RECOMMENDATION OF BAMBOO AND TULSI AS INDUSTRIAL SOUND ATTENUATION MATERIALS

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ABSTRACT

Noise control is one of the major requirements to improve industrial working Environment. The higher noise level is one of the most highly found contaminant in the industrial sector. Its negative effects are related to hearing system and professional deafness and permanent deafness. Industrial noise can interfere with communication between supervisors and employee. Continuous exposure to higher noise level reduces the pace and quality of work. Noise affects negatively on health of industrial workers and life of surrounding people. The research work was conducted to investigate the use of Bamboo and Tulsi for industrial noise attenuation to give effective solution for industrial noise problem. Specimens were prepared using Tulsi, Bamboo, cement and wood grip (Adhesive). Specimen having thickness 12.5mm And 25mm while diameter is kept 75mm for all specimen casting. Tulsi and Bamboo mixed with cement and wood grip at ratio 0.5:0.5:0.5:0.5 and 1:1:0.5:0.5 with addition of water. Noise Reduction coefficients of specimens were calculated by using impedance tube system experimental set up. Impedance tube system experimental set up consists of stereo speaker, noise level meter and frequency generator. Effectiveness of Tulsi and bamboo for industrial noise attenuation is discussed in this paper.

Keywords- *Bamboo, Impedance tube system, Noise reduction coefficient (NRC), Tulsi. Wood grip*

I. INTRODUCTION

A long exposure to noise over 85 dB might be dangerous factor for high blood pressure. Every industrial worker are exposed to noise and to all its consequent risks in their workplace. Recently noise has come to regarded as one of the most harmful environmental pollutants. A comfortable workplace free from harmful noises is always expected by industrial workers. Workers are exposed to continuous noises the whole work day. Continuous higher noise level causes heart problems, pain in internal tissues, hearing loss, higher blood pressure. The effect on blood pressure of industrial noise irritation at work, night shift work and work contentment were studied and effect of an annoyance on blood pressure was found [1].

Some advanced sound reduction techniques are available in the market for industrial noise reduction such as sound enclosure for industrial machinery, soundproof curtains, acoustical wall panel, barrier wall, duct silencers, but these techniques are expensive. In addition these materials consume Co_2 emission during their manufacturing process (i.e. glass fiber) [2]. However India has not yet yielded much into this issue possibly because of these methods are expensive. Therefore it is important to investigate Techno- Economically feasible product for attenuation of industrial noise.

An Economical and environmental friendly noise reduction technique, probably by using natural materials, will be a sustainable solution to protect industrial workers and surrounding peoples from industrial noise. In this research study main objective is to investigate sound reduction capacity of natural material (Tulsi, Bamboo) in the industrial frequency range(1KHz-8KHz).

In a previous study by N.S. Shinde investigated noise reduction properties of bamboo with cement. He have found that Noise Reduction Coefficient (NRC) is increases with increase in specimen thickness. Further he have found that NRC is greater for specimen of large particle size than that of specimen of small particle size[3].

In present study Tulsi (Holy Basil) and Bamboo was studied for their noise reduction properties. Tusli is selected due to their high availability it is also used in medicine. Tulsi stem fiber possesses noise reduction properties like low density, spun fiber having large pores, light weight and pores in nature and easily available in the market at moderate prices. Texture of Bamboo consists of fibers also easily available.

II. RESEARCH METHODOLOGY

Research methodology includes specimen preparation, development of experimental set up and laboratory testing.

2.1 Specimen Preparation

Circular shape was selected for specimen preparation. Specimens were prepared by mixing Tulsi (Holy Basil) and Bamboo of different particle size with cement and wood grip (Adhesive) at different mix proportions. Specimen diameter was kept 75mm for each specimen and thickness was kept 12.5mm and 25mm. The plastic mould of 100 guage PVC pipe ring was used for specimen preparation.

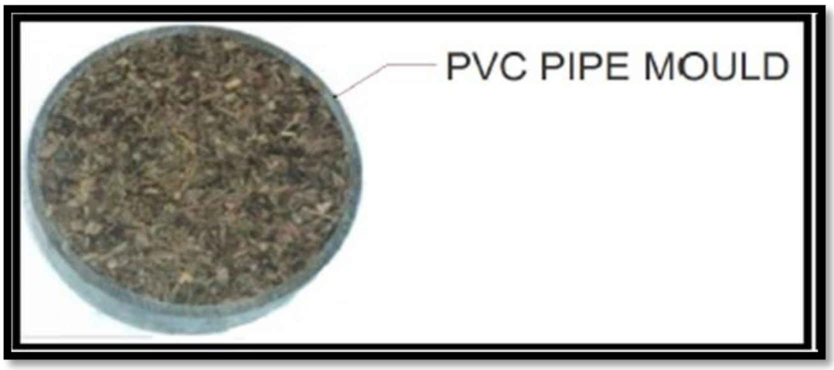

Fig.1 Specimen Used for Noise Testing

0.5:0.5:0.5:0.5 and 1:1:0.5:0.5 these mix proportions are used for specimen casting. Following particle size were used for specimen preparation

i) 0.6mm – 1.18mm

ii) 1.18mm-2.36mm

Sieve analysis is carried out according to IS: 2720 (part iv)-1985 to obtain fraction of mentioned particle size. Specimens were prepared using selected particle size of selected materials to investigate effect of particle size and specimen thickness on noise reduction capacity of specimen. Prepared specimens were kept in laboratory for one week hardening. Various material combinations and their mix proportions are as given in table 1.

Table 1: Material Combinations and Mix Proportions used for Specimen Casting

Sr.No	Material Combinations with its Nomenclature	Mix Proportions on weight basis	Particle size Ps (mm)	Specimen Thickness (mm)
1	**Cement:Wood grip:Tulsi:Bamboo (C:WG:T:BB)**	0.5:0.5:0.5:0.5	0.6<Ps<1.18	12.5
				25
			1.18<Ps<2.36	12.5
				25
		1:1:0.5:0.5	0.6<Ps<1.18	12.5
				25
			1.18<Ps<2.36	12.5
				25

2.2 Development of Experimental Set up

Experimental set up were developed similar like Impedance tube system [4]. The impedance tube system gives accurate measurements for sound absorption coefficient and the impedance according to the standards of ISO 10534-2[5]. Experimental set up were developed using apparatus and equipment's as explained below.

3 MHz function pulse generator with 40MHz frequency counter was used for sound generation by providing frequency input at each octave band center frequencies from 63Hz to 16000Hz, Function generator model specification Caddo 4061, Stereo speaker, Pyramid 4080 with frequency response 60Hz – 20000Hz and 250 watt power rating to produce noise of higher intensity inside the tube.

The tube materiel is not specified in ISO 10534-2 but strongly recommend that tube material must be sufficiently rigid to avoid transmission of noise from outside or background noise sources into the tube. ISO 10534-2 also recommend that length of the tube should at least 10-15 times of the tube diameter and wall thickness of the tube should 5% of the diameter. Thus SWR pipe is used as propagation tube which fulfill all above mentioned recommendations. Noise level meter (Model SL-4010) is used for noise level measurement.

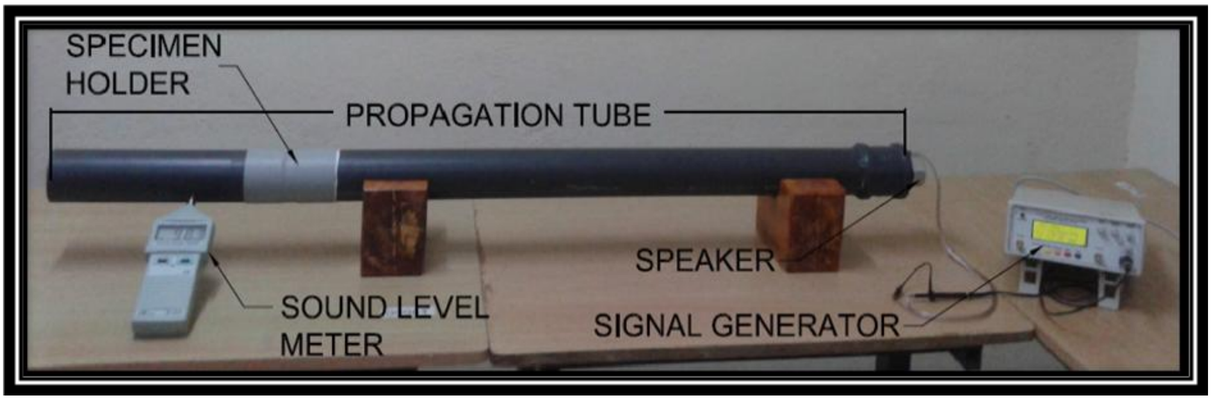

Fig.2 Experimental Set up for Noise Absorption Measurement

2.2 Laboratory Experimental Work

Experimental set up were developed as shown in fig.2. The main objective of this test is to determine sound absorbed by the specimen and to determine Noise Reduction Coefficient for each specimen. Noise levels are measured from 63 Hz- 16000Hz, starting from 63 Hz and gradually increased up to 16000Hz. Noise Reduction Coefficient can be determined by ratio between Reduced noise intensity due to placing specimen inside the propagation tube to the Incident noise intensity due to without placing specimen inside the propagation tube.

$$\text{Noise Reduction Coefficient (NRC)} = \frac{\text{Intensity of the Reduced Noise}}{\text{Intensity of the Incident Noise}} \quad \text{----------------} (1)$$

Here,

Incident Noise Intensity is Intensity of noise without placing specimen ("a" dB)

Reduced Noise Intensity is Intensity of noise with placing specimen ("b" dB)

Incident noise intensity is measured without placing specimen, twice to take accurate measurements. Then reduced noise intensity is measured for each frequency center (63Hz-16000Hz) without placing specimen

III. RESULTS AND DISCUSSION

From observations and Noise Reduction Coefficient it is observed that NRC values increases with increase in thickness of specimen and larger particle size. Effective NRC values were observed for following material combinations.

Table 2. Calculated Noise Reduction coefficient of Effective Material Combinations

Material Combination	Mix proportion	Particle size (mm)	Specimen thickness (mm)	Octave band frequencies (Hz)								
				63	125	250	500	1000	2000	4000	8000	16000
				Noise reduction coefficient (NRC)								
C : WG : T : B	0.5 : 0.5 : 0.5 : 0.5	0.6 < Ps < 1.18	25	0.15	0.15	0.11	0.01	0.16	0.34	0.33	0.38	0.44
		1.18 < Ps< 2.36	25	0.14	0.11	0.07	0.01	0.08	0.40	0.30	0.35	0.41
	1:1:0.5:0.5	1.18<Ps <2.36	25	0.14	0.12	0.07	0.01	0.08	0.30	0.32	0.34	0.53

Fig.3 shows Noise Reduction Coefficients for the material combinations Cement: Wood grip:Tulsi: Bamboo having ,mix proportion 0.5:0.5:0.5:0.5, specimen thickness 25mm and particle size 0.6mm-1.18mm. NRC value is 0.34 at 2 KHz frequency. i.e. selected material combination is effective for noise reduction at moderate frequency range. NRC value increases from 0.33 to 0.44 at 4KHz-16KHz frequencyge, hence selected material perform well at higher frequency range. Hence selected material combination gives better results for noise reduction and reduce noise uo to 44%. It brought 100 dB noise level upto 66dB,67dB,62dB and 56dB at 2KHz, 4KHz, 8KHz and 16KHz respectively.

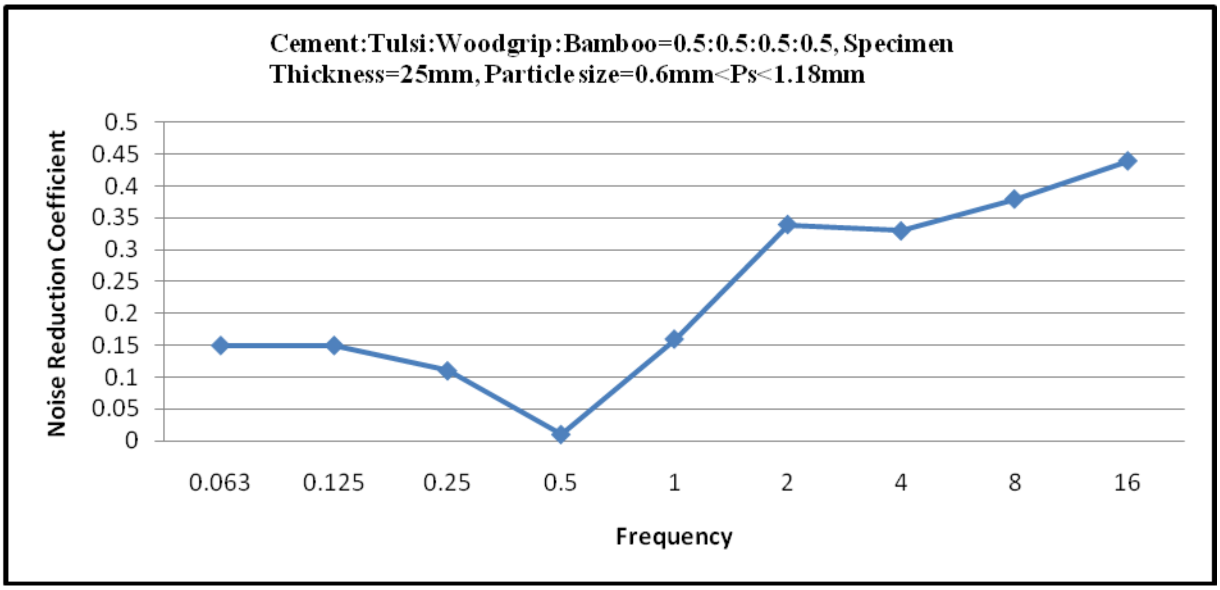

Fig.3 Graph Showing NRC Values for Cement:Woodgrip:Tulsi:Bamboo

Fig.4 showing NRC values for the material combination Cement:Woodgrip:Tulsi:Bamboo having mix proportion 0.5:0.5:0.5:0.5, specimen thickness 25mm and particle size in between 1.18mm -2.36mm. At frequency 2KHz NRC value is 0.40, it means selected material gives better results at moderate frequency range. NRC increases from 0.30 to 0.41 at 4KHz-16KHz frequency range. i.e. selected material combination perform well at higher frequency range.

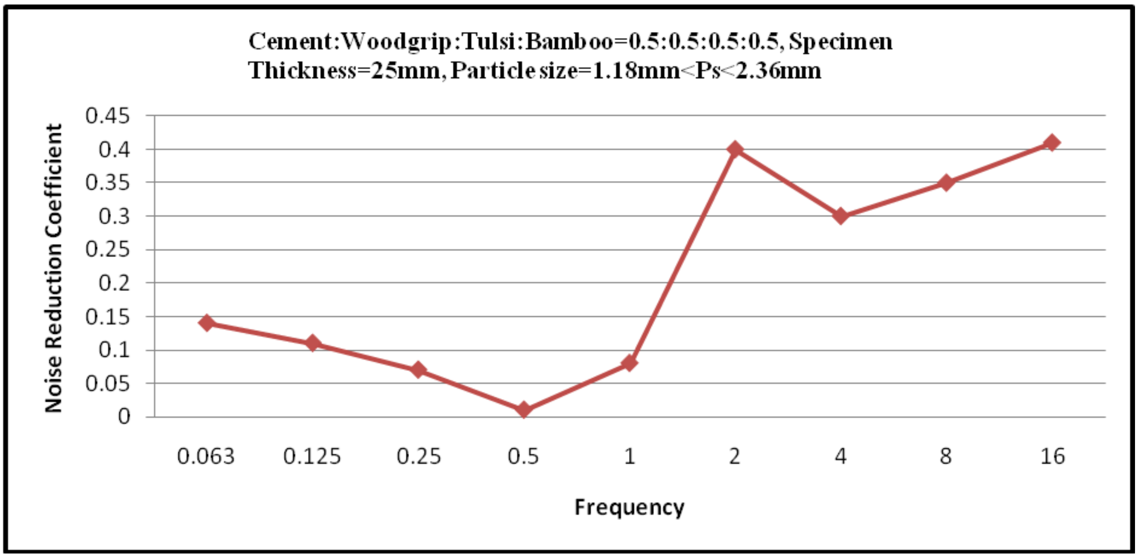

Fig.4 Graph Showing NRC Values for Cement:Woodgrip:Tulsi:Bamboo

Fig.5 shows Noise Reduction Coefficients for material combination Cement:Wooip:Tulsi:Bamboo having mix proportion 1:1:0.5:0.5, specimen thickness 25mm and particle size in between 1.18mm -2.36mm. NRC value increases from 0.30 to 0.53 at 2KHz to 16KHz frequency range. it means selected particle size of selected material combination is effective for noise reduction at higher frequency range. it can reduce noise level of 100dB up to 70dB,68dB,66dB and 47dB at 2KHz,4KHz,8KHz and 16KHz frequencies respectively.

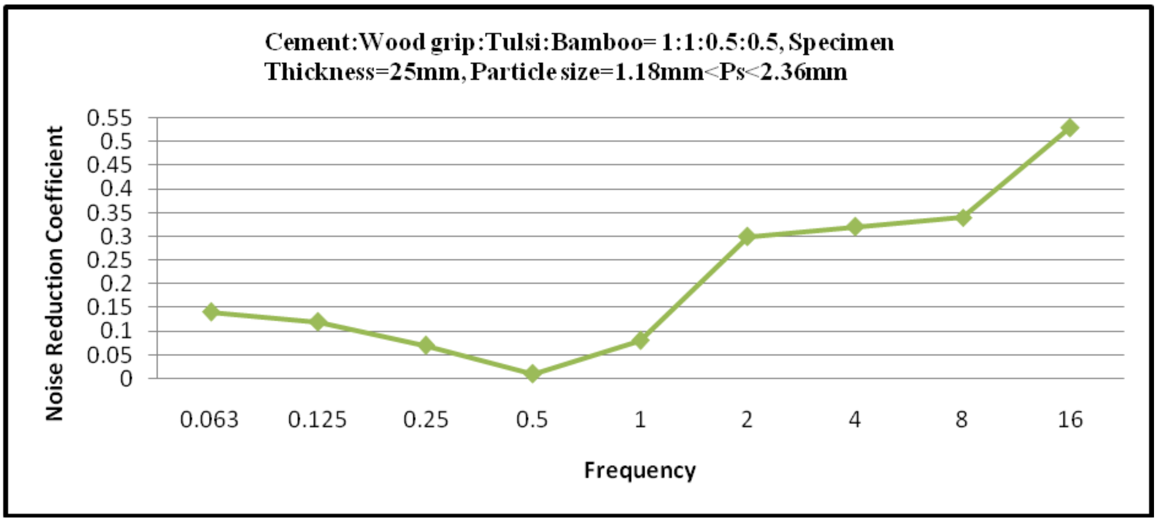

Fig.5 Graph Showing NRC Values for Cement:Woodgrip:Tulsi:Bamboo

IV. CONCLUSION

Noise Reduction Coefficient for different specimen thickness and different particle size was investigated for material combination Cement: Wood grip:Tulsi:Bamboo. These material combinations were found effective for industrial noise reduction. Selected material combination performs well at moderate frequency (2 KHz) and at higher frequency (4KHz-16KHz) range. Higher noise level of 100dB can be brought to permissible acceptable limit of ambient noise standards both during day and night. Selected materials easily available in the market with low cost. Hence industrial noise can be easily brought to acceptable limit of ambient noise standards. From analysis overall efficiency of selected material combination observed better. It is recommended that this material combination is more suitable for industrial noise reduction.

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