Chapter 1

Introduction

In today's world sound pollution is not a new problem for mankind. It has become a major issue after air and water pollution for the modern world. The scientists and environmentalists of various disciplines have also addressed this issue. The study conducted by WHO in 2011, found that at least one million healthy years of life are lost each year in Europe alone due to noise pollution (and this figure does not include noise from industrial workplaces). The study also highlighted that environmental noise has adverse effects on the health of the population. The authors also noted that while other forms of pollution are decreasing, noise pollution is increasing [1].

Sound is one of the essential elements of human life for communication. Harmonic sound like the music is pleasant to hear, while the unwanted sound known as noise is unpleasant to hear. Noise creates several harmful effects on human beings and also on the environment. In today's modern world, due to industrialization the use of heavy machinery in industries and an increase in transport vehicles has led to an increase in noise pollution. Noise has a harmful physiological and psychological effect on a human being. Noise causes adverse health effects like hearing loss, disturbance in the sleep pattern, reduce working efficiency, cardiovascular problems, and also affects the social behavior of human beings [2–4]. The impact of noise pollution on human beings and the environment is a matter of concern. Scientists and researchers of various disciplines have made considerable efforts to reduce noise pollution.

It is essential to control or reduce the noise from industries, offices, traffic, and various public places. Several practical solutions to reduce noise pollution are available. The textile is one of the best materials used to reduce the noise because of added advantages

like lightweight and low cost. Sound absorption materials are generally porous, thicker, and lighter in weight. Generally, sound absorption materials are known as acoustic materials. Acoustic defined as the study of sound in a scientific manner, can be very useful in controlling noise pollution. Acoustic also includes the study of the effect of refraction, reflection, interference, diffraction, and absorption. Acoustic material plays a vital role in controlling the industrial noise, traffic noise, office noise, noise at public places, and noise at home. To control noise pollution, understanding the behavior of noise is a prerequisite. The entire noise system can be divided into three elements.

Source of Noise : A starting point where the air molecules get disturbs.

Path of Noise : The medium through which the noise energy propagates from one point to another point.

The receiver of Noise : The person who receives the sound energy and able to quantify the level of noise.

It is necessary to treat at least one element of the noise system to control or reduce the noise. The noise level at the receiver end can be reduced by reducing or controlling noise level at the source of noise and treating noise somewhere in between the source of noise and receiver. Control of sound at the source of noise is least preferred due to its cost. Similarly, noise at the receiver can be reduced by treating the receiver is also least preferable because, in this method, each receiver needs to be treated individually. Control of noise in between the source of noise and receiver by placing acoustic material somewhere in between noise and receiver is best and the most straightforward approach to control or reduce noise.

The conventional materials like glass and rock wool used for sound absorption are non-biodegradable. Many currently used acoustic materials are harmful to human health and not ecofriendly. This is where unconventional natural fibre finds relevance due to their properties like low cost, low weight, renewable, biodegradable nature, and unique structural properties making them an attractive choice for Acoustic application. Due to an increase in environmental consciousness, researchers are attempting to develop eco-friendly and green material products. This research, is an effort to study the acoustic properties of eco-friendly sound-absorbing needle punch nonwoven fabric developed by

using eco-friendly natural fibres like Kapok and Estabragh (Milkweed) for acoustic application. Kapok and milkweed fibres are selected due to their unique natural hollow structure. The naturally hollow fibre such as kapok and milkweed has a huge potential to be used for acoustic applications due to the higher surface area.

The design of the experiments is planned as per Response surface methodology - Central composite design (RSM-CCD) methods using Minitab 18 software in this research work. A total of sixty-two samples were produced by varying kapok or milkweed fibre proportion in the blend %, carded web mass, needle stroke frequency, needle penetration depth. Physical properties of developed samples like fabric thickness, fabric GSM, porosity, and air permeability measured using standard testing methods. Acoustic properties of developed samples were measured by measuring the sound absorption coefficient using Impedance tube test methods for different frequencies (250 Hz to 6300 Hz) of the incident sound. Objectives of the Research work:

The main objectives of this research work are:

- To study the acoustic properties of kapok and estabragh (milkweed) fibre needle punch nonwoven fabric.
- To develop the needle punched nonwoven fabric using natural hollow fibre kapok and estabragh (milkweed) for acoustic applications.
- To study the effect of kapok or milkweed fibre proportion in the blend, carded web mass, stroke frequency, needle depth, and their interaction on sound absorption coefficient.
- To study the effect of fabric thickness, GSM, air permeability, porosity, and their interaction on sound absorption coefficient.

Secondary objectives of the study are:

- To collect kapok and milkweed fibre
- To develop a low cost customized impedance tube.
- To conduct different tests like fabric sound absorption coefficient, fabric thickness, fabric GSM, air permeability, and porosity of fabric.
- To carry out analysis with the use of statistical methods.