Study for the Insulating Materials for Use in Walls

[1]Prof. Mohammad Azaz, [2]Gauri Dongarwar, [3]Ishrar Shah, [4]Gaurav Watkar, [5]Ritik Somkuwar, [6]Saloni Dupare

[1]*Assistanat Professor, Anjuman College of Engineering and Technology Nagpur, India*

[2,3,4,5,6]*Student of Graduation, Anjuman College of Engineering and Technology Nagpur, India*

***Abstract*-The sound insulation and thermal insulation of walls made with polystyrene sheet and hemp sheet was tested in Anjuman College of Engineering and Technology, Nagpur. It was found through the results of sound insulation test that the wall with polystyrene sheet gave less emitting sound than the wall with hemp sheet which was 76 dB. In the test of thermal insulation wall with polystyrene sheet emitted 32˚C which is less heat energy than wall with hemp sheet. From both the tests, polystyrene proved to be a better material than hemp sheet as an insulator for walls. Though polystyrene is harmful for the nature and it is prevented these days still the use of polystyrene as insulating material proves to be economical and efficient in the long run.**

***Index Terms*—Thermal insulation, sound insulation, polystyrene, hemp sheet.**

I. INTRODUCTION

Insulation is a type of material used in a building to reduce the flow of thermal as well as sound energy. Insulation helps keep a house at a desired temperature all year round, protecting it against cold in winter and excess heat in summer.

Whether we are considering investing in solar panels, solar water heating, heat pumps, or any other source of green energy for our home, the first step we should take is to improve our home's insulation. This will ensure that the use of natural resources can be maximized without wasting energy. If we ignore this step, we may end up spending a lot of money on buying a very powerful system to meet the energy needs of a badly insulated house. Insulation helps keep a house at a desired temperature all year round, protecting it against cold in winter and excess heat in summer. Insulation also has noise reduction benefits. A well-insulated house can be highly energy efficient, needing very little additional heating and cooling. How much money can be saved by insulating a home depends on a number of different factors, like the type of insulation and size of the house. Moreover, depending on the age of building, planning permission may be required to fit insulation, yet most houses do not require such permission. In the long run, insulation will pay back any initial outlay, and is invariably considered a wise investment. Modern houses are usually built to very good insulation standards but older houses often require a lot of work in this respect. Fortunately, there are many options to improve the energy efficiency of older houses.

In cold weather, heat can be lost from the house in all directions, and owners should consider integral insulation to ensure that heat is properly retained. A wise choice is to insulate roofs, floors, walls, windows and doors. The most important of these is walls, because in a typical house, they account for 30 to 40% of heat losses. Next come roofs, which account for approximately 25% of heat losses; then windows and doors, through which 10-20% is lost; and finally, floors. Home insulation needs are met by a variety of natural or synthetic materials. The production process and applications differ depending on the specific design of houses and the particular structure involved. The energy requirements of the materials also vary in terms of the energy consumed in production, transportation and application. Building insulation is a broad term and refers to any object in a building that is used to insulate for any purpose. While the majority of insulation in buildings is for thermal purposes, the term also applies to acoustic insulation, fire insulation and impact insulation (for example, where vibrations have to be damped in industrial applications). Often an insulation material is chosen for its ability to perform several of these functions at once. Insulation requires intelligent planning. Not only does it make homes warmer in winter, it also helps keep them cooler in summer.

The principle here is the same as a flask, which can keep drinks hot or cold by
providing an insulating layer between the liquid and the outside air. Air is a poor conductor of heat and it is the tiny pockets of air trapped within the insulating material which minimize the amount of heat that can pass between the inside and outside of a house. This means that in winter, the heat stays inside a home, and in the summer it stays outside. Different types of insulation materials possess different properties, and as a result, are suited to different areas of buildings.

II. LITERATURE REVIEW

1.Study on Potential Application of Natural Fiber Made Fabrics as Thermal
Insulation Medium By: Prof. Swapan Kumar Ghosh, Mr. Satyaranjan Bairagi, Mr. Rajib Bhattacharyya, Mr. Murari Mohan Mondal
Thermal properties like thermal conductivity, thermal resistance, thermal insulation, etc. are important in many textile applications such as apparel, blankets, and sleeping bags, interlinings, building insulation, automobiles, aircraft and industrial process equipment [1]. In fact, these thermal properties are fundamental to determine the heat transfer through fabrics [2]. The thermal property of fabric is very important for both its thermal comfort and protection against challenging weather conditions [3]. The different types of textile materials which are generally used as thermal insulation media are mostly in nonwoven, woven and knitted forms. Thermal conductivity of needled nonwoven structures can be predicted with high accuracy using model with fabric thickness, porosity and structure along with applied temperature as was investigated by Mohammadi et al. [4]. Jirsak et al. concluded that thermal conductivity decreases with increasing material density [5]. Morris concluded that when two fabrics have equal thicknesses but different densities, fabric with lower density shows greater thermal insulation [6]. Abdel-Rehim et al. studied heat transfer through different fabrics made by polypropylene and polyester mass in a range from 400 to 800 g/m2 and they concluded that the investigated fabrics have high thermal performance and thermal response as insulators.
2.Experimental Investigation of Utilizing the Natural Palm Tree Fibers as Thermal Insulator in Brick Industry By: Ali M. Othman, Adnan I.O. Zaid

The available literature reveals that thermal insulation is very essential issue in the building industry both in cold and hot climates. Utilization of the available waste materials in the enhancement of soil blocks, clay and cemented bricks has engaged the researchers for a long time to produce more robust and comfortable homes for the poorest communities in Developing Countries. A wide range of these materials such as chopped barley straw, processed waste tea, vegetal, oil palm empty fruit bunches, lechuguilla, pineapple leaves, cassava peel and hibiscus cannabinus have been investigated by many authors either as stabilizers and/or reinforcement elements to enhance the engineering properties of soil blocks and the clay and cemented bricks by many authors, [1-10]. In all these investigations, there were improvements in their engineering properties. This caused more interest to researchers in further investigating the use of the available natural's fibres an attractive alternative material to the synthetic materials because in addition to their low cost structural benefits they also have economic, environmental and social significance when used in buildings as they present diverse markets for farmers, minimizes the volume, weight of the structure and reduces the emission of carbon dioxide.

III.MATERIAL AND METHOD

The material and method has been classified as same dimension wall with different type of insulating material. Types of material are-

1. Hemp Wool sheet
2. Polystyrene sheet

3.1) Equipments used in the study:

1. Smartphone and sound meter app (https://play.google.com/store/apps/details?id=com.splendapps.decibel)
2. A audio speaker which was purchased locally emitting 90 Db.
3. Coal with good calorific Value
4. Thermometer

3.2) Construction of walls:

1) First, the bricks(190x90x90mm) were soaked in clean water in the tank for about 1 hour. After soaking of bricks, they were fully dried.
2) Then, the 1st side of the brickwork was laid with the mortar.

3) The brickwork was properly levelled with the help of trowel and plumb bob. Then a thin slurry was made with cement and water.
4) The slurry was applied to both the sided of the polystyrene sheet.
5) Finally the polystyrene sheet was attached to the brickwork with the help of the slurry.
6) And then the 2nd layer of brickwork was laid as earlier. The polystyrene sheet was fully compacted between the two layers of the brickwork .

Similarly, hemp sheet was placed by the same procedure as above.

A closed chamber is made with the other two walls of normal brick without any thermal insulating material.

Figure 1. Polystyrene sheet and Hemp wool Sheet model

3.3) Measuring Method

1. Sound Insulation Test

i. To initiate the test, firstly, the insides of the model were cleared. All the dust is removed and no moisture is present is made sure. The sound source is further setup.
ii. The bluetooth device is connected with a tone of stable frequency. And volume.
iii. After the setup is completed the Bluetooth device is placed inside the model such that the distance between the device and all the walls is same.
iv. The top is then covered with the slab without leaving any voids for sound leakage.
v. The sound is then measured by placing the smartphone app in front of both the walls and the readings are recorded.

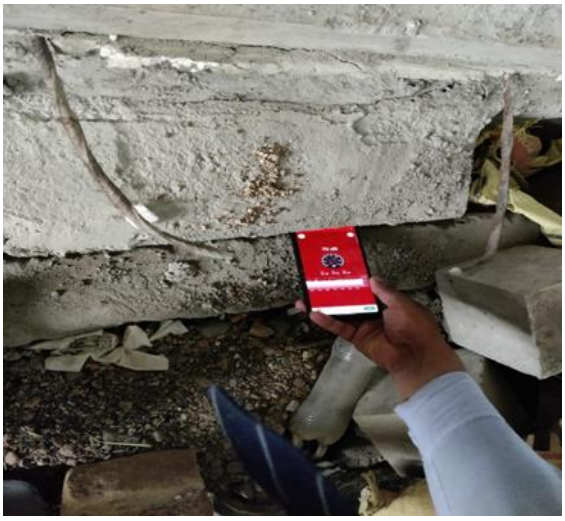

Figure 2. Pictures showing measurement of sound insulation of the walls.

2. Thermal Insulation Test

i. To initiate the test, firstly, the insides of the model were cleared. All the dust is removed and no moisture is present is made sure. The coal is ignited in a pan and kept inside the model.
ii. After the coal is completely ignited and there are no longer emitting flames, the pan with the coal is gently placed inside the model.
iii. Once the pan is placed a cover of slab is placed on top of the model perfectly so that no gaps are there to prevent heat loss.
iv. The temperature is then recorded with the thermometer of both the walls for the measurement of thermal insulation.

Figure 3. Picture showing thermal insulation measurement.

IV.RESULTS AND DISCUSSION

4.1 Sound Insulation Results

MATERIAL	dB
Polystyrene	76
Hemp Sheet	77

4.2 Thermal Insulation Results

MATERIAL	TEMPERATURE
Polystyrene	32˚C
Hemp Sheet	38˚C

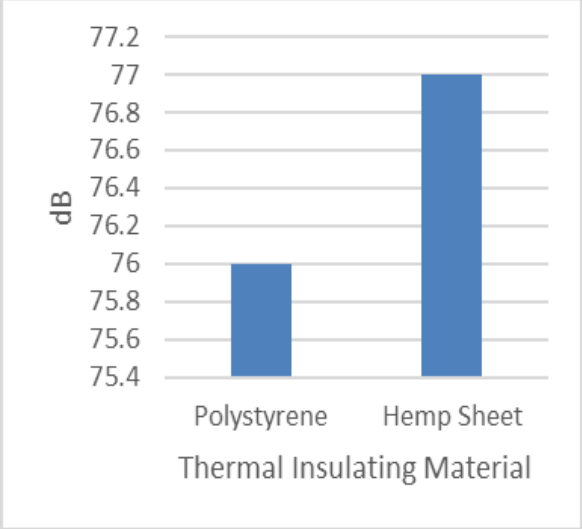

Figure 5. Values of Sound Insulation test

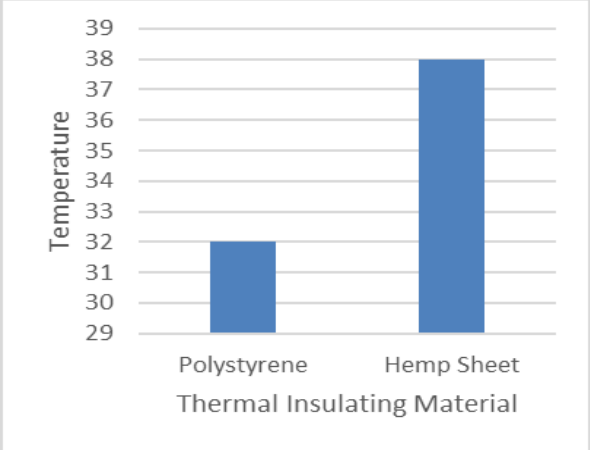

Figure 6. Values of Thermal Insulation test

V. CONCLUSION

1. The lowest emitted sound was recorded from wall with polystyrene which is 76 dB while the wall with hemp sheet recorded 77 dB.
2. Both the walls having completely different material yet they don't show major difference in their sound emission.
3. The lowest temperature was recorded for wall with polystyrene which is 32˚C while the wall with hemp sheet recorded 38˚C.
4. There is quite a difference between emitted temperatures of both the walls.
5. From sound insulation test and thermal insulation test, we conclude that polystyrene sheet is better building insulating material.

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