Chapter 1

INTRODUCTION
1. General Introduction

The phrase, “noise control” implies the control of noise for a purpose. Most often its purpose is to control the noise environment in which people live, work or play [1]. Noise has become a serious environmental problem causing hearing loss, impact on auditory health effect, individual behaviour, sleep, communication interference and effect on domestic animals and wildlife [2-5].

Efforts to control noise and vibration in a wide range of mechanisms and devices inevitably require the use of passive acoustical materials. To achieve the greatest performance per unit cost requires not only the correct choice of materials, but also an understanding of how they work, and of how and where to install them. All passive noise control systems use at least one of the following material types: absorbers and isolator for airborne sound, and vibration isolators and damping materials for controlling vibration for solid borne sound [6-8].

With absorption, small amount of sound energy is changed into correspondingly small amount of heat energy. Suitable materials are usually fibrous, light weight and porous. The ability of a material to absorb sound is typically quantified by the sound absorption coefficient. A material with no absorption (reflective) has a sound absorption coefficient of 0. A maximum sound absorption coefficient is 1 [9, 10]. The absorption coefficient not only depends on the material but also on what is in front and back of the material. The sound isolation properties of the materials are generally characterised in terms of transmission loss. It is related with the sound energy transmitted through it. The ability of a material to block sound is typically quantified by transmission loss (TL). The attenuation of sound passing through a material is also referred to as Transmission Loss (TL) [3]. It is ideally increasing with frequency at the rate about 5 to 6 dB per doubling frequency [6, 10-13]. A material with a TL of 0 does not block sound. All materials permit sound energy to pass through, although in varying degrees depending on its structure and the frequency of sound. Most of the construction materials are typically neither the good sound absorber nor the barrier. Further, it can be generalised that materials with a high transmission loss (concrete, gypsum board, sheet metal) also
have a low sound absorption coefficient. Conversely, materials with a high sound absorption coefficient (thick carpet, drapes, and fibre glass batt) typically have low transmission loss [3].

Damping materials are used to reduce resonance effects in solids. Essentially, damping materials are absorbents for solid-borne sound, converting the vibrational energy into heat. Vibration isolator is introduced into the transmission path a material whose wave–transmitting properties are as different as possible from the medium carrying the sound wave.

Traditionally, air borne sound can be controlled by using expensive and non-biodegradable sound absorbing materials made from mineral and synthetic sources such as glass wool, fabric filler, and polymer foams and fibres [14-16]. Mineral ‘wools’ and similar products use natural minerals like silica, but these can cause problems to the skin and lungs of the people around them [6,14]. Whether in composite or in fabric form, these materials can also be harmful to the environment after use, when they are processed or returned to the earth, or exposed to the open environment.

In the 1970s, a series of events related to public health concerns made makers of sound-absorbing materials to change the main constituents of their products from asbestos-based materials to new synthetic fibres. Moreover, the concept of “green” building materials is gaining its usage in several countries. In addition, public awareness and concern about the negative effects of pollution has led consumers to favour environmentally friendly materials, less contaminating processes, and recycled products. Therefore, it is important to increase research on acoustical materials based on renewable resources that can lead to viable alternatives to conventional materials for current and future applications [16]. In addition, the use of traditional material with the advantage of being lightweight, high strength-to-weight ratio and stiffness has made the product costlier for the domestic industry sectors as well as for applications where the strength is not an issue. In consequence, the uses of natural fibre in making absorbing and barrier material are catching up fast in recent times.
With this background, the present research work has been undertaken to use essentially the natural fibre like jute, abundantly available in Eastern part of India for development of new noise control materials *viz.* acoustic absorber along with transmission loss barrier material. This task involves a critical investigation of noise control behaviour of ‘jute nonwoven based porous absorber’ as well as ‘jute nonwoven polyester composite barrier material’ over a range of frequencies (50-3150 Hz) characterising the audible range of sound wave. The investigation also includes establishing the relation of characteristic non-acoustic and acoustic parameters of jute nonwoven with process parameter from statistically robust design of experiment as well as the effect of structural parameter of composite material on acoustic property. Further comparison with the commonly used similar products like acoustic absorber or barrier is also carried out. This detailed analysis thus give rise to scope of designing the newer jute based absorbing as well as barrier material for noise control application. So it is conclusively understood that jute based porous absorbing material as well as its composite can be low cost, environment friendly alternative to commonly used material for noise control.
1.2 Objective

A review of literature helps in understanding the unexplored domain of study on noise control behaviour of jute nonwoven and jute nonwoven polyester composite. The need for detailed understanding of noise control behaviour of jute nonwovens and jute nonwoven composite in terms of material and process parameter at audible frequency zone has been felt consequently. So the research work is designed with following objectives

1. Development of porous absorbing material from industrial jute nonwoven fabric.
2. Development of low cost simple instrument measuring suitable noise control parameter.
3. Investigation of the non-acoustical and acoustical properties relevant to noise control behaviour of jute nonwoven and relating these properties with the material and nonwoven process parameters for engineering of jute nonwoven based porous absorbing material.
4. Development of barrier material from jute nonwoven composite by industrial method.
5. Investigation of the mechanical and acoustical behaviour (properties) of jute composite leading to establishment of relationship of these properties.