A STUDY ON SOUND ABSORBING PROPERTIES OF BIO-DEGRADABLE ACOUSTIC MATERIAL

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ABSTRACT

Due to increase of population on earth day by day the requirement of foods and good are increasing. To achieve this so many construction and factory are developing in a rapid way. So utilization of electrical and mechanical apparatuses at home and enterprises has made a noise pollution. To control this high noise pollution so many research is done. Many material good sound absorbing material were found to control the high noise but these are non-biodegradable. Basically non-biodegradable product are not easily decomposed and these are harmful for human environment. So to replace this material new research were started to produce new advance material. This paper is based on the acoustical properties of different natural fiber (Husk, Rice paddy, Rice straw, Sugar cane fiber, Coconut fiber) and animal fiber(Sheep wool) which are plentily available in the environment and these are eco-friendly. The whole experiment is conduct by impedance tube method. This paper gives the choice of tube measurement, length, tube material, enhancement circuit, microphone and LAB VIEW. The material were tested at different frequency in the both glass tube and PVC pipe. Then the result illustrate that all the material are the good sound absorption performance and among them rice paddy can be very effective for sound absorption.

KEYWORDS: Impedance Tube, Sound Absorption Coefficient.

Fast development of science and innovation was seen in the current past and many number of innovations were made proposed for a good life. So expanding utilization of electrical and mechanical apparatuses at home and enterprises has made a sympathy toward noise pollution made by them. However, this quick development has a few negative results Noise pollution right now affects living conditions. Human space requires a situation with low decibel levels free of unpleasant noises. If one is presented persistently to abnormal amounts of noise amid the day, he may encounter inert impacts. Presently a day new acoustic materials are found by different analysts for acoustic application. A portion of the materials have better permeable nature, some having great absorption and some having great reflecting nature are found. Aside from this there are wide scopes of acoustic materials effectively underutilization. Discovering the way of the acoustic materials is so required before utilizing it in the application. Nature of the acoustic materials at different frequencies is to be discovered. Contingent on the recurrence of the noise specific materials can be picked. Sound absorption is characterized as the procedure by which a material takes in sound vitality when sound waves experienced. At the point when sound waves are gone through the acoustic material there are three procedures.

1. Absorption
2. Reflection
3. Transmission

The sound absorption coefficient (α) is depends on how much sound is absorbing.

α =Ia /Ii

Where Ia = absorbing sound intensity

Ii = incident sound intensity

It is a dimensionless value whose value vary from 0 equal to 1. If α=0 indicates the entire incident sound on the material get absorbed. Similarly, if α=1 indicates the entire incident sound waves on the material get absorbed. If the value of α is greater than 0.75 then that is a good material for sound absorbing and if the sound reflecting value of a material is less than o.25 then that also a good material for sound absorbing.

3 regularly utilized procedures for discovering the sound absorb coefficient are Reverberation chamber, Reflection Method and Impedance tube. Resonation camber is most seasoned strategy and utilized now a day, yet it requires more space and costlier. Reverberation Chamber is not appropriate for research reason since the specimen estimate in this technique is greater so just impedance tube strategy is favoured by analysts. Resonation and Wave tube technique are not suited for discovering the ingestion coefficient of the material on the reasonable condition. Reflection method cannot be completed in the ordinary room condition alongside foundation sound. This technique is exceedingly touchy, even a

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minor mistake will create in precise outcomes. So I use impedance tube method.

EXPERIMENTAL SET UP

Impedance tube technique has more preferred standpoint when contrasted with other strategy because of its smaller in size, low cost and quick outcome. In this strategy sound is made inside the impedance tube and made to strike on the acoustic material. From the reflected waves a portion of the sound is absorbed by the acoustic materials. Impedance tube strategy is well appropriate for the small specimen.

Speaker is kept at the one end of the impedance tube while the specimen is kept at the flip side of the impedance tube. One receivers is kept at the middle of the impedance tube. A speaker of 4Ω / 3W is used to produce signal from the signal generator.Here the sound of specific frequency is delivered by means signal generator or android application in the mobile.

Figure 2.1: Impedance tube set up (glass tube)

Figure 2.2: Impedance tube (PVC pipe)

Impedance tube

The inside area of the tube can be round or rectangular however ought to be consistent measurement starting with one end then onto the next. The tube ought to be straight and inside surface ought to be smooth, nonporous, and free from dust. The tube length might be large so solid transmission through the tube wall can be made to neglate. This paper the length of tube is 120cmand its diameter is 6.8mm. The hole is made on the impedance tube from a distance of 40cm from the sample holder side. On both end side of the tube sound prevent cap is used. On sample holder side there is rigid holder is used to prevent the vibration on the sample. There is polarized micro phone is used to acquire sound from the impedance tube. This 3.5 mm jack microphone is connected to the laptop to calculate by the help of LAB VIEW software.

Methodology

In the experiment various green material were used for testing of sound absorption. Like Husk, Rice paddy, rice straw, Jute, Sheep wool, Sugar cane. To fabrication of material the fast step to cut the material in small pieces in different manner. Then clean the material and extract the unwanted parts. Then put these material under the sun light for removing the water particle.

After that produced a mixture of epoxy and resin in the ratio of 1: 10. Then mix the resin and hardener properly add the material. Then prepare a mould of round shape with 6.5 mm diameter. The put all the mixing material in it to produce the material.

Figure 2.3: Different natural fibre material

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Calculation of Absorption Coefficient

All the hardware is put in a steady casing so that there should not be any wavering in impedance tube. Power supply is given to the speaker circuit. Test to be tried is continued the opposite side of the impedance tube. Initially the test is managed with no sample. Exceedingly reflecting aluminium foil is kept at the flip side of the example so that the absorption coefficient should to be almost to 0. To start with the speaker is made to keep running for certain time frame for adjustment. Temperature of the encompassing must be kept up all through the examination. Amplitude and frequency of the input signal can be balanced. LAB VIEW gain the sound contingent on the inspecting rate. Presently the estimation of the frequency is changed

and the signals are procured for every trial. Test is made with distance across same as that of the tube diameter, thickness 10 mm. There should not be any gap between the specimen and the tube. The value of the sound reflection is imported to excel file.

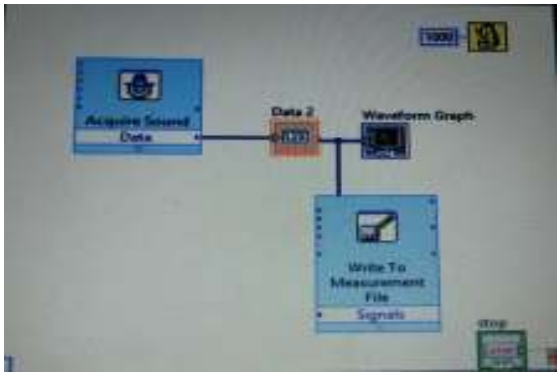


Figure 2.3: Lab View software

RESULTS AND DISCUSSION

Absorption coefficient of the material is calculated using the following formula:

$$\alpha = 1 - Ia/ Ii$$

Sound absorbing coefficient of different material in the PVC pipe

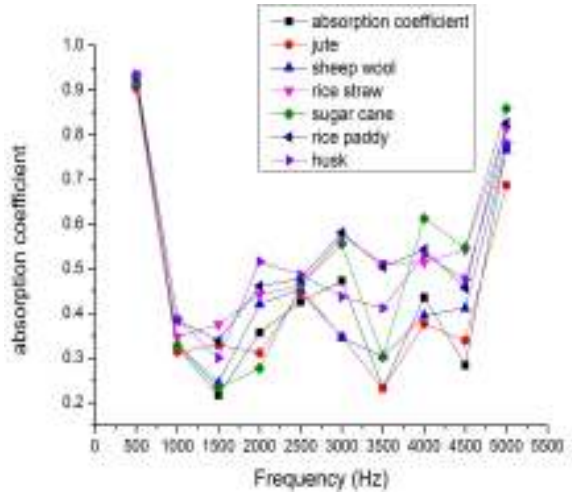
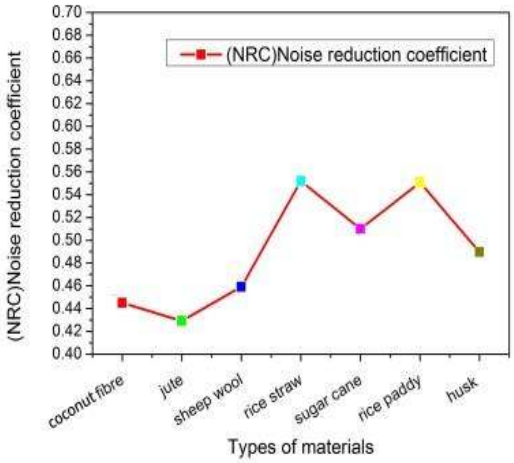


Figure 3.1: Absorption coefficient for different specimens in PVC test tube

This graph is plotted between frequency (Hz) and absorption coefficient of different material at different frequency. In the graph indicate the different value of absorption coefficient at different frequency in PVC pipe. So finding out the actual sound absorption coefficients I calculate the average value of all the frequency. I.e. called NRC (Noise reduction coefficient).



From Fig. 3.2 the following points may be noted:

1. The rice straw have high absorption capacity than other materials.
2. Rice paddy also have high value near to rice straw.
3. Jute have low absorption capacity than other materials.

From the plotted graph we saw that the in PVC pipe rice straw had the sound absorbing quality among them and rice paddy is the 2nd highest and the jute is lowest absorbing quality.

Sound absorption coefficient of different material in glass tube

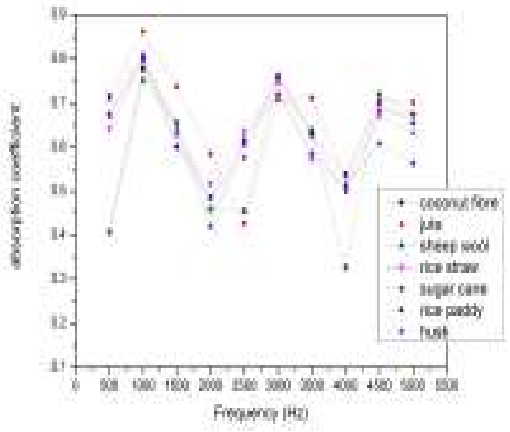
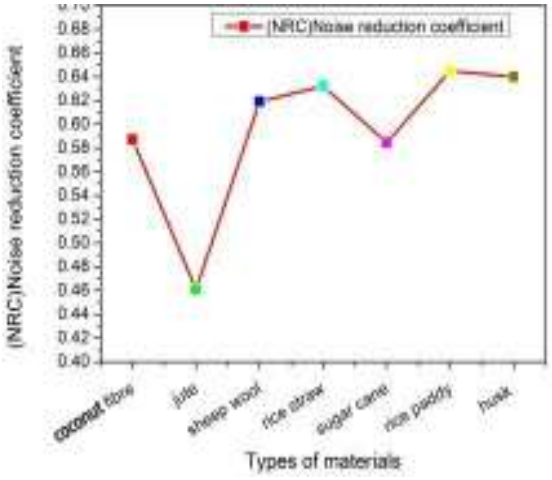


Figure 3.3: Graph between absorbing coefficient and frequency

This graph is plotted between frequency (Hz) and absorption coefficient of different material at different frequency. This graph indicates the different value of absorption coefficient at different frequency in glass tube. So finding out the actual sound absorption

coefficients I calculate the average value of all the frequency. I.e. called NRC (Noise reduction coefficient).



From Fig. 3.4 the following points may be noted:

1. The rice paddy have high absorption capacity than other materials.
2. Jute have low absorption capacity than other materials. After found out the best absorbing material in glass tube and PVC pipe the there is a comparative study in the following graph

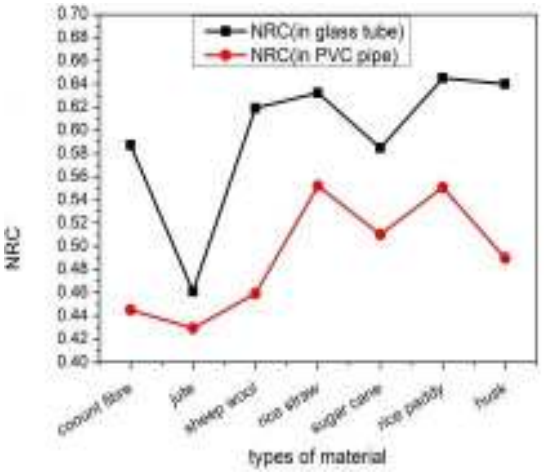


Figure 3.5: Comparative graph between glass tube and PVC pipe

In the above graph NRC is in y axis and all material are in x axis. In above graph we saw that all the material had good absorbing quality. In the comparative graph the set up response was good i.e. all the values were in the range of 0 to 1. Among them rice paddy was the good absorbing quality.

Types of materials	NRC (Glass tube)	NRC (PVC Pipe)
Coconut fiber	0.58722	0.445026
Jute	0.46097	0.429207
Rice paddy	0.64499	0.550791
Rice straw	0.63229	0.551989
Sugar cane	0.58471	0.510017
Sheep wool	0.61908	0.459139
Husk	0.63997	0.489582

CONCLUSION

Exploratory setup is developed to compute the ingestion coefficient of any acoustic material requiring little to no effort as could reasonably be expected. Beginning testing of the setup is made with aluminum foil and after that with various natural fiber test it is found that the framework reacts better at this ease. Examinations of the framework are finished with changing frequency range. Noise control in home appliances has to be economic, simple and easily implemented, since there is global competition among manufacturers. New eco- friendly materials for noise control are being explored and their acoustical properties are good to using a sound absorbing material.

Many natural materials (jute, sheep wool, rice paddy, sugar cane, coconut fibres, husk and rice straw) show good sound absorbing performances and among them rice paddy can be very effective for impact of sound absorption.

FUTURE WORK

Set up can be modified for a tapered glass and PVC tube.

Different material can be fabricated for testing best acoustic material.

Test like thermal conductivity and vibration can be done with the test material of this experiment and some soft computing technics can be implemented to found best result.

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