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Analysis of Sound Absorbing Panel Using Agro Waste Products

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***Abstract*- Sound pollution, is the propagation of noise with ranging impacts on the activity of human or animal life, most of them harmful to a degree. The source of outdoor noise worldwide is mainly caused by machines, transport, and propagation systems. poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. Some of the main sources of noise in residential areas include loud music, transportation (traffic, rail, airplanes, etc.), lawn care maintenance, construction, electrical generators, explosions, and people. As an alternative in our research project we are concerned with maximum utilization of agro-waste Material Such as Rice straw to develop Noise absorbing Composite with bamboo as reinforcing material and study of acoustical and flammability properties of Composites.**

***Keywords*- Noise Absorbing Composite Materials, Agro Waste Products, Noise insulation.**

I. INTRODUCTION

Noise is generally unwanted sound caused in the outside world due to various reasons, involving machines, transportation systems, engines, aircraft, etc. Noise pollution has become the third pollution resource that has great adverse influences on the environment, human health and economy. How to reduce the damages of noise has become an important issue. Generally, the means of controlling noise include active control and passive control Noise absorption constitutes one of the major requirements for human comfort today. The former is accomplished by reducing the production of noise at the locations of noise sources, but it can only control the noises of a narrow frequency range.

The passive control is normally achieved by utilizing high sound absorption materials, which can be used to absorb noises of a wide frequency range by effectively dissipating sound energy on the process of propagation of the sound wave.Noise insulation requirements in automobiles, manufacturing environments, and equipment, generating higher sound pressure drive the need to develop more efficient and economical ways of producing sound absorption materials. Industrial applications of sound insulation, generally includes the use of materials such as glass wool, foam, mineral fibers and their composites. A porous laminated composite material manufactured by lamination, preheating and molding of premix, exhibits a very high sound absorption property in the frequency range 500–2000 Hz.Use of synthetic porous and fibrous acoustic materials is still frequently found especially in building acoustics as well as in noise control applications. The products such as foam, rock wool, and glass wool made from minerals are known for their toxicity and polluting effects which are harmful to human health as well as to the environment. It has been presented that their production can release more carbon dioxide into the atmosphere compared to those made from natural materials. In order to support “Green” environment campaign, Acoustic absorbers from natural materials are therefore of interest due to their biodegradability and sustainability. As an alternate, natural fibres like jute, cotton, flax, ramie, sisal, and hemp obtained from renewable resource can be used as a cheap, biodegradable and recyclable sound absorbing materials. Although composites made of jute fibre/felt with other fibres are being used for various applications in automotive industry, construction, building sectors, furniture etc.

The health risk factors associated with glass-and mineral-fibre materials, also provide an opportunity to develop the sound proofing material made of natural fibres. Sound absorption panel produced from particle composite boards using agricultural wastes, Natural fiber have challenged researchers to develop novel enhanced sound proofing material made up of natural fibre. At present the focus, is to develop a cheap, renewable and biodegradable sound proofing material with the help of jute (natural fibre) fibre/felt which is a non-abrasive, porous, good insulator, hygroscopic and combustible material for automobile, home appliances and architecture applications.

II. LITERATURE SURVEY

1. Noise Absorbing Composite Materials Using Agro Waste Products

2019 Mr. Nagendra K.S., Ms. Tejaswini M. Composit panels -Noise has determined effects on human lives and it is Nuisance to Environment in the current market which

is hazardous. Conventionally, expensive sound absorption materials are employed to control noise disturbances. The use of synthetic materials as acoustic absorbers is still applied extensively in building industry. These non-biodegradable materials do not only cause pollution to environment, but also contributes significantly in increasing Carbon-di-oxide causing effect of global warming and are also quite expensive for small need. Main objective is to find a sustainable and an eco-friendly materials to be an alternative sound absorber. Natural materials such have been receiving considerable attention as substitute for Synthetic materials. Hence, it is possible to utilize Agro waste Material as a potential candidate for sound Absorption Panel.

2. Composite Eco-Friendly Sound Absorbing Materials Made of Recycled Textile Waste and Biopolymers

Chiara Rubino,Marilés Bonet : Composite sheet, made of 100% wool waste fibers. Experimental results demonstrated that the samples had thermal conductivity ranging between 0.049 and 0.060 W/(m K), well comparable to conventional building materials. Similarly, acoustic results were very promising, showing absorption coefficients that, for the given thickness, were generally higher than 0.5 from 500 Hz on, and higher than 0.9 from 1 kHz on. Finally, the effects of the non-acoustic properties and of the air gap behind the samples on the acoustic behavior were also analyzed, proving that the agreement with absorption values predicted by empirical models was also very good.

3. Sustainable absorption panels from agricultural wastes

It can be concluded that the acoustic panel made from a mixture of 25% coconut coir powder with 75% shredded waste paper provided higher absorption coefficient compared to the performance of the other samples. This might be caused by the size of the coir powder which is very small, creating less void space in between the panel and thus causing it to absorb less sound. Since sound absorption is very much affected by the availability of void space of the panel, further studies on other potential materials from waste should be conducted.

4. Noise absorbing materials using waste products

the usage of the rice husk and bamboo as noise absorbing materials propylene cloth as they are available abundantly in the environment and cheaper than other traditional methods. The use of renewable materials from a sustainable source is increasing in variety of applications raising. So, use of Panels which is combination of natural cellulose fiber with other recourses such as bio-polymers, resins or binders based on renewable raw materials. It is proposed to develop a comprehensive Acoustic Panel for absorption of noise level. It is also envisaged to design the fixture with in building interior space. This cost effective method will potentially open the door for a wide variety of Agro waste in development of Acoustic Panels.

5. The major findings from literature review are as follows:

The experimental analysis of the thermal properties showed that all the samples have thermal conductivity ranging between 0.049 and 0.060 W/(m K), independent of the binder used.Porosity variation also affected the air flow resistivity of samples, influencing their acoustic performance.

It was observed that more porous samples were characterized by a lower air flow resistivity, showing a better sound absorption in the mid and high frequency ranges (with α higher than 0.8 at frequencies above 500 hz).the increased air flow resistivity values of the less porous samples improved sound absorption at low frequencies yielding α as high as 0.5 from 315 hz on.A comparison between measured and predicted absorption coefficients was useful to identify the johnson, c.hampoux, and allard model as the most suitable to perform any optimization exercise. In addition, using some of the selected samples in combination with air gaps allowed achieving α higher than 0.8 at frequencies above 315 hz, using only a 5 cm gap.

Further investigations are under way in order to define the mechanical characteristics of the samples and the practical application of the proposed solutions in the building industry.a life cycle assessment will be carried out to better clarify which solution is more eco-friendly.Composite panels which are eco-friendly, biodegradable and economical will be developed as an alternative for noise absorbing materials.

6. Objectives:

Noise has determined effects on human lives and it is Nuisance to Environment in the current market which is hazardous. Conventionally, expensive sound absorption materials are employed to control noise disturbances. The use of synthetic materials as acoustic absorbers is still applied extensively in building industry. These non-biodegradable materials do not only cause pollution to environment, but also contributes significantly in increasing Carbon-di-oxide causing effect of global warming and are also quite expensive for small need. Main objective is to find a sustainable and an eco-friendly materials to be an alternative sound absorber. Natural materials such have been receiving considerable attention as substitute for Synthetic materials. Hence, it is possible to utilize Agro waste Material as a potential candidate for sound Absorption Panel.

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III. MATERIALS AND METHODOLOGY

The materials used in developing a noise absorption boards are as follows

- Rice straw
- Bamboo
- Poly propylene

Rice Straw Rice straw is a by-product produced when the harvested paddy is separated from the grains after plants are threshed. They are thrashed either manually, using stationary threshers or combine harvesters. Each kg of milled rice produced results in roughly 0.7–1.4 kg of rice straw depending on varieties, cutting-height of the stubbles, and moisture content during harvest.
The average rice straw produced in world is equal as annual rice produced. About 45% to 63% of rice straw is used for cattle feeding purpose and the remaining rice straw is dumped or it is burned in the open field.

1. Composition and Characteristics of Rice Straw
The biochemical composition of rice straw and wheat straw is characterized by a typical composition of an agricultural-based lignocelluloses residue: it contains on average 30 – 45% cellulose, 20 – 25% hemicelluloses, 15 – 20 % lignin, as well as a number of minor organic compounds. Rice straw is poor in nitrogen, but relatively high in inorganic compounds, often referred to as ash.

Table no 1. Composition and Characteristics of Rice Straw.

Sl .no	Component	Mean value In %	Minimum value in%	Maximum value in %
1	Water content	23.9	6.8	88
2	Volatiles	83.9	80.1	98.2
3	Ash	18	9.6	24.4
4	HHV	18824	17673	19718
5	C	48.7	43.3	60
6	H	5.92	4.94	7.01
7	O	44.2	30.8	50.4
8	N	1.05	0.57	2.11
9	S	0.14	0.07	0.23
10	Cl	0.489	0.013	.909
11	Cellulose	36	28.1	41
12	Hemicellulose	24	21.5	26.5
13	Lignin	15.6	9.9	23.3

1.1. Properties of Rice Straw

- Water or moisture does not pass through the surface of straw due to presence of wax nature on its outer surface.
- Due to presence of hollow space it exhibit light weight property.
- It has good thermal resistance nature

2. Bamboo
Bamboo is a naturally occurring composite material which grows abundantly in most of the tropical countries. It is considered a composite material because it consists of cellulose fibers imbedded in a lignin matrix. Cellulose fibers are aligned along the length of the bamboo provides maximum tensile strength.

It is a cheap and fast-grown resource with superior physical and mechanical properties compared to most wood species, bamboo offers great potential as an alternative to wood.

Bamboos are subfamily of grass, grown in all over the world except Europe. Currently there are 1200 species of bamboo in the world. It is divided into two main groups i.e., woody and herbaceous group. Woody bamboo are interesting one due to its size. In Asia, bamboo grow about 40m tall. It is fastest growing plant on earth having a growth increment of 11cm per day.

2.1. Composition and Characteristics of Bamboo
The specific gravity of bamboo various from 0.4 to 0.8 depending on its anatomical structure. The composition of bamboo is primary cellulose of 60%, hemi cellulose and lignin of 32%.

Bamboo has good acoustic property due to the presence of voids in it. It helps in mitigating water pollution due to high nitrogen consumption. It generates upto 35% of oxygen. It has good mechanical strength.

3. Polypropylene (PP)
It is a non-woven thermosetting fabric material. It is used in many fields due to its property. It is called as engineering plastic. It is flexible, good resistance to fatigue.

The density of PP varies between 0.895 to 0.92g /cubic cm. It is thermally resistant to all solvents. PP‟s melting point lies around 162degree Celsius. It is a slow degradable material. Due to its thermosetting property it is used has a binding agent in developing the composite.

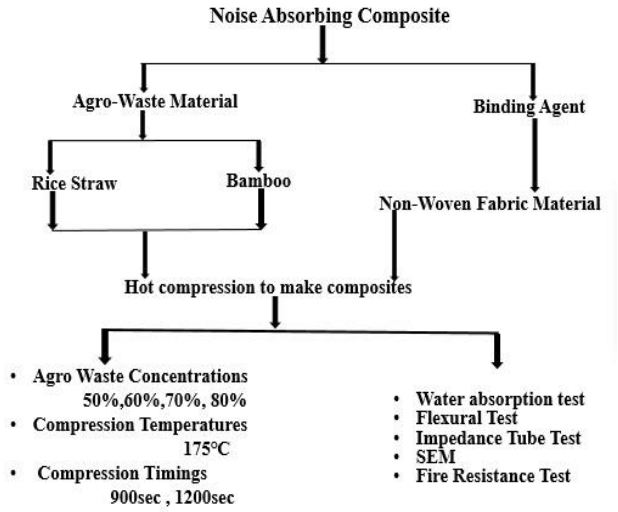

Fig no 1. Polypropylene (PP).

Weight/area and dimension of composites have been set at 200g/m2 and 300g/m2 dimension of 25cm x 30cm .The non-woven web was rolled and cut into 25cm x 30cm rectangles. After determining the total bamboo and rice straw weight necessary to achieve desired concentration for 200g/m2 and 300g/m2 weight/area. For achieving good strength agro waste concentration is divided into 3 different ratios that is 30/70, 50/50 and 70/30 (Rice straw / Bamboo). For knowing good strength concentration of binding material and agro-wastes are divided into 2 ratios i.e., 50/50 and 70/30 (Agro-wastes / Polypropylene).
Bamboo strips are cut into 30cm x1cm dimension and thickness is maintained about 0.2cm. Rice straw is cleaned to remove weeds and other wastes. The rice straw length is made maintained around 30cm .These agro-wastes are sundried for 2 days to remove the moisture content in the materials. The calculated weights are taken according to the ratios. Rice straw and bamboo are laid in parallel to each on top and bottom layer of polypropylene web. To achieve smooth surface rice straw is laid, both top and bottom surface. The layered mass of agro-wastes (bamboo strips and rice straw) and polypropylene web was pressed in between two Teflon coated aluminum sheets in a pre-heated compression machine which is maintained at 170oC under desire control pressure.

After 120sec minutes PP melts and it is passed through the voids and starts binding with agro-wastes. After 1200seconds cold water is turned on until the hot plates temperature decreases to 500C and then pressure is removed. The composite is removed and it is placed in conditioning room.
The procedure is followed for all ratios and the composites are tested for the study.

The following list of test are conducted after the composites are made

- Impedance tube test:- It is conducted to know the acoustic coefficient of the material
- Flexure test:- It is conducted to know the strength of the composite.
- Moisture absorption test:- It is conducted to know moisture absorption capacity of composite.

IV. CONCLUSION

In India, grain and other seeds are the main objectives of the farming activity, there is great interest in developing uses for residues that are currently burned or ploughed back into the ground.Most of the developing countries are very rich in agricultural and natural fibre. Except a few exceptions, a large part of agricultural waste is being used as fuel. India alone produces more than 400 million tons of agricultural waste annually. It has got a very large percentage of the total world production of rice husk, jute, stalk, bagasseand coconut fibre. All these natural fibres have excellent physical and mechanical properties and can be utilized more effectively in the development of composite materials for various building applications.From centuries, mankind has used natural fibre for various types of applicationincluding building materials. In most of the countries, users have explored the possibilities of using natural fibre from different plants, which includes bagasse, cereal straw, corn stalk, cotton stalk, kenaf, rice husk/rice straw etc. Most of the fibre were used mainly for the production of hard board and particle board. Emergence of polymers in the beginning of the 19th century has provided the researcher new dimensions to use natural fibre in more diversified fields.

At the same time, necessity has also increased the interest in synthetic fibre like glass fibre which, due to its superior dimensional and other properties seems to be gaining popularity and slowly replacing natural fibre in different applications. As a result of this change in the raw material and production process of synthetic fibre based composites, energy consumption has increased.The environmental loss suffered by society due to pollution generation during the production and recycling of these synthetic based materials has once again drawn attention to the use of natural fibre. The renewed interest resulted in new ways of natural fibre modifications/use and brought it to be at par/superior to synthetic fibres.
Composite panels which are Eco-friendly, Biodegradable and Economical will be developed as an alternative for Noise Absorbing Materials.

REFERENCE

[1] Zulkifli R, Nor MJM, Ismail AR, Nuawi MZ, Tahir MFM. Effect of perforated size and air gap thickness on acoustic properties of coir fiber sound absorption panels. Eur J Sci Res 2009; 28:242–52.
[2] Zulkifli R, Nor MJM, Ismail AR, Nuawi MZ, Tahir MFM. Acoustical properties of multi-layer

coir fibres sound absorptionpanel. Eur J Sci Res 2008; 8:3709–14.

[3] Mohanan V, Sharma O, Chhapgar A F. Sound absorption by conical absorber and glass wool layer combination 1987; 22:91–101.

[4] Khedari J, Charoenvai S, Hirunlabh J. New insulating particleboards from durian pee and coconut coir. Build Environ 2003; 38:435–41.

[5] Khedari J, Charoenvai S, Hirunlabh J, Teekasap S. New low-cost insulation particleboards from mixture of durian peel and coconut coir. Build Environ 2004; 39:59–65

[6] Yang HS, Kim DJ, Kim HJ. Rice straw–wood particle composite for sound absorbing wooden construction materials. Bio resource Technology 2003; 86:117–21.