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SYNOPSIS

Study Acoustic Properties of Estabragh - Kapok Natural Fiber Fabrics for Technical Uses

Sound pollution has become a third important issue after air and water pollution that has been addressed by scientists of various disciplines. Control of sound in various industries is of paramount importance. Noise is an increasing public health problem according to the World Health Organization's "Guidelines for Community Noise". Noise can have the following adverse health effects: hearing loss, sleep disturbances, feeling tiredness, cardiovascular and psycho physiologic problems, performance reduction, annoyance responses, and adverse social behavior [1]–[3]. Therefore, it is very important to control or reduce noise from traffic, and in factories, offices, and houses. Noise also significantly decreases productivity in various environments. Undesirable and potentially hazardous noises are a side effect of a wide range of modern engineering and other purposes. With the continuing development of new technologies, particularly the trend towards faster, more powerful machinery, the environmental impact of noise is a matter of increasing concern, and considerable efforts are being made to finding effective means of noise abatement. The use of textiles for noise reduction is based on two major advantages of these materials, namely low production costs and small specific gravity.

In the last few years, industries are attempting to produce eco-friendly products due to the increased environmental consciousness. This leads to the need to investigate environmentally friendly, sustainable materials to replace the existing one. Thus, significant efforts applied by the researchers are generally involved to find new recourses of natural fibers instead of using the petroleum-based synthetic fibers, among the variety of newly known natural resources.

Textile materials are effective in converting the mechanical motion of the air particles in sound waves into low-grade heat. Almost all materials have some kind of acoustical property. However, materials that absorb a majority of the sound impinging upon them rather than reflecting the sound are termed "acoustical material". Sound absorbing materials are attracting much attention as a solution to the ambient noise impact on people's lives and they are performing greatly [4].

Currently, the most viable way towards eco-friendly noise absorptive material is the use of natural fibers/fabrics as acoustics material. The existing sound absorption materials are generally made of synthetic materials, which are not bio-degradable. This is where natural fibers find relevance due to their intrinsic properties such as low weight, low cost, mechanical strength, renewable and biodegradable nature making them an effective choice for acoustic applications[5], [6]. Hence in this research work, Natural fiber fabrics developed to study Acoustic properties of naturally hollow fiber Estabragh-Kapok for technical uses. Kapok and milkweed (In the Persian language known Estabragh) are categorized as versatile substitutive fibers with numerous unique properties which are mainly attributed to their hollowness structures. The presence of a hollow channel along the fiber length is responsible for their lightweight, good insulation and acoustic properties. Due to the unique structure both fibre have huge potential to be used for acoustic application. Looking into their properties both the fibres were selected for present study. Here a Persian name Estabragh of milkweed fibre was used, in India, it is also known as Mudar. Moreover, many studies focused on developing natural fibres as raw material have been done and reported, such a palm, kenaf, coconut coir, and many others that have potential to be used as raw material for acoustic application[7]. Similarly coconut, palm and jute fibre have high potential to be used as a sound absorber material[8]. The industrial tea-leaf-fibre waste material also has sound absorption properties at high frequencies[9]. These show that natural fibres have high potential to be applied as raw materials of sound absorbing materials.

The present research is aimed to study the acoustic properties of Kapok and milkweed fibre, which could serve as an alternative for other commonly used sound absorbing materials. It is expected that hollow fibers due to their structure can significantly influence noise insulation performance of materials in which these fibers are incorporated. Therefore, sound absorbing material composed of a blend of natural hollow fibers kapok and modal, Milkweed or as it known Estabragh and Modal fibers were used to produce needle-punched nonwoven samples. Sixty-two different samples were produced by varying blend ratio, carded web mass per unit area, needle stroke frequency and needle depth. Noise Absorption Coefficient (NAC) of the samples were evaluated using the impedance test method for different frequency of the incident sound[10]. After conducting several pre-trial, designs of the experiment was planed using

Response surface methodology - Central composite design (RSM-CCD) method and the evaluation procedures were designed using RMS-CCD method. Results showed samples as the proportion of kapok and milkweed fibers in blend increased, have shown higher sound absorption coefficient at higher frequency. Although the results showed an increase in stroke frequency, carded web mass per unit area and needle depth improves sound absorption coefficient value of the samples. It was found that the sound absorption coefficient increases in direct relation to the increase in carded web mass per unit area (g/m2) of the samples. This was attributed to the increase in tortuosity of the samples and the energy losses due to frictional resistance. Finally it was observed that NAC peaks at frequency of 6300 Hz.

In the present investigation, an attempt has been made to explore the development of sound absorbing needle punch nonwoven fabric using natural fibres kapok-milkweed for acoustic application.

In the thesis entitled, “Study Acoustic properties of Estabragh - Kapok natural fibre fabrics for Technical uses” quite sensitive work to developed eco-friendly, biodegradable and renewable acoustic material using naturally hollow fibres kapok and Milkweed nonwoven fabrics for acoustic application. The thesis comprises of six chapters.

1. Introduction

Provides an introduction and article survey on sound absorption properties of various materials, and also the present scenario in the acoustic field. This chapter presents the significance and scope of work to be carried out in the thesis

2. Literature Review

Basics of sound waves, sound absorption mechanism, factors affecting sound absorption coefficient, different techniques used to measure sound absorption, kapok fibre and milkweed fibres have been discussed [11], [12], [21]–[29], [13]–[20].

3. Material & Methodology

Nonwoven fabrics are developed from Estabragh (milkweed) and kapok fibre (separately) on Needle punch nonwoven machine with following controllable process parameters and materials:

- Type of base material (Milkweed & Kapok)
- The proportion of Kapok fibre in the blend
- The proportion of milkweed fibre in the blend
- Carded web mass (g/m^2)
- Needle stroke frequency (/min)
- Needle penetration depth (mm)

Development of samples with detailed methodology is covered in chapter 3.

4. Testing

Sound absorption tests to measure the acoustic properties of developed nonwoven needle punched samples at different frequencies and different physical properties of fabric – mass per unit area, thickness, air permeability, porosity, etc. as per standards for fabric samples are covered in this chapter[10].

Development of Impedance Tube Transfer-function Tester with two microphones during this research work to measure a sound **absorption coefficient (α)** with different frequency and its testing methodology is also included in this chapter.

5. Result and Discussions

Measurements taken for acoustic properties and other physical properties are summarized and its discussions are covered in this chapter.

6. Conclusions

The conclusions are summarized with future scope of work in this chapter.

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