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Performance improvement in acoustic boards through natural fibers and wastage of tiers

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Abstract— ***Abstract*** **- The use of wood-based composite panels as building construction material is usually to function both as structural and non-structural components. Natural fiber reinforced composite has emerged as a highly potential replacement for the synthetic fibers. Various natural waste fibers are used for various engineering application. This paper investigates the mechanical properties which were fabricated using recycled rubber and natural fibers. Emission of formaldehyde from wood-based composites is concern in research. Its bonding strength is very high compared to other resin, though it emits hazardless air when reacting with atmospheric air so that change of resin is needed to make the specimen as eco-friendly. For acoustic testing, sound absorption coefficient was evaluated using impedance tube method. For particle board with the density 0.5g cm^{-3}, sound absorption was good at high frequencies the Medium density fiberboard was prepared using two different natural fibers and its bending properties were tested. The suitability of using recycled rubber and neem as raw material and ethyl vinyl acetate as a resin in the manufacturing of medium density fiberboard was also studied. The MDF was fabricated at the prescribed percentage of filler. The performance of composite was evaluated by its mechanical and physical properties. The Experimental investigation indicated that the mechanical strength of medium density fiberboards such as modulus of rupture and modulus of elasticity increased with increasing board harness.**

Index Terms: **Acoustic Board, Medium Density Fiberboard, Recycle of waste rubber, Natural fibers.**

I. INTRODUCTION

India, endowed with an abundant availability of natural fibers such as jute, coir, sisal, pineapple, ramie, bamboo, Neem, Mango, banana etc., has focused on the development of natural fiber composites primarily to explore value-added application avenues. Such natural fiber composites are well suited as wood substitutes in the housing & sound proofing sector. Sound absorption coefficients of materials are one of the most important information for architects, engineers, and musicians, in determining the reverberation time of an enclosure, for examples theaters, classrooms, car interiors, studios and others.

The uses of natural fibers in various applications have received considerable attentions to many researchers. Normally waste natural materials are burned or dumped, thus creating environment problems. There have been efforts to utilize these waste materials for something beneficial to human. These include waste material from tea leaf fiber, coconut fiber and rice wood. The research focuses on sound absorption panel that can be used in various applications. Another investigation focuses on producing the medium density fiberboard that can be applied for furniture, cupboards and flooring

The aim of this study was to determine the acoustical properties of sound absorption as well as physical and mechanical properties of particleboard made from natural fibers especially Neem and Mango leaves powder is mixed with tire powder. These composites are prepared by adding resin as ethyl vinyl acetate with natural fibers and the prepared material in kept in separate die for making a particle board by pressing at high pressure in a hydraulic press machine.

Noise controls in buildings are isolated from external sound sources and absorption of sounds generated within the interior space. Sound isolation or sound insulation is related to sound waves transmitted between rooms in a building. The airborne sound insulation of building elements depends on material properties and is expressed as the transmission loss factor. Sound absorption is correlated to the sound quality in a room. The sound absorption of an acoustical material is expressed as the sound absorption coefficient. Sound absorbing materials absorb most of the sound energy striking them and reflect very little.

II. LITERATURE REVIEW

HosseinYousefi [1] has described Common physical and mechanical properties of experimental boards including modulus of rupture (MOR), modulus of elasticity (MOE), internal bond strength (IB) and thickness swelling (TS) were measured. Nadir Ayrilmis [3] has described A series of commercial phenol-formaldehyde bonded MDF panels were exposed to a post-manufacture heat-treatment at various

temperatures and durations using a hot press and just enough pressure to ensure firm contact between the panel and the press platens. Ümit Büyüksarı [4] has described the objective of study was to evaluate some of the physical and mechanical properties of medium density fiberboard (MDF) panels laminated with veneer sheets compressed at different levels of pressure and temperature. Tingting Wu [5] has described an environment friendly biodegradable board called Bio-board using corn straws was introduced. Board making results showed that under all experimental conditions, it is successful in making board using corn straw.

From this study, an idea regarding the setup methods by which the experiment and be performed by different materials used in acoustic particle board are identified. Also, an idea regarding the terms that should be noted down for determining the respective characteristics of frequency against sound absorption coefficient. But while reviewing, the most of them used wood and bamboo, which would have involved a more amount of cost and it is difficult in availability also. So to avoid this the acoustic particle would be better to produce from natural waste (leaf fiber) by means of using a simple and economical method.

III. PROBLEM DESCRIPTION

The daily noise exposure in our life leads to a demand for new materials offering the possibility of an effective noise reduction. Today most of people using wood as a foaming material which is low cost and light weight. Wood composite boards as MDF used for interior building and furnishing many grades of high- density fiberboards (HDF boards, hardboards) also require a certain amount of binder. Formaldehyde is used in glues in composite wood products such as medium density fiberboard or MDF and particleboard which are generally recognized as being the highest formaldehyde- emitting composite wood product (used for kitchen and bathroom cupboards and drawers.) particleboard (used as sub- flooring and shelving and in cabinetry and furniture); and plywood paneling (used for decorative wall covering and used in cabinets and furniture). . Formaldehyde has been re-classified as a human carcinogen by International Agency for Research on Cancer. Formaldehyde can be toxic, allergenic and carcinogenic. In addition, the health hazards of formaldehyde (carcinogenic to humans) emissions during board production and end- use of fiberboard products made with amino resins are a concern among consumers and manufacturers. Formaldehyde has also been shown to have short- term health effects, including burning sensations in the eyes and throat, nausea and difficulty in breathing.

The trend has been to use formaldehyde based resins for MDF, a practice that carried over from particleboard technology. Though epoxy resins have superior properties the cost of them makes their use unfeasible. Originally Urea formaldehyde was used but this is being replaced as concerns over its health risks and moisture susceptibility grow. The formaldehyde family is still primarily used. The Laminex MDF plant phenol formaldehyde is used.

IV. OBJECTIVE

- To avoid human disease caused using of formaldehyde and to make eco-friendly.
- To achieve the good acoustic properties with low cost compared to wood.

V. ACOUSTIC BOARD PREPARATION

Air-dried treated fiber was used for preparation of MDF. A total of 273 g fiber was used for making the board with target panel density of 970kgm^3. A locally designed by manual hand was used to mix the fiber and adhesive. A mat of dimension 220 mm × 220 mm was prepared after adding 30% ethyl vinyl acetate adhesive by weight of the fiber and pre-pressed to a thickness of 6 mm in hydraulic press. Total pressing time was 300s and applied pressure was 2 MPa and both these parameters were kept constant for all samples.

A total of 70 g & 8 g fiber was used for making the board of larger and smaller size. A locally designed by manual hand was used to mix the fiber and adhesive. A mat of dimension mentioned for larger and smaller size sample 50 mm &8 mm was prepared after adding 15% ethyl vinyl acetate adhesive by weight of the fiber and pre-pressed to a thickness of 1mm in hydraulic press. Total pressing time was 300s and applied pressure was 0.5 MPa and both these parameters were kept constant for all samples.

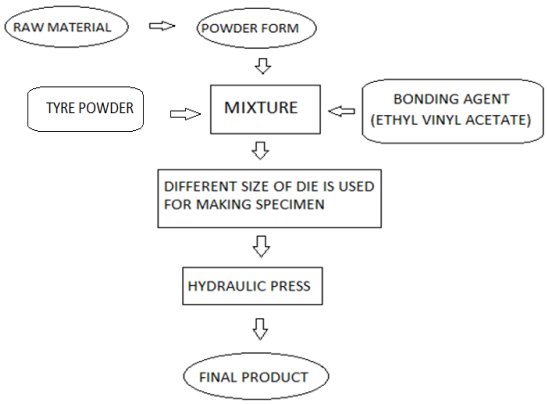


Fig.1: Procedure for preparing samples

Fig.2: Specimen made for the test of Acoustic Properties

TESTING RESULTS

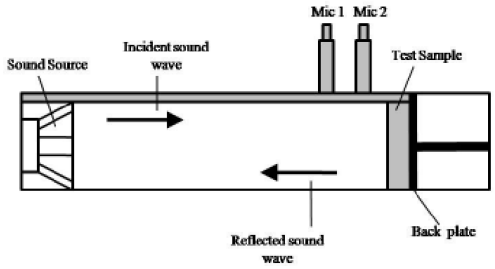


Fig.3: Impendence Tube Method

Result for Mango

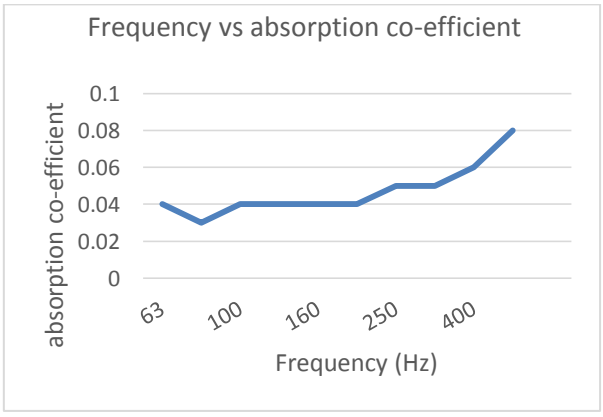
The frequency of different range indicates the adsorption capacity of material. The two different sizes of material were done for acoustic testing. Sound adsorption co-efficient is maximum at 1000 to 2000 Hz and it indicates that material having strong absorption capacity. It also indicate that absorption co-efficient is increases with increasing the frequency input to the material. The result for smaller particle is from 63 to 500 Hz and for larger particle is from 800 to 6300 Hz. The adsorption co-efficent for mango is shown below:

Tabulation

S.No	Frequency(HZ)	Sound absorption
1	63.00	0.04
2	100.00	0.04
3	200.00	0.04
4	250.00	0.05
5	400.00	0.06
6	500.00	0.08

Table 1: Frequency and sound absorption of smaller mango specimen

Graphical representation



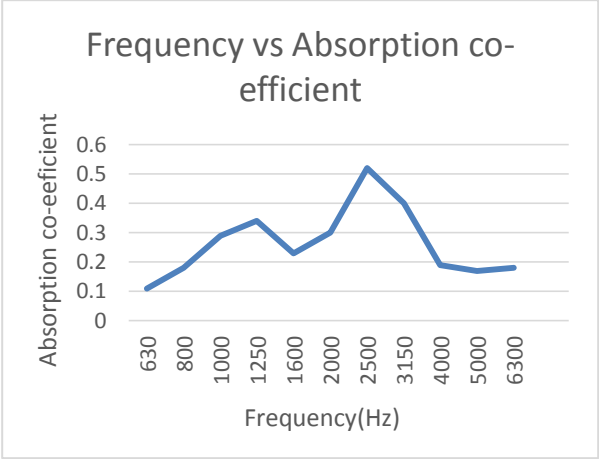
Graph 1: Frequency Vs absorption co-efficient of smaller mango specimen

Tabulation

S.No	Frequency(HZ)	Sound absorption
1	630.00	0.11
2	1000.00	0.29
3	2000.00	0.30
4	2500.00	0.52
5	3150.00	0.40
6	4000.00	0.19
7	5000.00	0.17
8	6300.00	0.18

Table 2: Frequency and sound absorption of larger mango specimen

Graphical representation



Graph 2:Frequency Vs absorption co-efficient of larger mango specimen

Result For Neem

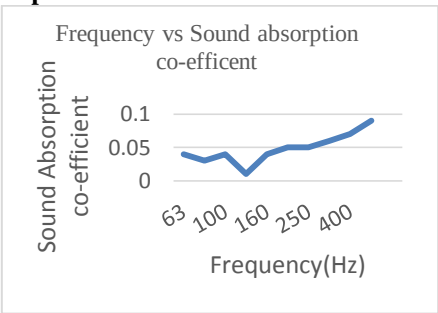
The frequency of different range indicates the adsorption capacity of material. The two different sizes of material were done for acoustic testing. Sound adsorption co-efficient is maximum at 1000 to 2000 Hz and it indicates that material having strong absorption capacity. it also indicate that absorption co-efficient is increases with increasing the frequency input to the material .the result for smaller particle is from 63 to 500 Hz and for larger particle is from 800 to 6300 Hz. The adsorption co-efficient for neem is shown in the table 3

Tabulation

S.No	Frequency(HZ)	Sound Absorption
1	63.00	0.04
2	100.00	0.04
3	200.00	0.05
4	250.00	0.05
5	400.00	0.07
6	500.00	0.09

Table 3: Frequency and sound absorption of smaller neem specimen

Graphical representation



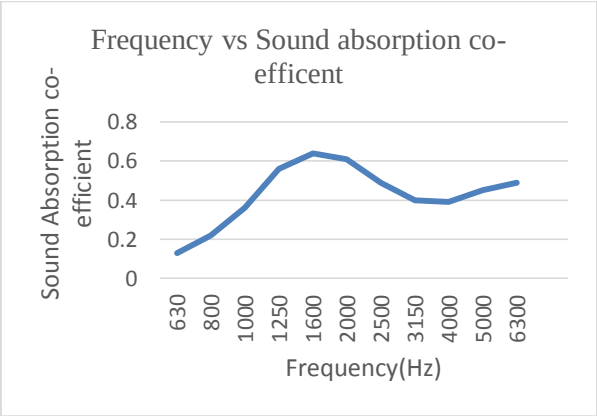
Graph 3: Frequency Vs absorption co-efficient of smaller neem specimen

Tabulation

S.No	Frequency(HZ)	Sound Absorption
1	630.00	0.13
2	1000.00	0.36
3	2000.00	0.61
4	2500.00	0.49
5	3150.00	0.40
6	4000.00	0.39
7	5000.00	0.45
8	6300.00	0.49

Table 4:Frequency and sound absorption of larger neem specimen

Graphical representation



Graph 4: Frequency vs absorption co-efficient of larger neem specimen

VII. CONCLUSION

The effect of neem and mango in improving the adhesion property of MDF was evident in this study. All boards prepared using neem and mango adhesive showed higher internal bonding strength. The properties of material are considerably increased when adding the recycled rubber. For specimen of given size 240*240 is selected for mechanical testing is yet to be done. And the specimen of two different diameter 99.9 mm and 29.9 mm is used for acoustic testing and compare normal fiber wood absorption is lesser than MDF and this indicates that material is used for high frequency material. Thermal conductivity for MDF is below 0.2W/mk and it suits for high temperature withstanding capacity. The lesser the thermal conductivity, the material perform the good characteristic. The sound absorption co-efficient is good for neem and it indicates it fit high frequency absorption and thermal conductivity. From the above testing the sound absorption co-efficient and thermal conductivity is done.

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