EVALUATION OF ACOUSTIC CAPABILITIES AND AFFORDABILITY OF A SUSTAINABLE ALTERNATIVE TO TRADITIONAL ACOUSTIC PANELS

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Introduction:

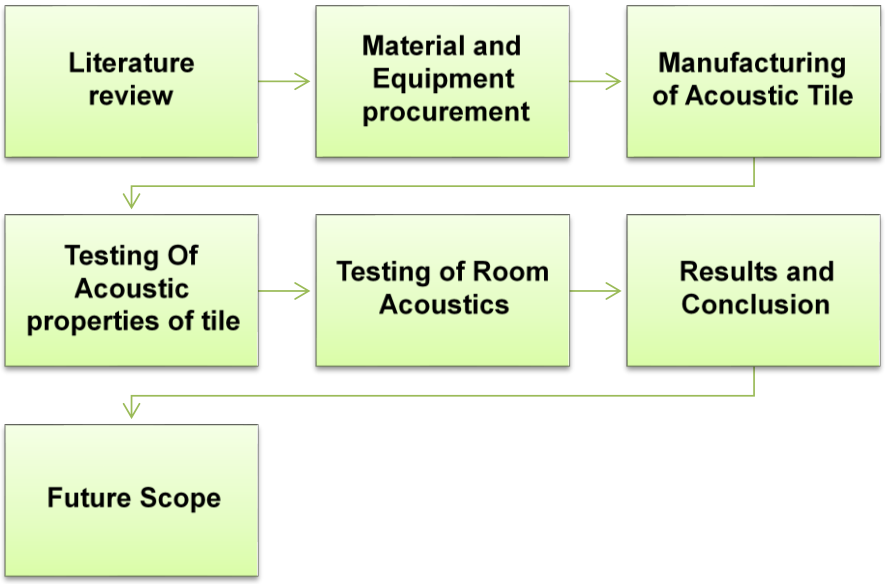
Figure 1: Acoustic panels

Acoustic panels are used to absorb sound and reduce noise in indoor spaces. They are commonly installed in areas like recording studios, home theatres, and offices to improve sound quality by minimizing echoes and reverberation. The panels are typically made of materials that absorb sound waves, such as foam or fabric wrapped fiberglass etc. Acoustic tiles (also sound absorption tiles, soundproof tiles) are sound-absorbing fabric wrapped boards designed to control echo and reverberation in a room. One of the main engineering approaches to control environmental noise is to use sound-absorbing materials. The traditional method of environmental noise reduction is tousle materials of non-renewable sources such as clayey soil, natural fibers, plastering fibers, cementitious material. Such materials often provide high sound absorption coefficients, but they are not considered environmentally friendly. Noise control could be achieved using recycled or natural sound absorbing materials as well. Such an approach has become more interesting nowadays since the legislations in most countries are moving towards waste reduction or reusability. Such goals create motivation to look for a new environmentally friendly alternative for noise control. The most common approach is to use natural coconut fibers. Such materials showed high potential to be used for sound absorption applications. Many of the materials mentioned could be made into tiles for sound absorption applications. Such panels usually are 10–20 cm thick and are often used with air space behind the panel to increase the sound absorption in low and middle frequencies. Often, acoustic tiles studies are concerned with micro perforated and porous panels.

Objectives:

1. To manufacture eco-friendly and economical acoustic wall tile.
2. To study the mechanical & acoustic properties of acoustic wall tile.
3. To compare the acoustic properties of manufactured wall tile and traditional acoustic panels available in market.
4. To evaluate the manufacturing and installation cost of acoustic wall tile in comparison with traditional acoustic panels.

Methodology:



The clay soil procured from standard clay tile factories in Tumkur, Karnataka, involves identifying potential suppliers in the area. The procured coir fibre, cut to a size of 0.5 cm, is a valuable and eco-friendly material sourced from coconut plantations. Derived from the outer husk of coconuts, coir possesses inherent strength, durability, and resistance to water and decay. In setting up a universal testing machine (UTM) for tile casting, careful attention is paid to applying a load of 500 KN to ensure accurate evaluation of the tile's mechanical properties, Hence the Acoustic tile is manufactured.

Figure 2: Manufactured Tile

Figure 3: Analysis setup

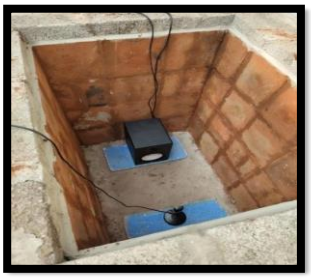


Figure 4: Acoustical Chamber

Room acoustic treatment using a microphone and speaker in conjunction with REW software is a process that helps you understand the acoustics of a room and optimize it for sound quality. The test conducted to the Room of 3'x4' with Manufactured tile, Wood wool, Rock wool, Coir and the Results are compared with manufactured tile.

Results:

Acoustic properties obtained from REW:

- Sound pressure level.
- Reverberation Time 60 (RT 60)
- Clarity

The Sound pressure level of the room using the manufactured acoustic tile shows higher levels compared to other acoustic panels. It can also be observed that the frequencies above 2000Hz show higher attenuation that lower frequencies. This can be an advantage for spaces where speech is of utmost importance as the human speech frequencies have frequencies predominantly around the range of 2000Hz.

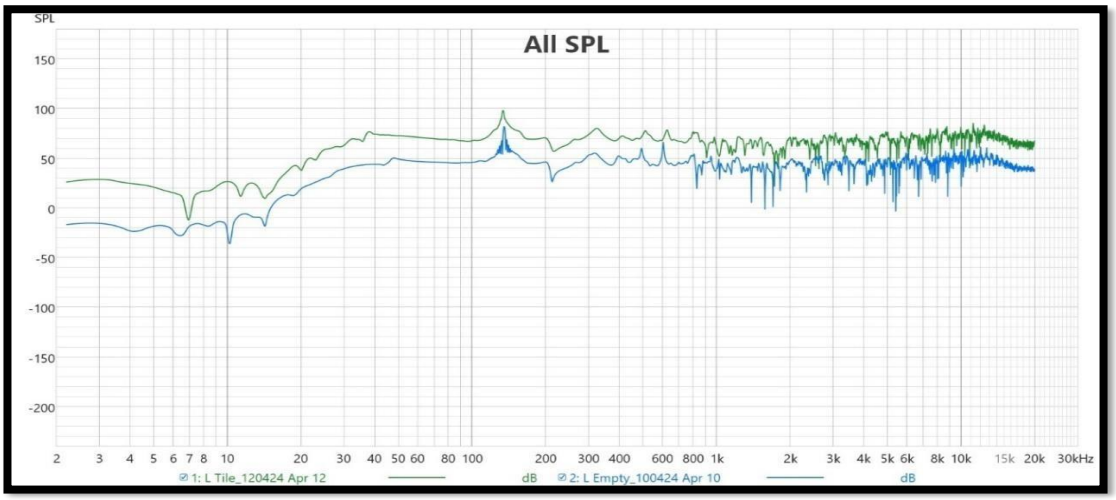


Figure: 5 All SPL of Tile & empty

This shows that the sound in the room is damped quicker than when other panels are used. This property of the acoustic tile is very appreciable as the damping effect required for maintaining good acoustics of a room is being achieved at lower cost and installation time.

Conclusion:

With reference to the results and comparison reported in the previous chapter, the following conclusions can be drawn.

1. The manufactured acoustic tile has excellent acoustic properties and can match the traditional acoustic panels available in the market in terms of acoustic performance.
2. The acoustic tile majorly has acoustic properties suitable for auditoriums, office spaces, meeting halls, and conference rooms etc where speech clarity is of utmost importance. However, acoustic behaviour in terms of SPL show that it might not be suitable for audio recording studies where flat frequency responses is desired.
3. The installation of the acoustic tile is quite similar to traditional wall tiles and hence does not need especially skilled labours and techniques required for traditional acoustic panels. This reduces installation cost and time.

4. The acoustic panel which is made of clay is naturally fire proof and hence doesn't require any special fire resistance treatment as required for other panels.
5. The acoustic tile in comparison with other commercially available panels has extremely low embodied energy. A major part of this energy is consumed for baking the clay tile in the kiln. Thus, it can be concluded that the tile is ecofriendly compared to other acoustic panels considering a reduction of 75%.
6. The cost of raw materials and manufacturing is low compared to the traditional acoustic panels with a reduction of around 80% in the manufacturing cost. This can decrease the cost of the project largely and contribute to the economy of the project.

Scope for future work:

1. Keeping the strength of the tile in check, the density of the tile can be further decreased to improve the ease of handling the tile during installation.
2. The tile can be manufactured for different surface absorption area by increasing the number of holes.
3. The tile thickness can be increased further and checked for improvement in sound absorption.