Using Nonwoven Hollow Fibers to Improve Cars Interior Acoustic Properties

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ABSTRACT

Noise in Cars

Noise has become serious environment pollution in our daily life and is an increasing public health problem, as noise can cause serious health effects such as hearing loss, sleep disturbance, tiredness, cardiovascular and psychophysiologic problems and performance reduction. It is very important to control or reduce noise from traffic, and in factories, offices and houses .Car noise is essentially caused by the unit sound, the exhaust system noise, the air suction, noise, rolling and wind noises . Today, the dominant approach to achieving interior quietness relies to a large extent upon the ability to create impermeable enclosures around vehicle occupants through the use of several heavy interior layers (sound transmission loss), but recently a new concept has been emerged suggesting that sound can be reduced by replacing reflection (sound transmission loss) with dissipation (interior sound absorption area) by eliminating heavy barrier layers with light weight porous materials . Nonwoven is employed as fabrics for different kinds of interior applications. The numerous applications of nonwoven in cars can be classified into functional and aesthetic but there is a third category that of substitutes for other materials. Nonwoven can be made in a wide range of densities and different forms; the use of nonwoven is increasing because it offers great versatility and cost effectiveness . Each vehicle requires about 20 m2 of nonwoven materials .which are used specially for insulation, noise dissipation and as filter materials. Woven and knitted fabrics are also used in producing automotive fabrics but to a lesser extent compared to nonwoven fabrics.

Hollow Fibers

Hollow fibers are polymeric fibers that have a continuous hole running down the middle, which is created by the introduction of air or other gas (nitrogen) in the polymeric solution (in the wet spinning process) or by melt spinning through specially designed spinnerets .Hollow fibers provide greater bulk with less weight; they are therefore often used to make insulation fabrics .

Results of the experimental tests carried out on samples under study are presented in tables. Results were also statistically analyzed for the data listed and relationships between variables were obtained.

Sound Absorption Efficiency Test

It is clear from results that the increase in fabric weight improves the sound absorption efficiency of fabrics at both low and high frequencies. This is mainly because of that the increase in fabric weight means increasing in number of fibers per unit area and also

increasing in fabric volume and so the interconnected voids will be increased which absorb the sound waves rather than reflecting them, if the fabric was compacted, the sound absorption efficiency will be increased.

Air Permeability Test

From tables and figures , it can be seen that there is an inverse relationship between fabric weight and its air permeability properties. We can state that the increase in fabric weight increases the number of fibers per unit area and therefore free spaces in the fabric will be decreased, delaying the free passage of air through the fabric. The effect of heat bonding technique also facilitates this because of the melting of fibers (polyester fibers of low melting point) which causes pore spaces of the free area between fibers to be decreased, resulting in the decrease in fabric air permeability.

It can also be noticed from figure that that the more the hollow fibers, the less air permeability the fabrics become for the same weight. This is because the increase in the number of hollow fibers

increases the air volume in the fabric as the air is entrapped in the fibers and so the free spaces into the fabrics will decrease because of fabric bulkiness and so the ability of air flow to be passed through the fabric will be decreased.