"Application of Nonwoven Fabrics in Thermal Insulation in Automotive Industry (Using Wastes And Hollow Fibers)''

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Abstract

Use of textiles in automotive

Over the last decades , the field of non-conventional textiles has been witnessing a material revolution which has resulted in improved and economical products . The automotive industry has become so competitive that manufactures are reluctant to divulge precise details of their process for fear that it could be helpful to their competitors .Industrial textiles are widely used in transportation vehicles and systems including cars, trains, buses, airplanes and marine vehicle , automotive textiles are growth markets in terms of quantity ,quality ,and product variety .

The motor vehicle remains an important means for individual transport worldwide

.The interior of transportation vehicles are receiving more attention these days. Acoustical insulation products are frequently used in automotive interiors to reduce heat levels , the use of textiles in motor vehicles essentially covers vehicle interior cladding materials .interior décor textiles have a considerable predominantly stylistic function ,they give the vehicle interior a pleasant cosy feeling

Nonwoven in automotive industry

Nonwoven are fabrics made by bonding webs of fibers through mechanical , chemical or physical means .There is a very wide scope of utilization of various types of nonwoven textiles in different fields of industrial. The use of nonwoven structures in automobiles today , as well as in all transportation industries , is very large and quite diverse . its use is not limited to certain area of the vehicle Nonwoven become a major importance in all types of industries , this kind of a relatively new substrate has grown to such importance ,that we hardly can live without ,the major industries for this kind is automotive ,in recent years, automobile manufactures have recognized that nonwoven products offer great versatility and cost effectiveness for their vehicles . Automotive uses of nonwoven were introduced in the early 1950 s, when needlepunched waste fibers were adapted for thermal insulation.

Nonwoven is employed as fabrics for different kinds of interior applications such as seat covers ,door and side panels ,roof substrate and headlining as carpets, they are also used for floor covering and as lining in the trunk compartment ,and as sound and thermal insulation materials. The numerous applications of nonwoven in cars can be classified into functional or 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 of their cost –to performance ratio as substitutes for more expensive materials and their versatility, in addition they are easy to work with, retain their shape when molded and are easily recycled . Recycling is the most viable approach to reducing solid waste stream after source reduction. The main goal of textile recycling

efforts is to reprocess the textile and fiber by products so that they can be recycled back into the original stream or into useful end products.

Recycling of industrial textiles is more difficult than traditional consumers textiles because they are built as durable high performance products

Using textiles in thermal insulation

Thermal resistance is the ability of the fabric to remain relatively unchanged when exposed to radiant, conductive and connective heat.

The performance of thermal fabrics depends on its ability to insulate and to maintain structural integrity when exposed to high heat assault .

The influence of heat on the properties of fibers is of paramount importance with respect to textile processing as well as use .

The insulation materials most frequently utilized include polypropylene, polyester, polyacrylic, in this research the polyester (hollow fiber is used) .

Hollow fibers

The technology behind holofiber was discovered in the late 1980s . it wasn't until the mid –1990s that this technology was successfully applied in fibers . in 1980s and early 1990s ,holofibers worked to find way to use materials often found in aerospace applications and combine them which textile fibers .

For a number of years now , melt –spinning and wet spinning process have been used to produce hollow fibers . Hollow fibers are made of a sheath of fiber material and a hollow space at the center . this hollow may be formed in a number of different ways .the fiber may be made with a core of one material and a sheath of another , and then the central material is dissolved out . or inert gas may be added to the solution from which the fiber is formed ,with the gas bubbles creating a hollow area in the fiber .

Hollow fibers provide greater bulk with less weight,. they are therefore ,often used to make insulated fabrics .

The experimental work

Two kinds of textile materials were used in this research, polyester hollow fibers and polypropylene polyacrylic fibers. Non woven construction was used for producing all samples, it depended on using random- laid web with needle punching processes for web bonding.

Results and Discussion

Results of experimental examination on the produced samples are presented in the following table and graphs. Results were statically analyzed for data listed.

Through this research, it was reached to the following results

1- It is obvious from the statistical analysis of thermal insulation results that there are direct relationship between weight per m2 and thermal insulation. I can state that the increase fibers in unit area, which cause the produced samples to be bulked, so air spaces in the fabrics well be decreasing but air sinuses are increasing, and so quantity of lost heat is decreasing, due to increasing thermal insulation

2- It is obvious from the statistical analysis of thermal insulation results that there are direct relationship between puncture depth and thermal insulation. I can state that the increase of puncture depth, which cause the produced samples to be compacted, so air spaces in the fabrics well be decreasing but air sinuses are increasing, and so quantity of lost heat is decreasing, due to increasing thermal insulation

3-tables show critical F- test and tabulate F- test for effect of for weight /m 2 and puncture depth , weight and number of beats , weight / m2 and fiber type on thermal insulation and interaction between them , it is obvious by comparison between them that a highly significant effect on thermal insulation .I can state that increasing of weight , puncture depth and number of beats/min increase the air pods ,which cause the thermal insulation.

4-tables show critical F- test and tabulate F- test for effect of for puncture depth , and number of beats , puncture depth and fiber type on thermal insulation and interaction between them , it is obvious by comparison between them that a highly significant effect on thermal insulation .I can state that increasing of puncture depth and number of beats/min increase the air pods ,which cause the thermal insulation.

5- It can be seen from the figures that the more number of beats/min and puncture depth, the higher thermal insulation the samples become. I can report that the increase in puncture depth increase compacted fabrics, so air spaces in the fabrics well be decreasing but air antrum are increasing, and so quantity of lost heat is decreasing, due to increasing thermal insulation

6- It can be seen from the figures that the more number of beats/min, the higher thermal insulation the samples become. I can report that the increase in number of beats /min increase compacted fabrics, which cause the decreasing in the fabric thickness so air spaces in the fabrics well be decreasing but air antrum are increasing, and so quantity of lost heat is decreasing, due to increasing thermal insulation

7-It is also clear that from the tables, that samples produced with hollow fibers had recorded the highest rates of thermal insulation, whereas samples produced without hollow fibers have recorded the lowest rates. I can report that samples produced with hollow fibers contain of air pods between fibers ,so these pods increase the thermal insulation

8-It is also clear that from tables and diagrams that an inverse relationship between, number of beats /min and the decrease ratio in fabric thickness, I can report that the increase in number of beats / min cause the fabric to be more compacted which cause the decreasing in the fabric thickness under load.

9-It is also clear that from the figures that sample produced with hollow fibers, puncture depth 20, 950 beats/min and 2500 g/m2 has achieved the best results by Radar analysis

110- tables show critical F- test and tabulate F- test from theses tables that there is a highly significant effect of weight /m2, and puncture depth, weight /m2 and fiber type weight /m2 and number of beats /min on thermal insulation whereas interaction between number of beats /min and weight /m2 is not highly. Also there is a highly significant effect of puncture depth and fiber type, puncture depth and number of beats /min on thermal insulation for blending contain hollow fibers whereas there is a significant effect of puncture depth and number of beats /min for blending without hollow fibers as well as there is a highly significant effect of number of beats /min and fiber type on thermal insulation .

13-It is also clear that from the tables that critical F- test and tabulate F- test from theses tables that there is a highly significant effect of weight /m2, and number of beats /min on thickness whereas the interaction between them is a significant ,