON HERBARIUM CSEB BLOCKS

In Scanning electron microscope (SEM) we can derive the crystalline chemical structure formed and bonding of any new chemical and Energy dispersive X-ray spectroscopy (EDX) shows all the chemical elements present in the sample with certain peaks.

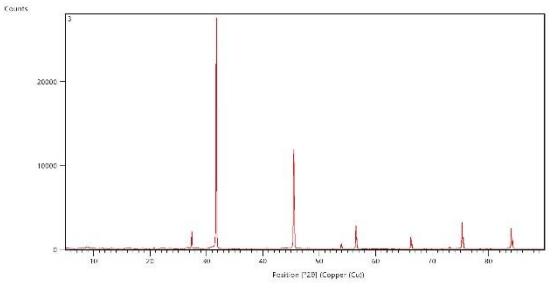
Energy dispersive X-ray spectroscopy (EDX) shows all the chemical elements present in the sample with certain peaks.
S-1 to 4

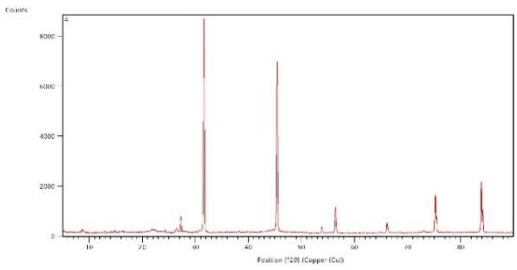




XRD test was carried out as preliminary test and the peak at °2Θ starts from position 28 indicates good peak

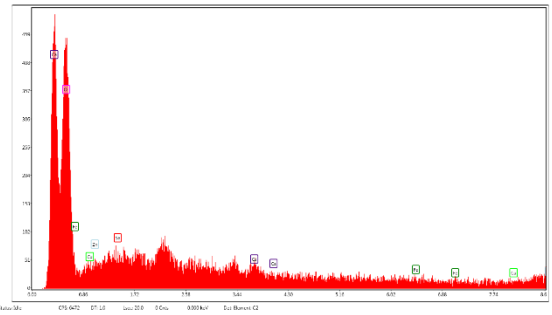
XRD test was carried out as preliminary test and the peak at °2Θ starts from position 15 indicates good peak

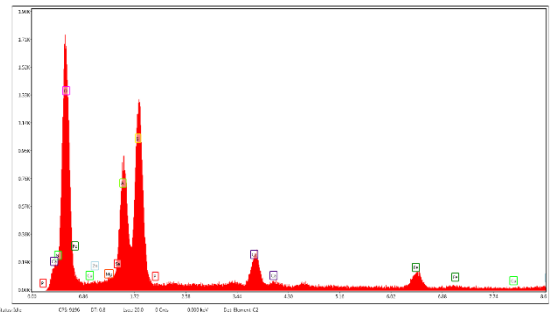




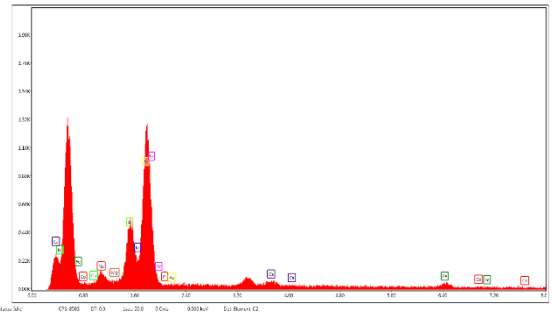
XRD test was carried out as preliminary test and the peak at °2Θ starts from position 32 indicates good peak

XRD test was carried out as preliminary test and the peak at °2Θ starts from position 30.5 indicates good peak

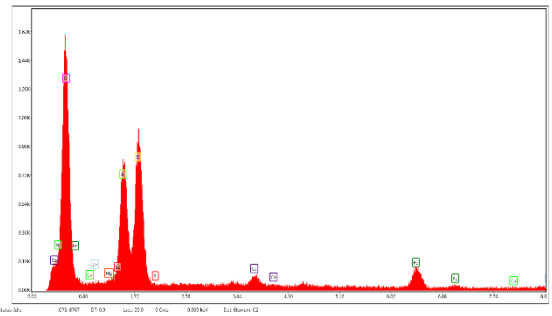




OBSERVATION BASED ON EACH TEST AND



OVERALL RESULT



Trial 4

From the observations it is found that all the samples contains Iron[Fe], Calcium[Ca], Selenium[Se], Copper[Cu], Oxygen[O], Zinc[Zn].

Trial 5
From the observations it is found that all the samples contains Calcium[Ca], Potassium[P], Nitrogen[N], Oxygen[O], Iron[Fe], Copper[Cu], Zinc[Zn], Magnesium[Mg], Aluminum[Al], Selenium[Se], Silicon[Si].

Trial 6
From the observations it is found that all the samples contains Calcium[Ca], Potassium[P], Nitrogen[N], Oxygen[O], Iron[Fe], Copper[Cu], Zinc[Zn], Magnesium[Mg], Aluminum[Al], Selenium[Se], Silicon[Si], Cobalt[Co], Sodium[Na], Krypton[Kr], Strontium[Sr], Gold[Au].

Trial 7
From the observations it is found that all the samples contains Iron[Fe], Calcium[Ca], Selenium[Se], Copper[Cu], Oxygen[O], Zinc[Zn], Magnesium[Mg], Aluminium[Al], Silicon[Si], Potassium[P].

5. CONCLUTION

Main focus of HERBARIUM CSEB was to reduce the conductivity so that this material becomes a natural, eco-friendly and sustainably green material. It was being observed that the thermal gravimetry TGA was stable at all points of the test, from normal room temperature 27°c to 600°c there was no major slope found. Hence, it is proved that my material is stable Trial 3,6,7 but out of all 3 the trial 7 is the best stable one as it can be seen which is the Lime and henna together. Considering the DSC test analysis for the 3 trials, it can be seen that when the material is heated the heat absorbed per unit mass of the material remains constant up to exactly the needful degree which is material is stable it increases crystallization along with the time but no major failure or not even very peak melting point seen, hence it has a heat resistivity property and not fully melting both endothermic 250°c and exothermic 110°c also glass transition at 77-°c. It was observed in TCA that the trials with Lime showed lesser thermal conductivity than the cement added trials still, trials 4&6 i.e, henna with cement showed good thermal result than other CSEB cement blocks, Hence, the final values of TCA trial 4,5,6,&7 gave the good and expected results as per my research. Totally 7 trial mixes were been carried out. It was observed that in trial 6 & 7 i.e, trial -6 (cement-henna), trial-7 (lime-henna) the compressive strength of trial 6 was best than trial 7 in 21 days of test but as lime takes time for setting it was observed that at 32nd day test the compressive strength of lime was high than trial 6. Hence it was proved that henna has good strong bonding in trial 7 as lime acts as a very good stabilizer. Totally 7 trial mixes were been carried out. It was observed that except the trial 3, all other trials had the standard percentage of water absorption, but at initial stages i.e, In first 3 trials the compressive strength after water absorption was very low but later trials were carried out trial 4-7 and found that the stable/ standard wet strength to be 4.4 N/mm2 in trial 7, and in trial 6 it was 3.5 N/mm2. Hence, somehow we achieved the dry and wet strength as per needful standards. Totally 7 trial mixes were been carried out. It was observed that in trial 6 & 7 i.e, trial -6 (cement-henna), trial-7 (lime-henna) the heat, fire resistance of the blocks were good the test was carried out at 600°C for 1 hr and 4hrs and the mass of the brick was weighed, and the same process was carried out for 1100°C And the result were observed to be stable at the 1hr slot for both the trials there were minor mass changes but while checked for 4 hours it was seen that the material was still in a stable condition mass was reduced to some extent, in comparison to other bricks this blocks were stable, as Henna has best acidic attack and fire resistant capacity. Hence with all these I hereby, conclude my dissertation-1 journey of research on HERBARIUM CSEB as a successful material than expected.

6.0 RECOMMENDATIONS

1] This material could be used for the residential purpose for the warm-humid, moderate[coimbatore], hot & dry climatic zones.
2] This material could also be applied to buildings at certain direction so that it achieves more benefits.
3] The Transmittance value of CSEB compared to conventional brick building is good, i.e, this material obviously has less thermal conductivity which would result in temperature management.

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Vaishnavi Ramakrishnan is an accomplished architect and sustainable design expert. She obtained her Bachelor's and Master's degrees in Architecture from Karpagam Academy of Higher Education, specializing in sustainable design during her Master's program. Born on January 28, 1999, in Madurai, Vaishnavi has always been passionate about creating environmentally friendly spaces.

With her exceptional communication skills, Vaishnavi has been able to effectively convey her ideas and collaborate with colleagues and clients. Her expertise in sustainable architecture has allowed her to work on various innovative projects that prioritize environmental preservation.