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Study on Sound Insulation Properties of Different Coated Woven Fabrics

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Abstract

The aim of this paper is to find the relation between material parameters and insertion loss of different fabrics using statistical analysis. This research primarily deals with the sound absorption analysis of different uncoated and coated woven textiles fabrics used for curtains as household textiles. The analysis of surface morphology was done by scanning electron microscopy to determine the significance of surface structure onto the sound insulation property. The acoustic properties were measured by reverberation method. The maximum sound insertion loss, minimum sound insertion loss, over all sound insertion loss and percentage improvement in sound insertion loss has been discussed and suggested the woven textiles to be better sound absorber at higher frequencies. Moreover, the effect structural parameters on average sound insulation index were analyzed using SPSS software. The results revealed that warp density, linear density of warp yarn, thickness are influential parameters for the sound insulation property of uncoated fabric whereas the areal density, linear density of warp yarn and thickness influence the sound insulation property coated fabrics.

Keywords: Coated Materials; Sound Insulation; Fabrics; Surface Morphology

1 Introduction

Among many types of pollution, noise is also one of the pollution. Like other pollution noise also results health and hygiene problems. Longer exposure to noise may result hearing loss by damaging the nerve fibers of the inner ear. Such type of hearing loss is called as "noise-induced hearing loss", and it cannot be corrected by medication and surgery. Blood pressure might be elevated due to exposure of noise for longer duration [1,2]. Noise may also result heart diseases [3]. Studies suggest that longer exposure to noise results blood pressure and hyper tension. Noise pollution also results Insomnia, and thus people who lives in the noisy areas cannot sleep well. Noise insulation is necessary for home. Particularly, who lives in such areas whose home is nearer to noisy areas, such as airports, industries, power generations, highways, etc.

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There are many textile products at home that are commonly used for aesthetics and decorative purpose only. These products may include table covers, bed sheets, quilts, sofa covers, curtains, carpets and rugs. These products not only provide us aesthetics and beautification of our home, but also they provide sound insulation till some extent. A large research has been done on sound insulation by textile material. This sound insulation has been analyzed by nonwoven fabrics [4–6], woven fabrics [7, 8], knitted fabrics [9], combination of non-woven and woven fabrics [10], fabrics having sound insulating fibers [11], chemically modified fabrics [12], textile composites and fabrics from recycled textile waste [13].

Weaving offers a large variety of weave designs due its different structures plain, twill, satin, etc, with all types natural or synthetic yarns or filaments; offering wide range of properties including open, light, heavy, dense etc by different weaving machines tappet, dobby, jacquard, etc [14]. Woven fabrics allow special finishes to be applied to make them soil resistant, flame retardant, water repellant, etc. Sound absorbers are essential requirement of sport halls such as acoustical banners have been investigated keeping the arena of sports [15]. The consequence of weave type [16], pick densities [17], pile height of carpet and pile density of carpet [8] has been determined on the acoustical properties of acoustic home textiles. Moreover, the different structures of woven fabrics jacquard woven (134 gram per meter square), jacquard woven (188 gram per meter square), plain woven/open structure, printed curtain, velvet with knitted back-up, jacquard woven two side fabric, velvet with woven back-up, denim and one side laminated fabric used for curtains has been analyzed [14].

There are various factors that can be altered in weaving to assess their affect on the final acoustical properties. Weave type, fabric density, pile height and pile density are the factors affecting the final acoustical property of the woven fabrics. There is large variety of type of weaves available today. Type of weave not only affects the aesthetic and physical properties of the fabric but it also affects the acoustical property of the fabric. In one research, the consequence of weave type on noise reduction coefficient was studied of plain, 2/1 twill, 3/1 twill, 2/2 twill, rips and satin woven fabrics on same warp and weft density of yarns possessing same linear density and tpm, the noise reduction coefficient decreased in the respective order [16]. The different structures of woven fabrics used for curtains has been analyzed, and it has been found that plain woven/open structure holds lowest sound reduction and one side laminated holds highest sound reduction. The air permeability is considered as the main factor affecting the sound reduction negatively [14]. This suggests that weave type or fabric structure affects the sound insulation property of the fabric.

The number of warp yarns per unit width of the fabric is termed as the warp density, and the number of weft yarns per unit length of the fabric is termed as weft density. This both in general termed as fabric density. While changing other properties of the fabric, the fabric density also changes the acoustical properties of the fabric. In one study the consequence of weft density was determined, and it was maintained that incremental in noise reduction coefficient of layered fabrics was larger for the fabrics woven at lower weft densities [17]. Pile is the yarn that is deliberately inserted to be extended outward from the axis of the fabric. The piles are inserted in towel and carpets mostly. The length that is extended outward from the axis of the fabric is known as pile height and the number of piles per unit space in known as pile density. This pile also affects the acoustical property of the fabric. In one study two parameters of pile, i.e., pile height and pile density was analyzed in terms of their affect on the acoustical property of the fabric, it was finalized that pile height does not affect noise absorption co-efficient significantly, yet pile density affects positively on the noise absorption coefficient of tufted carpet, regardless of