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Eco-Friendly Noise-Absorbing Panels from Waste Materials: A Sustainable Solution to Control Noise Pollution

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1. Abstract:

This research article deals with one of the major forms of pollution that is invisible but is a threat to living beings. Controlling noise pollution is important so to deal with this, a test was performed using a method known as the impedance tube method. To tackle this noise pollution a sustainable material would be good to use, so waste coming from food industries such as orange peel, sugarcane husk, and eggshells are used with newspaper sludge as a binding material. Disks were prepared of 90mm with different constituents of waste material and paper sludge. The test result showed that these panels were able to reduce sound coming from the source to the receiver side. Sound absorption capacity is different for every material depending upon their structural features.

The test was done with 120 decibels of sound and at 120 decibels the SAC (sound absorption coefficient) was 0.35 which is better than other commercially available chemical-infused materials such as glass wool, mineral wool etc. As they are not better for the environment as well as living around. They cause lung disease if inhaled and skin problems come in contact with them.

Materials in use for soundproofing have polyurethane which releases a high amount of smoke if brunt hence we cannot rely on this in case of fire.

Hence environmentally friendly as well as materials that do not catch fire or realise high amounts of smoke and are also cost-effective should be used to reduce noise pollution in the environment we are living in.

Keywords: food waste; green technology; paper waste; sustainable method; noise absorption factor; noise pollution.

2. Introduction:

When the source is turned off, noise pollution vanishes and leaves no trace in the surrounding area, setting it apart from other types of pollution. It is also invisible to the unaided eye. Furthermore, it's common for people to discover a problem with their hearing a long time after the noise exposure starts. In any case, this fact contributes to the myth that noise has no negative effects on human health and that money and efforts would be better used to regulate and lower emissions of other pollutants[1].

When Florence Nightingale wrote in 1859, "Noise is the cruellest abuse of care that can be inflicted on sick or healthy," she was acknowledging the risks noise posed to health [2]

The study illustrates how towns and inhabitants close to roadsides are affected by noise pollution. Road traffic was determined to be the primary source of noise among all the noise sources, followed by industrial

and equipment. A health survey revealed that almost 52% of people experienced regular anger. Due to noise pollution, 46% of respondents reported elevated blood pressure and 48.6% had sleep problems. All of the chosen areas also recorded common noise descriptions. The Central Pollution Control Board, New Delhi's allowable limits (65 dB) were found to be lower than the Leq values, which ranged from 73 to 86 [3]

Therefore, waste materials that are readily available and reasonably priced are the subject of this study. Waste products include eggshells, orange peels, sugarcane husks, and green tea leaves. Instead of utilizing any chemicals, we are glueing this material together with paper sludge. Because the materials being utilized are recyclable and have no such negative effects on the environment or living things, they are superior to all other materials now in use.

In the United States, 32 million tons of wood and textile trash and 68 million tons of paper waste are produced annually, accounting for around 39% of municipal solid garbage. The CPCB in New Delhi, India, has conducted research that shows that this percentage varies for paper, wood, and textiles from 3 to 10%, 30 to 45%, and 1 to 5% [4]

When it comes to sound insulation, a material with an absorbency of between 0 and 1 is regarded as being exceptionally absorbent. For sound absorption, the fibres' diameter and porosity are also essential. Thin (thin or hollow) fibres work better than thick ones because more fibres are required to achieve the same volume density, which causes the sound to travel erratically and increases the airflow's resistance to the sound waves. Thus, when the fibre diameter reduces, the sound absorption coefficient rises.

The materials together with their sound absorption coefficient are displayed

The coefficient of Absorption for Materials is:-
Acoustic Tiles: 0.4 - 0.8
Glass Silk 50 mm: 0.8 - 0.9
Cotton Batts: 0.79
Mineral wool, 100 mm: 0.65
Polyurethane Foam: 0.95
Heavy concrete, carpet: 0.3–0.6

3. Materials and methodology:

3.1 Material collection

There are two stages to collecting material. In the first stage, the materials are collected, washed and dried in the sun for a week. The newspaper waste was collected and then soaked in water for 24 hours. In the second step, the dried materials were ground into a fine powder. The soaked newspapers were ground into a fine paste and stored in the refrigerator.

3.2 Fabrication process

In this firstly paper sludge is weighed and after that, each powder made up of squandered materials is weighed according to the table (1) given. After weighing, employing a petri dish as a shape a disk form of a blend is made and kept in the sun to dry out totally and get hard. A circular circular shape with a breadth of 90mm for each disk was made. Table 2 shows the weighing rate of each panel.

Sr.no	Materials by their weight in %
1	60% P.S, 40% W
2	60% P.S, 20% S.H, 20% G
3	60% P.S, 20% M, 20% E
4	60% P.S, 20% S.H, 20% E
5	60% P.S, 13.4% O, 13.4% S.H, 13.4% W,
6	60% P.S, 8% M, 8% O, 8% S.H, 8% E, 8% G
7	60% P.S, 8% M, 8% O, 8% E, 8% G, 8% W
8	60% P.S, 8% M, 8% O, 8% S.H, 8% E, 8% W
9	60% P.S, 8% M, 8% O, 8% S.H, 8% G, 8% W
10	100% P.S

Table: (1) Waste Materials with Different Composition.

S.H- Sugarcane husk
P.S- Paper sludge
W- Walnut
O- Orange peel
G- Green tea
M- Mosambi (sweet lime)
E- Eggshell

Image: (1) Panels

3.3 Sound measuring setup

The sound retention coefficient is calculated to measure the panels' acoustic execution. A sound-absorbing material's tall assimilation coefficient is calculated by the impedance tube technique. In the tube, one conclusion amplifier is kept and the other conclusion commotion meter between the board is kept. Whereas taking perusing we must take Incedient sound concentrated and ingested sound this will offer assistance to us to discover the coefficient of sound absorption. Intensity is measured in decibels.

The equation for the sound assimilation coefficient

α=Ia/Ii
α - The sound assimilation co-efficient
Ia - The retained sound-intensity
Ii - The occurrence of sound intensity
The sound-absorbing capacity is between 0-1 where 1 is the culminate safeguard.

Image: (2) Set-up for sound measurement

4. Result and Discussion

The study paper focuses on making noise-absorbing panels out of scrap materials. The sound-absorbing capabilities of these panels were investigated using the impedance tube approach. Paper sludge was mixed with the waste to act as a binding agent. Based on their varied compositions, the study sought to ascertain how well these panels reduced noise levels.

A reading at 120 dB was recorded for each sample. A graph was created based on the result to display the outcome.

Ten unique sample panels made of various waste material combinations were created. The trial outcomes showed that, depending on their particular composition, the panels might reduce sound and show signs of noise absorption.

Of the many compositions, a panel of a particular composition was shown to have notable sound absorption properties. The absorption coefficient was measured at 0.35 at 120 dB. These findings demonstrate how well the panels made of waste materials reduce noise levels. The study's basic ingredients were notably derived from food industry waste, highlighting the material's environmental friendliness.

Through the utilization of such waste materials, a sustainable approach to noise pollution management is promoted, in line with the principles of green technology.

Additionally, this method is economical, which might open the door to more widely available noise reduction techniques.

The study also emphasised the drawbacks of using traditional noise-absorbing materials such as cell polyurethane foam, glass wool, and mineral wool. Despite being used for a long period, these materials raise safety and health issues. When skin and respiratory health come into touch with or are inhaled, glass and stone components included in mineral and glass wool can be harmful. Moreover, commonly used polyurethane-based soundproofing materials are not fireproof and release a lot of smoke when burned, which reduces its dependability in fire situations.

The study highlights how important it is to find a material that can effectively reduce noise while still being resistant to ignite and smoke emissions during combustion. In addition, this material needs to put

environmental sustainability first, addressing the disadvantages of traditional noise-absorbing materials in terms of fire safety and health risks.

Table (2) shows the results of the panels.

Panels	At 120dB
1	81
2	78
3	83
4	81
5	84
6	80
7	80
8	81
9	84
10	98

Table: (2) Absorption intensity

Panels	At 120 dB
1	0.32
2	0.35
3	0.3
4	0.32
5	0.3
6	0.33
7	0.33
8	0.32
9	0.3
10	0.183

Table: (3) Absorption coefficient

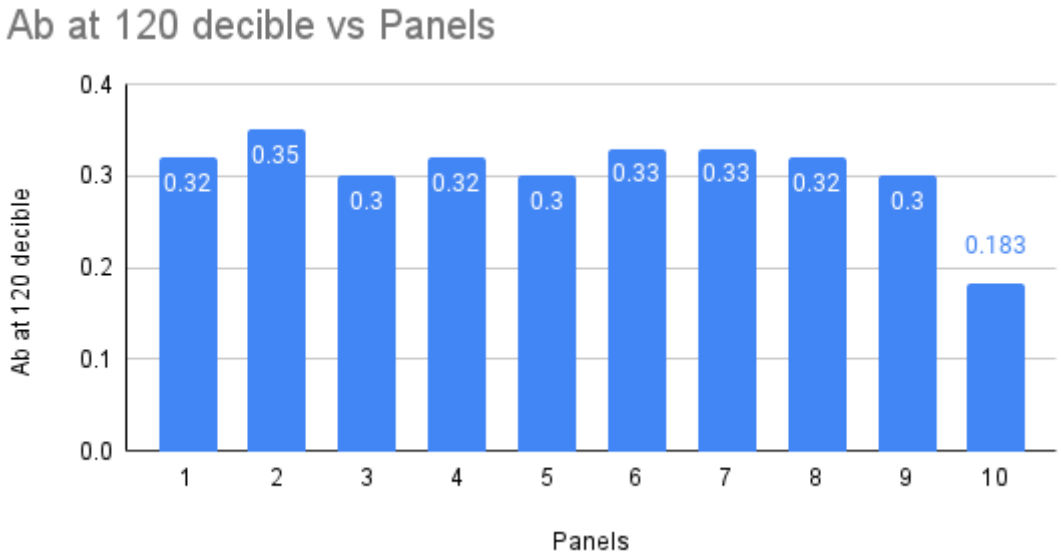

Image: (3) Graphical repression of the data.

5. Conclusion:

In conclusion, the investigative article sheds light on a promising road within the field of noise contamination control by utilising waste materials to make compelling noise-absorbing panels. A comprehensive examination including the impedance tube strategy, to think about effectively illustrates that these panels have the potential to diminish sound levels over different compositions of squandered materials.

The eminent accomplishment was the recognizable proof of a particular board composition with assimilation coefficients of 0.35 at 120 decibels. This result underscores the commonsense practicality of these squandering material-based boards in noise attenuation scenarios. Besides, the utilization of waste materials from the food industry in this setting may be a commendable case of natural obligation, adjusting with green innovation standards and advancing sustainability, by comparing the recently created waste material-based panels with ordinary ones.

The utilisation of noise-eliminating materials, including glass wool, mineral wool, and polyuric foam, is suggested the article highlights the restrictions of these broadly utilized alternatives.

These materials pose well-being dangers and need fire resistance, making them less alluring choices for commotion diminishment arrangements, especially in situations where security and natural concerns are paramount.

The inquiry accentuates the significance of seeking after materials that are multifaceted in their benefits—effective noise decrease, resistance to start, and negligible smoke emission upon combustion. This approach not only addressed the inadequacies of existing arrangements but also underscored the need for an all-encompassing approach to commotion contamination control that accounts for well-being, security, and natural considerations.

In pith, the think about underscores the potential of squandering materials in forming a modern worldview for noise-absorbing arrangements. It empowers the investigation of feasible and naturally friendly options, clearing the way for imaginative procedures that harmonize successful commotion decrease with security, well-being, and biological duty.

As communities proceed to hook with the challenges posed by noise contamination, this investigation offers a step toward comprehensive and forward-looking arrangements that benefit both individuals and the planet

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