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Techno-Economical Study of Innovative Construction Material for Industrial Noise Abatement

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***Abstract*— Now a days Noise pollution is largest unwanted sound in the industrial sector. The Global population has grown in different decades Such as 1980-2000, 2000-2024. The annual population increase during the preceding decade about 2 percent. Due to increase in population, urbanization and industrialization happening and because of this noise pollution is increasing. In the world mostly noise generated from industrial sector. This noise create negative impact on surrounding environment such as (human, vegetation and animals) health. Effect of exposure to high noise level on workers and their performance of work and calmness. This research work was conducted to investigate the use of sound absorbing various combinations of green material for industrial noise attenuation to give effective solution for industrial noise problem. The specimen was prepared using different combinations with binding material cement (Adhesive). Noise reduction coefficients of specimens were calculated by using impedance tube system experimental setup. Effectiveness of sound absorbing natural materials for industrial noise attenuation is discussed in this paper.**

***Keywords* — Sound absorbing of green material, noise level meter, Impedance tube system, Stainless steel. Cement**

1. INTRODUCTION

Noise is in invisible and overlooked type of pollution. As we all aware about the present situation of the country day by day the noise pollution is going to increases and this leads to serious impact on workers. Quality of life and peace is free from harmful noises is always excepted by industrial worker. Workers are exposed to continuous noises the whole work day. The effect on hearing loss, increase stress, communication barriers, health issue, decreased performance etc. Noise pollution can have detrimental effect on physical and mental well-being of workers.

Implementing noise control measures, providing bearing protection and creating quite zone to minimise it's impact on workers.

Noise pollution in large industries around the world is a serious environmental issue. The ear issue is a most permanent psychological issue caused by unwanted noise. This issue is reduced by using natural sound absorbing material. This techno - economic study focuses on evaluating the feasibility and economic viability of utilising unconventional material such as Bamboo, Coconut coir, Rice straw, Jack fruit peel, Cow dung, Tulasi. This material used in noise reduction in industrial sector.

These materials offer unique properties that make them potentially suitable for noise reduction, such as sound absorbing capabilities, natural acoustic properties and sustainability benefits this research seeks to provide valuable insights into the feasibility of implementing unconventional noise reduction strategies in the industrial sector.

1.1 Problem Statement

Noise pollution is largest unwanted sound in the industrial sector. The Global population has grown in different decades Such as 1980-2000, 2000-2024. Due to increase in population, urbanization and industrialization happening and because of this noise pollution is increasing. In the world mostly noise generated from industrial sector. This noise create negative impact on surrounding environment such as (human, vegetation and animals) health. To investigate the use of sound absorbing various combinations of green material for industrial noise attenuation to give effective solution for industrial noise problem.

1.1 Objective

- To study of industrial noise and it's important characteristics.
- To improving the quality of life for workers and surrounding communities.
- To identify Properties of each material and their potential for mitigating industrial noise.
- To identify important noise sources in industrial sector.
- To study cost effectiveness of new construction materials and their suitability.

2. Literature Review

1. K. Nagasahadeva Reddy; B. Chidambar Reddy, M. Bhavya, J. Sailaja, J. Jaisai ‘’Sound Reduction Technology by using Agro waste’’ Corresponding

Author: K. Naga Sahadeva Reddy Civil Engineering Department; Sanskrithi School of Engineering, Puttapatthi, Affiliated by JNTU Anantapur, Andhra Pradesh, India, 25 May 2020

Increasing use of electrical and mechanical appliances at home and industries has created a concern for noise pollution created by them. Urbanization and heavy growth of construction work in every neighbourhood further emphasize the need of new technologies for noise reduction.

2. Mr. Rupesh R. Kadam, Mr. Nitin S. Shinde, RECOMMENDATION OF BAMBOO AND TULSI AS INDUSTRIAL SOUND ATTENUATION MATERIALS, International Journal of Innovative Research in Science and Engineering, Vol. No.2, Issue 09, September 2016

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.

3. Kuo-Tsai Chen, "Study on the Acoustic Transmission Loss of a Rigid Perforated Screen" Applied Acoustics, Vol. 47, No. 4, pp. 303-318, 1996.

This literature also highlights the technique of noise control using a sound absorber consisting of a perforated facing backed with a porous material, and is commonly used as a sound barrier, muffler in any of the practical acoustic application.

4. A. Y. Ismail, N. A. M. Shadid and A. M. M. Nizam ''Development of Green Curtain Noise Barrier Using Natural Waste Fibres'' Journal of Advanced Research in Materials Science ISSN (online): 2289-7992 | Vol. 17, No.1. Pages 1-9, 2016

Noise pollution is one of the major problems in industry. Noise, which is commonly known as undesired sound, comes from numerous industrial machineries and very harmful to the human body.

5. Lamyaa Abd AL-Rahman, Raja Ishak Raja and Roslan Abdul Rahman. "Attenuation of Noise by Using Absorption Materials and Barriers", International Journal of Engineering and Technology Volume 2 No. 7 pg. 1207-1217, July, 2012.

In this paper authors have highlighted the recent approach of sound attenuation using various absorption materials, barriers and screen techniques.

3. Questionary Setup

In our industrial visit we asked questionnaire open ended and closed ended questions. We were need to balance these considerations with available time and resources so both type of questionaries asks. In close ended questions and responses is limit and open - ended question responses is broad range of answers.

4. Data Collection and Testing

Data Collection includes specimen combination, specimen size, material, Impedance tube setup and Testing.

4.1 Specimen Preparation

PVC pipe ring used for for specimen preparation. It PVC pipe ring in a circular shape. Specimen were prepared using Tulasi, Bamboo, Cow dung, Coconut coir, Rice straw, Jack fruit peel, Salvinia, Cement (Adhesive). Specimen thickness is 12.5mm and diameter is kept 75mm for all specimen casting.

Two or three green materials mixed with cement at different ratio with addition of water.

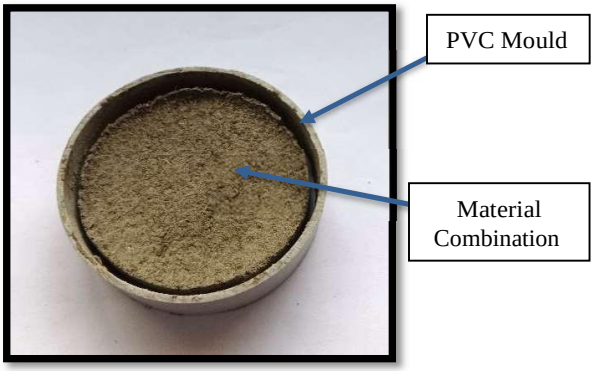

Fig.1 Specimen Used for Noise Testing

Identify firstly particle size of material by sieve analysis. Sieve analysis doing according to IS 2720 (part 4) 1985 to obtain fraction of mentioned particle size.
Particle size and specific thickness is important for noise reduction capacity of specimen. Specimen are prepared in the lab and kept 14 days for cement proportion.

Fig.2 Material Collection

Various material and their mix proportion are as given below:

Table No. 1 Material Combinations and Mix Proportions used for Specimen Casting

Sr. No.	Material Combination With its Nomenclature	Mix proportion on weight basis
1	Cement : Cow dung : Tulasi (C : CD : T)	1.5:0.3:0.3
2	Cement: Tulasi : Rice straw : Cow dung. (C : T : R : CD)	1.5:0.3:0.15:0.3
3	Cement : Cow dung : Coconut coir (C : CD : CC)	1.5:0.5:0.3
4	Cement : Salvinia : Coconut coir. (C : S : CC)	1.5:0.5:0.3
5	Cement : Salvinia dust : Rice straw: Tulasi (C : S : R :T)	1.5:0.25:0.2:0.25
6	Cement: Salvinia dust : Rice straw. (C : S : R)	1.5:0.5:0.2

4.2 Development of instrument setup

Instrument setup developed show in fig.2 Purpose of this instrument is to determine noise observed by specimen. Instrumental setup were developed using apparatus and equipment details below. Use of stainless steel pipe is propagated tube. Impedance tube system experimental setup consist of stainless steel union, stereo speaker, noise level meter and frequency generator. Stainless steel union is connected by brass plate with bolt. Stereo speaker was used 5 watt produce. Wooden support required to the propagated tube. Noise intensity inside the tube. 30 MHz function pulse generator use in specimen testing. Providing frequency input at each octave band centre frequencies from 63 Hz to 16000 Hz. Function generator model specification Hi-tech (FG5003).

Tube material is not mentioned in ISO 10534-2 but recommend that tube material must be sufficiently to avoid noise from outside or background of noise sources. Length tube should be at least 10-15 times of tube diameter these are recommended in ISO 10534 -2. Propagation tube fulfill all recommendation. Noise level metre (accordance with the international committee IEC -651) is used for noise level measurement.

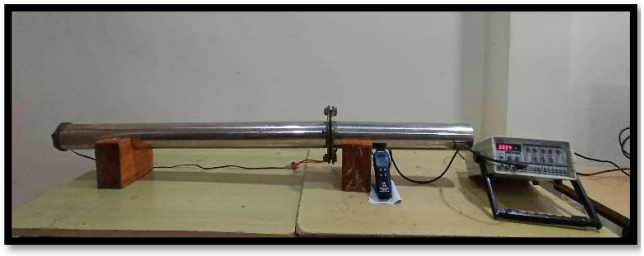

Fig.3 Experimental Set up for Noise Absorption Measurement

4.3 Experimental work

The tube give accurate measurement for sound absorption coefficient. Objective of this tube give noise level absorbed by specimen and to find noise reduction coefficient for each specimen. Use of frequency generator noise level are measured from 63 HZ - 16000 HZ. Gradually increased noise start from 63 HZ up to the 16000 HZ. Noise reduction coefficient (NRC) is ratio of intensity of reduced noise and intensity of incident noise.

$$\text{Noise Reduction Coefficient (NRC)} = \frac{\text{‘a’} - \text{‘b’}}{\text{‘a’}}$$

Here, Incident noise intensity is intensity of noise without placing specimen in propagation tube (‘a' dB)

Reduction Noise intensity is intensity of noise with placing specimen ('b' dB)

Then reduced noise intensity is measured from frequency is 63 HZ - 16000 HZ without placing specimen.

5. Result and Discussion – Refer Table No. 2

6. Conclusion

Natural waste considered and studied for effectiveness as a noise controlling medium techno-economically succeed without any harmful effect. Selected materials are easily available in the market with low cost. The result of obtained from test shows that above mentioned combinations of Cement : Cow dung : Tulasi (C : CD : T) reduces the noise up to 20.37% as compared to incident noise intensity. Selected material combinations where found effective for industrial noise abatement than other material combinations. Hence recommended as noise control measures.

7. Reference

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Table No. 2 Calculated Reduced Noise Intensity

Material Combination with its nomenclature	Mix Proportion	Specimen Thickness (mm)	Octave band frequencies (Hz)								
			63	125	250	500	1000	2000	4000	8000	16000
			Incident Noise Intensity (dB)								
			86.6	93.8	115.1	106	117.2	110.6	95.7	110	77.4
			Reduced Noise Intensity (db)								
Cement : Cow dung : Tulsi (C : CD : T)	1.5:0.3:0.3	12.5	78.4	91.7	112.2	101	110.8	100	78.2	87.3	53.5
Cement : Tulsi : Rice straw : Cow dung (C: T : R : CD)	1.5:0.3:0.15:0.3	12.5	77.1	90.8	110.5	100	111.7	100.4	75.5	102.5	64.5
Cement : Cow dung. Coconut coir (C: CD: CC)	1.5:0.5:0.3	12.5	76.8	85.8	112.5	92.3	101.5	94.2	74.4	100	60.3
Cement : Salvenia : Coconut coir (C: S : CC)	1.5:0.5:0.3	12.5	76.5	86.5	110	95.7	105.3	95	72.3	94.8	56.8
Cement : Salvinia dust : Rice straw : Tulsi (C : S : R :T)	1.5:0.25:0.2:0.25	12.5	76.6	85.3	107.2	103.2	103.3	95	72.3	94.8	56.8
Cement: Salvenia dust : Rice straw (C : S : R)	1.5: :0.5:0.2	12.5	77	85.7	114	105.4	98.5	93	70	91	65.4