Noise Pollution And Control

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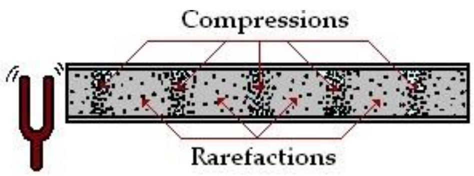
Abstract

Noise is the disturbing or excessive sound that disrupts a personal's life. It can come from a wide variety of sources, including machines and animals. Now noise pollution, noise control and their principles play a vital role in providing an acoustically pleasing environment. This can be achieved by using various techniques and by using different sound absorbing materials. This research paper helps in overcoming the drawbacks of noise absorbing materials and noise control. Mostly these materials are unsuitable for molding, non-recyclable, difficult to handle and install, accumulate dust and high density of foams. Absorbing materials should be manufactured by natural, biodegradable raw materials. The benefits of these materials are reuse of raw materials and diminishing manufacturing cost. Materials absorb noise and convert it to thermal energy through dissipation. Fibrous, porous or reactive resonators and other materials have been mostly accepted as sound absorptive materials and are generally resistive in nature. The amount of effective absorption is not only dependent on the absorption coefficient, but also the position of absorbent materials in the room and its relation to other surfaces. As a final objective, this research describes how the physical elements of nonwoven sound absorbent system like fiber type, fiber size, fiber cross section, material thickness, density, airflow resistance and porosity can change absorption behavior of nonwovens and noise control.

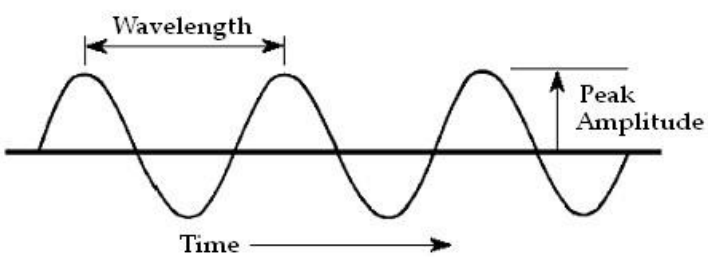
Keywords: Acoustics, Noise, Noise control, Nonwoven, Plyester Fiber , Polyurethane foam

Introduction

"Acoustic" is defined as a scientific study of sound which includes the effect of reflection, refraction, absorption, diffraction and interference. Sound propagates in the form of longitudinal (as opposed to transverse) waves, involving a succession of compressions and rarefactions in the elastic medium.



It means sound can be considered as a longitudinal wave phenomenon where particles of medium are temporarily displaced in a direction parallel to energy transport and then return to their original position. The vibration in a medium produces alternating waves and refraction respectively. How well a room absorbs sound is quantified by the effective absorption area of walls, also named total absorption area. This is calculated using its dimensions and the absorption coefficients of the walls. A simple sound wave can be defined in variable terms as amplitude, frequency, wavelength, period and intensity.



<u>Amplitude</u>:- the **amplitude of pressure changes**, which can be described by the maximum pressure amplitude, *pM*, or the root-mean-square (RMS) amplitude, *prms*, and is expressed in Pascal (Pa). Root-mean-square means that the instantaneous sound pressures (which can be positive or negative) are squared, averaged and the square root of the average is taken. The quantity, *prms* = 0.707 *pM*;

Frequency:- the **frequency** (*f*), which is the number of pressure variation cycles in the medium per unit time, or simply, the number of cycles per second, and is expressed in Hertz (Hz). Noise is usually composed of many frequencies combined together.

Wavelength:- The wavelength of a wave is that distance which is travelled by the pressure wave during one cycle.

i.e., wavelength= speed of sound/ frequency

Period:- the **period** (*T*), which is the time taken for one cycle of a wave to pass a fixed point. It is related to frequency by: $T = 1/f$

Intensity:- The **intensity** of a sound wave can be defined as the average rate at which sound energy is transmitted through a unit area.

Sources of noise and their levels or damaging level of noise:

Source	**Sound(db)**	**Effects**
Rocket launching	180	Danger level
Gunshot	140	Danger level
Jet	130	Cause damage(3.5min/day)
Car Horn	120	Cause damage(7.5min/day)
Night Club	110	Cause damage(30min/day)
Trucks/Scream	90	Cause damage(8hrs/day)
Alarm Clock	80	Annoying

Noise Control:-Noise can be defined as "disagreeable or undesired sound" or other disturbance. A noise system can be broken down into three sources

(a) Noise Source- the element which disturbs the air
(b) Noise Path- The medium through which the acoustical energy propagates from one point to another
(c) Noise Receiver- The person who could potentially complain about the level of noise as perceived at same point

In general four basic principles are here to reduce noise: isolation, absorption, vibration isolation and vibration damping.

The study here is focused only on the absorption phenomenon of sound where sound energy is converted into thermal energy.

Acoustic noise problems in the environment become more noticeable for several reasons:

- Increased numbers of large industrial equipments being used:
  - – Engines
  - – Blowers
  - – Fans
  - – Transformers
  - – Compressors
  - – Motors
- The growth of high-density housing increases the population's exposure to noise because of the proximity to neighbors and traffic.
- The use of lighter materials for building and transportation equipment, resulting from cost constraints in construction and fabrication.

Noise can be reduced by suppressing audible kinetic energy in three ways:

1) containing noise with barrier materials and enclosures,

2)canceling noise by introducing sound energy which mirrors the offending sound and

3) absorbing sound energy with panels, baffles, and other acoustic foam products.

From a geometric point of view, active noise control applications can be classified in the following four categories:

- **Duct noise**: one-dimensional ducts such as ventilation ducts, exhaust ducts, airconditioning ducts, pipe work, etc.
- **Interior noise**: noise within an enclosed space
- **Personal hearing protection**: a highly compacted case of interior noise
- **Free space noise**: noise radiated into open space

Specific applications for active noise control now under development include attenuation of unavoidable noise sources in the following end-equipment:

- **Automotive** (car, van, truck, earth-moving machine, military vehicle)– Single-channel (one-dimensional) systems: Electronic muffler for exhaust system, induction system, etc.
- Multiple-channel (three-dimensional) systems: Noise attenuation inside passenger compartment and heavy-equipment operator cabin, active engine mount, hands-free cellular phone, etc.

❖ **Appliance**

– Single-channel systems: Air conditioning duct, air conditioner, refrigerator, washing machine, furnace, dehumidifier, etc.

– Multiple-channel systems: Lawn mower, vacuum cleaner, room isolation, etc.

❖ **Industrial**: fan, air duct, chimney, transformer, blower, compressor, pump, chain saw, wind tunnel, noisy plant (at noise sources or many local quiet zones), public phone booth, office cubicle partition, ear protector, headphones, etc.

❖ **Transportation**: airplane, ship, boat, helicopter, snowmobile, motorcycle, diesel locomotive, etc.

Sound Absorptive Materials

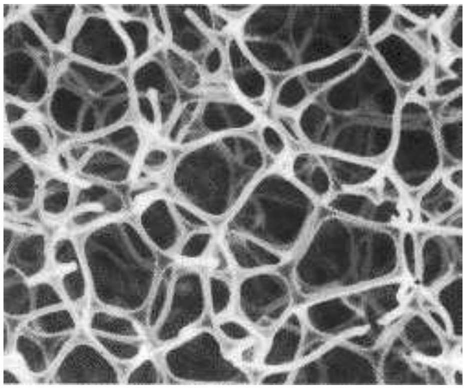
Materials that reduce the acoustic energy of a sound wave as the wave passes through it by the phenomenon of absorption are called sound absorption materials. Absorptive materials are generally resistive in nature, either fibrous, porous or reactive resonators. **Acoustical foam** is one of the most popular materials available for absorbing noise. When used inside or around loud machinery, sound-absorbing acoustical foam reduces the build-up of noise, which in turn protects employee hearing, improves safety and enhances communication. Acoustical foam is one method of changing sound energy from the form of vibratory energy of air particles to heat energy through dissipation. Acoustical foam is commonly used for enclosing noisy sound as well as in utility and maintenance rooms containing loud equipment where reflection of noise needs to be reduced. Absorbers are designed to reduce the amount of reflected sound energy. When sound hits any surface, it takes three paths: **1)**some goes through the surface (noise transmission), **2)** some dissipates within the surface (causing vibration), and **3)** some reflects back off the surface (noise reflection). Absorptivity of a material varies with sound frequency. The noise reduction coefficient for a given material may easily be eight or nine times greater at one part of the frequency scale compared to another.

Types of absorbers

Porous sound-absorbing materials are available in the form of mates, boards, and preformed elements. They are manufactured of glass, mineral or organic fibers, wood chips, coco fibers, felted textile, or open cell foam (usually polyurethane). These materials have open pores with typical dimensions less than 1 mm. These open pores are significantly smaller than the wavelength of sound. Open pore foam can be treated as a poor homogeneous medium with uniform structure or composition. Flexible polyurethane foams are widely used in automobiles, machinery, aircraft, and various industrial applications

Some benefits of acoustical polyurethane foam are:

- Its effectiveness to absorb noise in mid-to-high frequencies
- Can create cost effective enclosures around machinery
- Low susceptibility to material degradation (if faced and edges are sealed)
- Non-toxic and vibration resistant
- Made from self-fire extinguishing material (generally suitable for architectural purposes).



This figure shows the close up of polyurethane foam fiber arrangement.

Application of Sound Absorptive Materials:-

1) Used to counteract the undesired effects of sound reflection by hard, rigid and interior surfaces
2) Used to interior lining for apartments, automotives, aircrafts, enclosures for noise equipments and insulation for appliances.
3) also be used to control the response of artistic performance spaces to steady and transient sound sources.

Factors Affecting Sound Absorption Materials:

1) Fiber Size
2) Fiber Surface Area

3) Airflow Resistance
4) Porosity
5) Tortuosity
6) Density
7) Compression
8) Surface Treatments
9) Placement / Position of Sound Absorptive Materials
10) Surface Impedance

Conclusion

The results presented in this paper encourage more awareness of the application of nonwoven fabrics in acoustics.

Some of the important conclusions of this research are:

- An appreciable increase in Normal Absorption Coefficient
- Films such as aluminum attached to nonwovens increase sound absorption at low and mid frequencies at the expense of higher frequencies.
- Higher surface area and lower fiber size increases sound absorption.
- Use of reclaim and kenaf fibers in acoustics is feasible if the proper parameters (mass per unit area and thickness) are chosen to make the product.

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