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A Comparative Research on Seat Cover Fabrics for Comfort and Safety

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Abstract: This paper deals with a relative study of technical textiles in terms of comfort and health, designed for car seat covers (upholstery). The paper lays a relative comparison traced between various materials, but not a comparison of the properties evaluated with a particular and specified value. The goal and the only objective of the research was to establish a connection between the fabrics of automotive seat cover with different structures and certain parameters responsible for ease and comfort along with proper maintenance. Another aspect of the research and the study performed includes contrasting of various materials in regards to synthetic leathers.Specimens of the seat fabrics examined in this paper are in a form of spun/woven, knitted fabrics and synthetic leather so called (PVC). In reality the fabrics that appear to satisfy all the required seat cover prerequisites are often targeted to manufacture the seat covers. The research procedures and various methods thus included measurements of air porosity, abrasion resistance to the water-vapour permeability, and the flame retardance. In contrast to synthetic leathers, the current study aims to highlight the physiological convenience and protection characteristics provided by seat covers that is made of different materials. It also helps to establish the connection between the structure and other characteristics for collection of the seat cover fabrics which the automobile industry is presently using.The results emphasize on the importance of seat's type of material, fibrous composition and the fabric structure in regards to increase comfort and protection properties.

Keywords: Covers of car seats, increased comfort, Safety measures, Structure, Samples, and Materials.

INTRODUCTION

For the society, the field of automobile is considered as a lifeline as it is entirely based on numerous industrial sectors. The automobile industry is now facing a number of challenges. It is subjected to constant pressure to achieve health, performance, comfortability and aesthetic and environmental requirements with respect to increased fuel efficiency at reasonable costs[1]. The technical fabrics are commonly used for such purposes in the automobile industry.The automobile textiles can normally be fragmented into two groups consisting of visible and hidden items. The noticeable components involve seat upholstery, carpets, head liners, seat-belts, while the hidden constituents involve Components of noise and vibration, tire-cords, hoses, air filters, fuel filters and airbags [2].

As people spend plenty of time in cars for professional and personal purposes, the comfort has gained tremendous significance and is a major quality norm for the automobiles [3]. The car seat-cover is perhaps considered as the most familiar automotive material to the consumers, without taking into account the technical requirements and advancements. Nevertheless the seat must be physically, physiologically and thermally comfortable. Furthermore, the comfortability helps to prevent stress and fatigue caused to a driver and the rest passengers sitting inside the vehicles and thus leads to road safety by reducing unusual mishaps and accidents.Textiles thus have an important contribution to make in this respect. The Seat cover protection also has to be linked to the textile materials and flame retardancy. The properties of the

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seat cover's fabrics are linked to nature of fibres, properties of fibres, and structure of fabrics. Polyester, acrylic, nylon, polypropylene, wool, synthetic and natural leathers are the fabrics commonly used for seat coverings that provide increased comfort and reliability [4]. This paper deals with such a comparative study of technological textiles in terms of comfort and health, specially designed for the car seat cover's (upholstery).The research envisages a relative comparison tracked between different materials but not yet a relative comparison of the properties evaluated to a particular and given value. The goal of the research was to create a connection between fabrics of automotive seat cover with different structure and certain parameters responsible for comfort and security. The element of the research involves contrasting various materials to synthetic leather [5].

Experimental Part:

The experimental aspect began with the summary of the samples. Firstly, the research which is carried out revolved across the thickness of the cloth, the structure of the sample (woven, knitted fabric) as well as the description of the composition of the fibrous materials[6]. The knowledge has been supplemented with the samples of the structured images. In addition, the samples were examined and compared about their convenience and safety measures. The research methods thus includes tests for the air permeability, permeability of the water vapor, resistance to abrasion and the retardance of flame.

Materials:

The fabric samples with various combination in regards to a set of 7 includes the top layers T1, middle layers M1, and back layers B1 were investigated. Their fibrous composition, structure and other properties are illustrated in Table 1 and Table 2. (notations used- SL- Synthetic Leather; PVC- Polyvinylchloride; Co-cotton; PES- Polyster; S1- Woven fabric/plain weave and the combination of the weave rep with the referral figures; S2- Woven fabric or Diagonal weave; S3- fancy weave or woven fabric; S4- Knitted fabric or Jersey structure; S5- Jersey structure or knitted fabric, S6 - Knitted fabric or jersey structure; S7 - Knitted fabric or warp derivative knit structure, S8 - Knitted fabric or Interlock structure raised on a side; S9 - Sponge; S10 - Knitted fabric or Interlock structure raised on an side [7].

Table 1. A top and back images of the analysed samples.

SAMPLES	1	2	3	4	5	6	7
TOP VIEW							
BACK VIEW							

Regarding the Solubility test and examination, 98 percentage of the sulphuric acid (H_2SO_4)and the glacial acetic acid (CH_3COOH) purchased from "Sigma Aldrich" were employed.

METHODS OF OPERATION

Identification of the Sample Structures:

Use of the USB digital microscope camera, model DigiMicroProfi 5 megapixeli, to identify the structure. Focal length during the identification was kept at 100 millimeters and the software used for the identification is "Microcapture Pro Software" [8].

Table 2. The structure, material composition and thickness of the samples.

Samples			1	2	3	4	5	6	7
T1	Type/ Structure		SL	SL	SL	SL	S1	S2	S3
	[yarns /cm]	Warp	-	-	-	-	142	179	148
		Weft	-	-	-	-	122	178	129
	Material composition		PVC	PVC	PVC	PVC	PES	PES	PES
M1	-		-	S9	-	S9	-	-	-
B1	Type/ Structure		S4	S5	S6	S7	S8	S9	S10
	[stitch-es/cm]	Do Wale	16.2	11.48	17.12	17.41	10.51	-	10.49
		Do Course	19.03	11.79	18.77	17.47	10.52	-	10.48
	Material composition		32% Co, 68% PES	PES	32% Co, 68% PES	PES	PES	PES	PES
Samples thickness [mm]	-		1.28	3.01	1.33	3.26	2.02	2.68	2.35

Composition of the Fibre:

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Microscopy: The microscopic examination was conducted for longitudinal section of fibers by employing the optical "Zeiss Scope A.11 microscope" incorporating a 10X zoom magnifier.

Solubility Tests: Solubility tests were accomplished by means of suitable reagents (acetic acid and sulphuric acid) in order to accomplish the microscopic results.

Properties of the Samples:

Since only the top most layer of the samples is in contact with the driver, only for this part the characteristics of the sample such as abrasion resistance, air and water vapor permeability were determined.

Air Permeability: -Air porosity or permeability of the examined materials were performed in relevance with the "GB/T5453" standards employing a Digital Air Permeability Tester, YG461E model device.

Water vapor permeability: - The 'upright cup method' i.e. Water Vapor Permeability- ASTM E 96-Method B) was employed. Each samples of the fabric was positioned and closed above the cup occupied with the distilled water at the depth of three-fourth from height of the cup. The arranged samples were placed in the usual atmosphere "(23 ± 1 0C and RH 50 ± 2 %)" with the ventilation in the Calories-Group equipment. The test took eight hours to get completed. The gravimetric approach was used for determining the mass change. The samples were weighed every two hours on a responsive Kern balance, model ABT220-4M.

Abrasion resistance: -Model YG 401 B was used according to ASTM D4966 for recognizing the abrasion resistance of the Martindale Abrasion and Pilling Tester. The circular samples for this reason were abraded under pressure of 12 kilopascal. The mass and thickness were measured for each specimen before examination of the abrasion. The disparity in weight and thickness of the abraded samples were measured again after 85,000 cycles.

Retardancy of Frame: - The samples were made flammable using ISO 3795. The testing on the YG 815B horizontal flammability tester was carried out on specimens of 100 x 356 mm sizes. The parameters assessed were: weight loss, burning time, length of flames traveling along the samples tested, and burn rate.

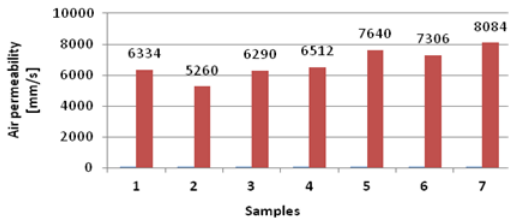

Fig. 1. Air permeability of the investigated samples

RESULTS AND DISCUSSION

The structure of the fabric and composition of the fibrous material are summarized in Table 1.

Air Permeability

Air permeability is an important factor in textile material efficiency, and provides breathability information. The yarn properties (diameter, curl, etc.), the structure of the fabric (knitted, woven, non-woven) and the properties (thickness, stiffness, porosity) together with the finishing techniques have a major influence on air permeability. The findings obtained for the samples under investigation are shown in figure 1.The best results for air permeability are provided in samples 5, 6, 7. Such outcomes can be related to the upper layer design which is a woven cloth. The rear layer often exerts an impact. In the sample 6 a sponge is present which is preferably a back layer, a slightly decreasing value is observed compared to samples 5 and 7 with knitted interlock fabric raised on the ground. The air permeability was lower for the samples from 1 to 4 with PVC as the top layer due to kind of material used.

CONCLUSION

This paper addressed the optimum conditions of cylindrical double tubes with aluminum foam subjected to oblique effect by taking into account different loading angles. To evaluate the maximum SEA and minimum PFC with varying thickness and diameter of the outer tube walls, the multi-objective optimization equation was formulated. PSO

algorithm used the Pareto front has achieved optimum results. This thesis studied the optimization of double tube aluminum foam subjected to angular loading variation.With the increasing angle of impact it causes effects on the SEA and PCF which decrease the value. These results can be the basis for designers to implement this structure especially for the bumper beam of automobiles.

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