



Rubber Crumb and Wooden Chips A Sound Barrier in RCC Structure

Prof. Mohd Atif¹, Aboli Sontakke², Apurva Nitnaware², Mohammed Shariq², Mohammed Shadab²

¹Assistant Professor, Department of civil Engineering & Technology, Anjuman College of Engineering and Technology, Nagpur, Maharashtra, India

²UG Scholar, Department of civil Engineering & Technology, Anjuman College of Engineering and Technology, Nagpur, Maharashtra, India

ABSTRACT

In this day and age, noise pollution is one of the hazards experienced by human beings. the commercial sector experience the peak level of noise pollution, hence building in commercial area experience a high level of noise pollution. to overcome such issues there are different alternative solutions available in the market. the alternative solution helps you achieve a certain amount of resistance to noise pollution. the alternative solution we are approaching is through producing acoustic sheets made from acoustic materials. the sound barrier sheets are prepared in dimension that the sheets can be introduced to outer walls of buildings. the material which is used for sheets are rubber crumbs and, these two material satisfy as an acoustic material, they also withstand the different atmospheric condition. rubber crumbs and , not only they serve as waste material but also they have acoustic property that fulfills the condition to prepare a sound barrier sheet. in terms of the provision in is 2526: 1862(Indian standard code of practice for acoustic design) the analysis is worked out on this basis. the amount of sound reduction approached by the sound barrier sheet will help in a commercial building to achieve that control over noise level. all these things considered, the sound barrier sheet will give an effective result for sound insulation. These sheets can also be introduced to the existing building structure. therefore, rubber crumbs and will approach resistance against sound. 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 Design, Wooden Chips, Rubber Crumbs, Harder Rubber

I. INTRODUCTION

The noise control plays an important role in assuring acoustically pleasant environments []. One of the most important factors in noise reduction is represented by the materials used in different structures with soundproofing role. The use of composite materials based on rubber crumbs and wood chips or flacks for noise reduction have two major advantages, namely low production costs and efficient sound insulation. Knowing acoustical properties of these porous materials is useful for proper application in products such as sound barriers,

walls, road surfaces. In order to protect the environment on one hand by recycling the residues from primary and secondary technological process and on the other hand by attenuate the noise from industry or urban traffic, different systems were developed based on recycling solid waste (wooden chips, rubber crumbs). Literature review relieved numerous studies regarding the sound transmission loss of different types of materials such polyester fibre, glass fibre and urethane foam.

In this paper the assessment of the acoustical properties of new composite structures based on

wood chips and rubber crumbs bonded together with chemical binders is presented.

II. Study of Material

We have understood properties of various materials having acoustic properties such as waste materials like wooden chips, rubber crumbs, wooden shavings, and fibre glass etc. We finalized rubber crumb and wooden chips as an acoustic material for our project because it is readily available in market and it is waste material and cheap alternative to fibre glass and other acoustic materials. Nowadays sound transmission by the use of vehicles is surging day by day the number of used tyres is also increasing which leads to a problem in disposing off. These used tyres of vehicles needs incineration for proper disposal. It requires immense energy and it is highly dangerous for our environment. So instead of disposing we can re-use it in other state like lumber and construction products, rubberized asphalt, insulation products, wheels of cart 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.

Properties of Rubber crumbs:

Tensile strength-

Tensile strength is the amount of force needed to tear apart a rubber specimen until it breaks, it also known as ultimate tensile strength.

Resilience-

Resilience, also known as rebound, is the ability of rubber to return to its original size and shape following a temporary deformation, such as contact with a metal surface. Resilience is critical in dynamic seals that serve as a barrier between stationary and moving surfaces.

Abrasion Resistance-

Abrasion resistance is the resistance of rubber to abrasion by scraping or rubbing, Abrasion resistant rubber is used in industrial application.

Elongation-

Elongation is defined as the percentage increase ,or strain, in the original length of rubber sample with the application of a tensile force, or stress. Certain elastic tend to stretch more compared to others. Natural rubber for instance can stretch up to 700% prior to reaching its ultimate elongation, which causes it to break.

Tensile Modulus-

Tensile modulus is the stress or force required for producing a strain or an elongation percentage in a rubber sample. Harder rubber usually has a higher tensile modulus, making it more resilient, It is also more resistant to extrusion, which is a process for manufacturing stock materials used in custom fabrication.

It is elastic, because of this property a rubber band can be stretched to 9 to 10 times its original length and when the load is removed it regains its original length.

It is strong and tough, because of this property it can be put to use even under abnormal conditions.

It is highly impermeable to both water and air and therefore, it can be used to retain water as in rubber bottles, hoses etc.

It exhibits a great resistance to abrasion, tearing and cutting over a wide range of temperature from 7 to 115 degree celsius.

It is a bad conductor of heat.

By vulcanizing the rubber, its mechanical properties can be considerably improved.

Rubber insulation and other rubber products require shaping prior to vulcanisation because the vulcanised rubber cannot be shaped by mechanical pressing once it has acquired its characteristic plasticity. By vulcanising rubber in moulds, products of rather intricate shape can be obtained.

Properties of wooden chips:

Serviceability-

It is a feature of wood to divide into parts of wood under the action of forces machining of wood with the removal of chips is based on this feature- sawing ,milling ,turning, grinding and without removing materials-cutting materials on shears ,punching ,chopping or bundling of wood- wood for logs ,wood chips on the needle-shaped shaving ,a big chip on the micro-and fibrous.

The ability of wood to hold metal fasteners-is a feature ,explained by the wood elasticity.when hammering a nail fibres move apart partially, putting pressure on the lateral surface ,causing the mutual friction ,that keeps the nail in the wood.

Cleavability-

It is the ability of wood to break down along the grain during penetration a wedge-shaped body into it.

Fragility-

It is the ability of wood to break down suddenly without significantly shape changing under the action of mechanical forces.

Impact strength-is the ability of wood to absorb the work without breaking.

Sieve Analysis

We got the rubber crumbs of variable grain sizes. So, we sieved this mixture of various grain sizes to obtain crumbs of different sizes by passing the crumb through different sizes of sieves. By passing the crumb through the sieves we can get the grains of size

800micron, 1mm, 2mm, 3mm, 5mm, 6mm. We stored all sizes of grains separately for further process. As different sizes of grains possess different absorption coefficient.

III. EXPERIMENTAL SET UP

2.1. METHODS AND MATERIALS

The sound insulation which we want to address, is through providing rubber crumbs and wooden chips sheets. the dimension of the sheet is secured to be 1ft x 1ft as a standard size. the sheets are made of a proper balance of wooden chips and rubber crumbs however the width of the sheets is fluctuating since to learn the behavior of the sound reflection by the changed width of sheets.

To make a uniform sheet the wooden chips and rubber crumbs need to be mixed within a balanced proportion including the cooperation of binder and hardener. hardener and binder performs a crucial role in preparing a sheet. Binder which we are applying in this process is Epoxy Resin.

The mold of size 1ft x 1ft is prepared to hold the blend of wood chips and rubber crumbs mixture with the cooperation of binder and hardener. Epoxy resin helps to secure the rubber crumbs and wooden chips collectively and mold serves to achieve the shape of the sheet plus the width of one sheet. Hardener helps to achieve the solid shape within 25 minutes.

One of the widely used methods to determine the acoustic properties (absorption coefficient, impedance ratio, reflection coefficient) is the international standardized impedance tube method, the one we are directing is the same as that except we are performing in a wood box. The principle of this method is based on the measurement of the transfer function between two signals of microphones mounted inside the box.

In accordance with the measurement chain, an audio frequency ranger is located at a certain measurement, the amplifier is located and then at an appropriate length microphone is installed at the unit side of the box. the other unit is installed in such a way that the sheet sample is placed at equal distance from each side and then at the regular distanced microphone is placed and then the amplifier is installed. the box is constructed out of wood hence there is a chance that sound is reflected, due to this observation can be disturbed, therefore, the thickness of cotton is installed on every side of the wooden wall to give efficient results. When the box fed by frequency bands, a stationary plane wave is created and pressure measured with microphones can be decomposed into its incident and reflected components. First, the equipment without samples was equipped, to configure the microphones. This operation is necessary because of the phase and amplitude of the two microphones are not perfectly identical. In this sense the frequency response function is measured with the two microphones interchanged position. each sample of sheet is properly inserted into the wood box and then the measurements start. the wood box is of Box size - 5ft x3ft x 3ft, wherever the wooden sheet thickness is 6mm. The cotton that is placed around the sides of the sheet is 6 inches.

Materials Used-

A. Double Component Epoxy Resin-

- 1. Epoxy resin- 800ml
- 2. Hardner-200ml
- Total cost=1200Rs/-

B. Rubber Crumb- 10kg

- Cost=18Rs/- (Per Kg)
- Grain Size- 850 micron – 6mm

C. Wooden Chips- 5kg

- Cost=5-10Rs/- (Per Kg)

D. Cotton- 20kg

- Cost=60Rs/- (Per Kg)

E. Wooden Plywood- 3 MR grade sheets

- Cost=1300Rs/- (Per sheet) Thickness- 6mm.

1. Rubber crumb is a recycled rubber produced from used tires. We collect a waste rubber crumb from the rubber company according to our needs in different sizes.they rubber company collect waste tire and converted it into rubber crumb to reuse them. Rubber crumb has a good acoustic material and they have good thermal coefficient of expansion.
2. Wooden chips are small to medium sized of wood formed by cutting or chipping larger pieces of wood. We collected wooden chips from the shop of wooden chips according to our requirement.wood is a light material, that why it is a good acoustic material. Wood transfer sound in longitudinal direction than perpendicular wood structure easily reflect sound.
3. We used single component epoxy resin and hardener according to our requirement which is needed to make a thick sheet of rubber crumb and wooden chips the ¼ part of epoxy resin is taken as hardener.

IV. 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)	Average Coefficient of Absorption	Remark
1.	6	850micron rubber crumb	2000-3000	0.54	1. Rubber Crumb individually proves to give efficient

					result over a sheet with combined rubber crumb and wooden chips. 2. Size of rubber crumb and wooden chips is directly proportional to coefficient of frequency absorption.					frequency absorption. More the thickness, more will be the frequency absorption coefficient.	
2.	6	850 micron Rubber Crumb + 2mm wooden chips	2000-3000	0.6		6.	8	850 micron Rubber Crumb + 2mm wooden chips	2000-3000	0.57	
3.	6	1mm Rubber Crumb	2000-3000	0.59		7.	8	1mm Rubber Crumb	2000-3000	0.56	
4.	6	1mm Rubber Crumb + 3mm wooden chips	2000-3000	0.66		8.	8	1mm Rubber Crumb + 3mm wooden chips	2000-3000	0.62	
5.	8	850micron rubber crumb	2000-3000	0.50	Thickness of Sheet is responsible for coefficient of frequency	9.	8	2mm rubber crumb	2000-3000	0.62	1. Finer grain size of rubber crumb cause the sound to insulate within the small voids available between each grain, thus causing more frequency absorption

					n.
10.	8	4mm rubber crumb	2000-3000	0.73	
11.	8	2mm Rubber Crumb + 5mm wooden chips	2000-3000	0.75	
12	8	4mm Rubber Crumb + 5mm wooden chips	2000-3000	0.82	

Table No 1. Coefficient of absorption calculation with respect to different frequencies and thickness.

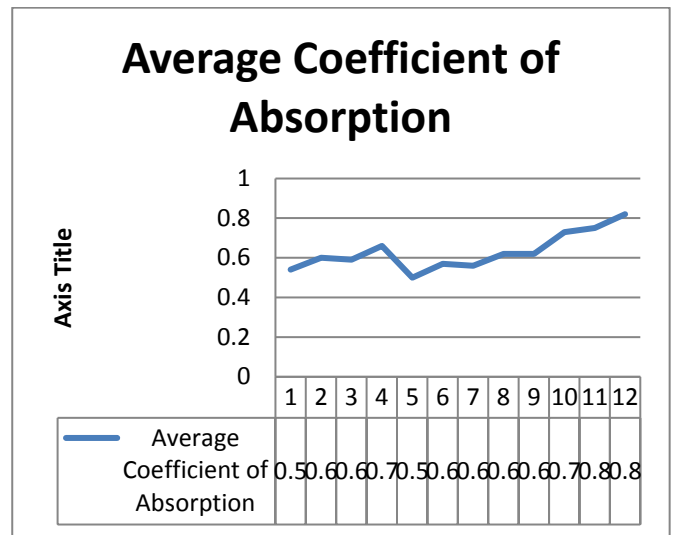
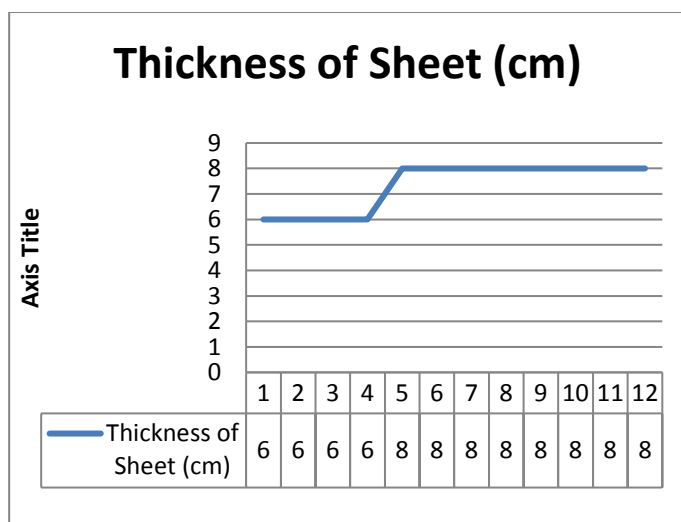
In table grain size :

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 sheet gives different coefficient of absorption.

The best sheet which is economical to use is of 8.5 cm of small grain size as it give required insulation so there's no need to.



V. CONCLUSION

The experimental investigation aimed to determine the acoustical properties of new materials obtained by waste rubber crumbs and wood residues. These materials were designed for assuring a good acoustic and thermal insulation. The composition of binder Epoxy resin had a great influence upon the acoustical properties of the samples (absorption coefficient, impedance ratio, reflection coefficient). Concerning the sound absorption coefficient, both the sheets offer a very good sound absorption at high frequencies, the fact that recommends the materials for sound insulation application.

VI. REFERENCES

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