Use of Acoustic Materials as A Sound Barrier In RCC Structure

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ABSTRACT

The main objective of this work is to determine the noise absorption capacity of a partition sheet prepared with the help of rubber crumb, epoxy resin and hardener with its varying proportion and thickness and comparing its results with the conventional partition which is usually of Brick masonry. An analysis is carried out by preparing a model with a hall using plywood as its exterior wall insulted with foam from inside and parted with a rubber crumb sheet of varying thickness and proportion.There are numerous ways to measure noise, depending on the code in which a noise level measurement is required. Included the possible measurements are: dBA, Leq, Ldn and dB at various frequencies.An analysis work is carried out as per provisions in IS 2526:1862 (Indian Standard CODE OF PRACTICE FOR ACOUSTICAL DESIGN). A long exposure to noise over 85 dB (A) might be a dangerous factor for high blood pressure (BP), and it may induces major increases of (BP) among sensitive individuals. It is a well-known fact that any code based acoustic design approach the performance objective at noise reduction level in preventing the inhabitants of the building against noise exposure and extending a certain level of comfort. On the other hand the owners of the buildings have an idea that once a building is designed without noise control technique the inhabitant of the building will suffer. Based on this new approach, it is possible to design a building that meets the performance levels named above. In order to achieve this "target performance" there are certain design alternatives to be applied one of which is "using rubber crumb". The basic approach in "using rubber crumb" is to provide additional resistance against noise to above conventional level. This approach provides almost elastic response on the structural members and limits the force accelerations sound acting on the structural elements of superstructure and hence to check the efficiency of sound proof structure.

Keywords : Acoustic, Acoustical Design, Rubber Crumb, Epoxy Resin And Hardner, Noise Level Measurement.

I. INTRODUCTION

In India sound pollution is a big problem, every day this problem is increasing and continuously irritating to all the people who living nearby roadways and railway tracks and all that places like bus stand, railway station street ways and so on, which are known to emit unwanted large quantity of sound.

Bestowing to the WHO rules, for a sound sleep, the sound in that room would not be extra than 30dBA. For upholding attention in any workroom, it should not outstrip 35dBA. The uproar level additional than these confines on a nonstop basis, may possibly damage mental as well as physical healthiness on a little time and extended on time basis and to minimize this problem it is required to obstruct sound to enter in workroom or workplaces. It may be in the

form of sheets or panel, which used in outer face or inner face of workroom so as to obstruct sound vibrations coming from highways or roadways.

Huge quantity of rubber tires have been used in shipping over the world for example aero planes, marketable automobiles, two wheelers, etc. That one means that the large figure of tire used is greatly extra than the pollution of vehicle. Finally, the waste tire will be severe environmental problematic due to its Unwanted and potentially hazardous waste since it cannot be despoiled naturally or need very long time for natural deprivation due to three dimensional crosslinking arrangements and occurrence of vulcanized means. Currently, various ways have been suggested for dealing waste tire and it is confidential into three categorizations i.e.: reuse, recycling, rethreading and energy recapture. Reuse method in rubber tire repossession is the lowermost ecological risk since it is changing left-over rubber to another object deprived of influence bad ecofriendly effect associated to energy recovery. Rubber item produced from left-over tire rubber have been broadly executed in human being.

Amongst the severe difficulties characteristic to our current society, those of the contamination and reprocessing have a first rating of importance. In acoustic characteristics, the traffic sound and the left-over tire pollution are a increasing problem. Now in this paper a different way to reduce both harms are presented, consisting in the application rubber waste in the method of recycled material as an absorbent in the manufacture of sound blockades along highways and streets to reduce noise to adjacent residential areas. In this example, the acoustic proposal of new material would be made in such a method that its immersion would be broadband and suitable to the energy band range of the impurity source.

The main objective to do this work is to introduce economical panel for sound proofing so that commercial buildings such as school collages and hospitals can be sound insulated.

II. MATERIALS

Rubber crumb:-

Rubber crumb is grain size waste tire rubber. First of all waste tire rubber are washed very cleanly then left for drying. After drying tire rubber is ready for grinding up to required size like 800micron, 1mm, 2mm, and so on. As plate sheets required.

• It absorbs sound frequencies and gives good sound insulation.

• Effects of heating and cooling are negligible.

• It gives good workability, density and compressive strenths.

Double component epoxy resin:-

one component of epoxy resin is binder which is used for better compaction and another is hardener which gives hard strenths to rubber grain size to combine together so as to sound

can't pass through the crumb rubber sheets or panels.

- It gives superb mechanical strength; it is always cheaper and faster than welding.
- Epoxy has excellence resistance to chemical. After setting, there is no worry of chemical reaction that will weaken the seal.
- It also resists heat. And good for electrical insulation, light weight, sound damping, vibration, and reduction corrosion, Flame resistance, environmental friendly.

III. METHODOLOGY

Study of material

We studied various materials having acoustic properties like foam, fiberglass, rock wool, rubber, etc. We chose rubber as an acoustic material for our work since it is easily available and cheap in cost. As the use of vehicles is increasing day by day the amount of used tyres is also increasing which causes problems in disposing. The used tyres of vehicles needed incineration to disposed off which required high energy and it is highly hazardous for our environment. So instead of disposing we can re-use it in other forms like rubberized asphalt, playground flooring, welcome mats, etc. It is also used in civil engineering to partially replace the aggregates in mortars and concrete. It is also used in the form of crumb or grain to prepare sound insulation sheets. It can provide us economical product for sound insulation.

Rubber crumb

Rubber crumb is a recycled rubber produced from used tyres. We bought a rubber crumb in ample amount from the company where they convert the tyres into crumb for re-use. The used tyres are converted into chips by removing the steel belts, wires, and fabrics. The chips are further processed to form a grain of different sizes through a mechanical process. It shows good acoustic properties. It does not affect through any climatic conditions. The rubber crumb is available in various grain sizes. Different grain sizes posses different coefficient of sound absorption.

Fig.1- Sample of Rubber crumb of specific grain size

Sieve Analysis

We got the rubber crumb in the form of mixture of various grain sizes. Separation of various grain sizes is done by passing the crumb through different sizes of sieves. By passing the crumb through the sieves we got the grain of size 800micron, 1mm, 2mm. We separately stored all sizes of grains for further process. As different sizes of grains posses different absorption coefficient the separation process is done.

Fig.2- Sieve analyis

Preparation of Mould

For the preparation of sheets we needed to prepare a moulds. The preparation of moulds is done by using the wooden boards. We prepared a moulds of size 1ft x 1ft and of variant depth to prepare a sheets of different thickness. As we needed to perform test on sheets of various thickness we prepared a moulds of different depths for the preparation of sheets of different thickness.

Fig.3- Sample of moulds used

Preparation of Sheets

According to the requirement, we took the required grain size of rubber. We mixed the rubber crumb with chemicals and hardener thoroughly in a fixed proportion for proper binding. On a plain surface we placed a plastic bag and a mould over it, mould and plastic bag is oiled or greased properly so that the mould can be

removed easily. After mixing the chemical and hardener we place it in a mould with light compaction. For obtaining the proper finishing we smoothened the surface. By using different grain sizes we prepared a sheets of different thicknesses.

Fig.4- preparing sheet by providing compaction

Fig.5- Sample of sheet after de-moulding

IV. EXPERIMENTAL SET-UP FOR TESTING

We have made wooden box of size 5x3x3 ft. Which open from the top so that we can place the necessary items inside it. Firstly we insulated the inside faces of the wooden box with cotton upto the height of 6 inch. At the center of the

box inside we be provided mould setup to fix our rubber sheet. And a table was provided, to keep our instruments on that such as sound, microphone, amplifier, CRO & a multimeter. And from these arrangement we will calculate our result, By producing certain amount of sound. The procedure is very simple, we produced different frequency amount of sound and then wie checked the frequency of sound reduced after passing through the sheet. And the original sound amount & reduced sound reading was taken and compare . According to this readaing we calculated absorption coefficient of the sheet and transmission loss.

V. RESULTS AND DISCUSSION

According to IS code-2526-1862
Absorption coefficient is the ratio of sound energy absorbed to the incident sound energy on a material.

Sheet no.	Thickness of sheet (cm)	Grain size (mm)	Frequency (Hz)	Avg Coefficient of absorption
1	2.5	Small	2000-2500	0.59
			3500-4000	
2	2.5	medium	2000-2500	0.54
			3500-4000	
3	4	Small	2000-2500	0.65
			3500-4000	
4	4	50% small+ 50% medium	2000-2500	0.62
			3500-4000	
5	7	Small	2000-2500	0.78
			3500-4000	
6	7	50% small+ 50% medium	2000-2500	0.72
			3500-4000	
7	8.5	Small	2000-2500	0.85
			3500-4000	
8	8.5	50% small+ 50% medium	2000-2500	0.8
			3500-4000	
9	10	Small	2000-2500	0.89
			3500-4000	
10	10	50% small+ 50% medium	2000-2500	0.82
			3500-4000	

Table no.1- coefficient of absorption calculation with respect to different frequencies and thickness

In table grain size
Small= 0mm - 2mm diameter
Medium= 2mm - 4mm diameter

According to the different coefficient of absorption calculated, we came to know that the different thickness sheets with different

proportion grain size sheets gives different coefficient of absorption. The best sheet which is economical to use is of 8.5cm of small grain size as it gives required insulation so there's no need to
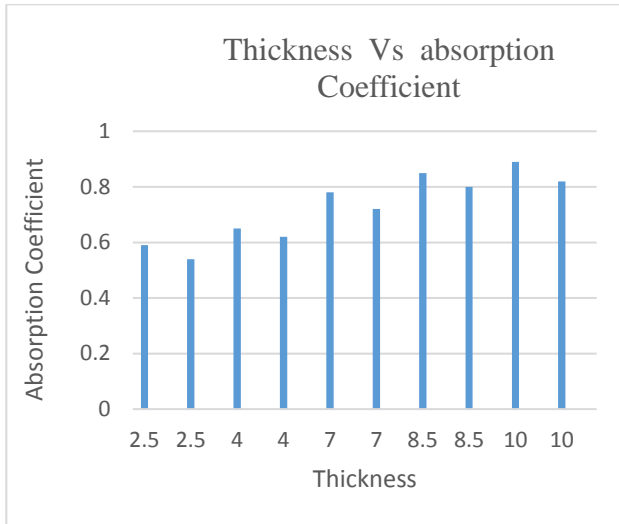

Fig.6- graph showing variations in thickness of different grain size

VI. CONCLUSION

According to the various experiments performed over different thickness sheet made of different proportion of grain sizes by using sound transmission loss equipment made by us in our laboratory, it is concluded that the rubber crumb has good sound absorption properties.

And as we compare different sheets coefficient of absorption, than the sheet made up of least diameter grain size with maximum thickness i.e. of 8.5 cm (90% rubber crumb of 2mm grain size and 12.5% double component epoxy resin) gives the best coefficient of absorption.

Moreover we also came to know that if we want more insulation from sound i.e. more than the traffic intensity than by increasing the thickness of the sheet we can achieve that.

It is durable and can be used in commercial buildings such as hospital, school, and collages because these are places where people gets disturb due to high noise, and hence their mental and physical health gets affected, so to avoid such conditions these sheets can used as its economical and easy to be prepared in less amount of time.

VII. REFERENCES

[1]. F. Asdrubali, G. Baldinelli, F. D'Alessandro, "Evaluation of the acoustic properties of materials made from recycled tyre granules", Proc. Inter-noise 2007, Istanbul, Turkey (2007)

[2]. Acoustics - Determination of sound absorption coefficient and impedance in impedance tubes - Part 2: Transfer-function method, International Standard ISO 10534-2: 1998 (International Organization for Standardization, Geneva, Switzerland, 1998).

[3]. M.J. Swift, P. Bris, K.V. Horoshenkov, "Acoustic absorption in re-cycled rubber granulates", Applied Acoustics 57, 203-212 (1999).

[4]. J. Pfretzschner, R.M. Rodriguez, "Acoustic properties of rubber crumbs" Polymer testing 18, 81-92 (1999).

[5]. Farrag Nermin Mokhtar1, Ibrahim Vitta Abdel Rehim2 and Elalfy Ayman Mahmoud (2007)- Applicability of using recycled rubber- tyre materials for acoustic insulation in barriers of residential areas in egypt

[6]. F. Asdrubali, F. D'Alessandro and S. Schiavoni Universit`a degli studi di Perugia, Via G. Duranti 67, 06125 Perugia, Italy