SPACER FABRIC UTILIZATION IN ACTIVE WEARS

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Abstract - *In this project is to develop the spacer knitted structure and analyze fabric and comfort properties for wet suits application.3D polyester warp knitted spacer fabric was used in this project work. The fabric is collected from south India textile research association. . The main theme of our project is difference between the utilization of spacer fabrics in wetsuits and normal neoprene fabrics will be investigated and discussed. The tests required for this projects are thickness test, bursting test, weight test,air permeability test, vertical wicking test. The spacer knitted fabric is thicker than the normal polyester knitted sports fabric was primarily due to increase in outer dimension of the fibres. The normal polyester knitted sports fabric begins to fail from the lowest breaking extension compared with 3D spacer fabric. The spacer fabric has more weight than the normal polyester knitted sports fabric was primarily due to higher micropores structure of the spacer fabric. The quantity of air passed through the spacer fabric was slightly increases the air permeability property compared with normal polyester knitted sports fabric. The length of wicking was increased in the spacer fabric compared with normal polyester knitted sports fabric. The developed spacer fabrics are extensively used in the swimsuits, medical, area of aerospace, building and other industrial applications.*

Key Words: **Spacer fabric, Neoprene fabric, Fabric development, Air permeability, Applications…**

1.INTRODUCTION

Textiles are the most widely recognized materials which are profoundly utilized in sports textile. Numerous filaments are utilized to build up another texture to meet the fundamental prerequisites of sports textiles. The necessity of sports material is sweat ingestion. Numerous different properties that impact the game materials are air porousness, water fume penetrability, and wicking ability. Mostly polyester textures are utilized in these sorts of sports materials for their special properties like fast dry, doesn't assimilate water oppose wrinkle. The polyester texture is the preeminent texture utilized in sportswear. Thermal solace in the state of the psyche that communicates fulfillment with the warm climate. It is key to consider when arranging a development that will be used by individuals. A cold sensation will be satisfying when the body is overheated, however unsavory when the center is cold. Simultaneously, the temperature of the skin isn't uniform everywhere on the body. There are varieties in various pieces of the body which mirror the varieties in the bloodstream and subcutaneous fat. The insulative nature of dress likewise has a stamped impact fair and square and separation of body temperature. Sensation from an individual piece of the skin will rely upon a time, area, and apparel, just as the temperature of the environmental factors.

1.1.OBJECTIVES

- To analyze the properties, behavior, and application of the spacer and neoprene fabrics.
- To make a development sample of spacer fabric.
- To get physical properties test about three Three-dimensional warp knitted fabric and neoprene fabric.
- To get comfort properties to test about three Three-dimensional warp knitted fabric and neoprene fabric.
- To evaluate the tests results from physical and comfort properties

1.2 LITERATURE REVIEW

Spacer fabrics can be of woven, nonwoven, and knitted types. Of these the knit spacer fabrics are the most prominent and find many and varied applications in technical textiles. When considering medical applications, a pressure ulcer is one such. A pressure ulcer is the damage of skin or underlying tissue caused by prolonged pressure or pressure integrated with sheer and friction over a bony prominence which heel is one of the most common sites for pressure ulcer development. In new product development, designers must pay increased attention to environmental issues. In the motorcar industry, materials recycling has become a very important requirement. Fabrics and carpets inside cars are often composed of several layers of different materials, usually, a polyester fabric laminated to a soft polyurethane foam backing by an adhesive. This type of construction makes disassembling virtually impossible, and the combination of different polymer chemistries for the fabric and backing makes recycling of the assembly extremely difficult. Furthermore, there is effluent emission from the flame bonding process, which is used to combine the different layers. As a result, the use of polyurethane foam in car interiors is environmentally hazardous both in terms of production and recycling. Owing to their excellent mechanical properties, woven fabrics have numerous applications in the field of technical textiles. Some of their outstanding mechanical properties include high stiffness, strength, and dimensional stability.

1.3. SPECIFICATIONS OF THE MATERIAL USED

Spacer fabric is a three-dimensional knitted fabric consisting of two separate knitted substrates which are joined together or kept apart by spacer yarns. First layer – hydrophilic nature Second layer – hygroscopic nature Spacer layer – mono or multifilament. This three-dimensional fabric is comprised of an initial layer for moisture release, an interior layer for airflow, and a third outer layer for heat dissipation. According to the end uses the spacer ends of mono-filaments may be polyester, polyamide, or polypropylene. These fabrics are designed for airflow and cushioning. The middle to create two separate fabrics (spacer fabrics) are essentially pile fabrics that have not been cut consisting of two layers of fabric separated by yarns at a 90-degree angle. Spacer fabrics (3D fabrics) are produced through knitting and weaving technologies; Among these technologies, knitting is the most common manufacturing process for the production of spacer fabrics. There are two types of spacer fabrics: warp-knitted spacer fabric and weft-knitted spacer fabric.

The physical properties are;

- Compression behaviour
- Breathability
- Air permeability
- Cushioning
- Bending property
- Drapability
- Reuse

Neoprene is a popular material in making defensive garments for oceanic exercises. Foamed neoprene is ordinarily used to make fly fishing waders and wetsuits, as it gives magnificent protection against cold. The froth is very light, and jumpers make up for this by wearing loads. petrochemical-based material has the following unique benefits:

- Impermeability
- Elasticity
- Heat retention
- Formability.

1.4. APPLICATIONS

Spacer fabric are broadly utilized in the creation of three-dimensional materials by the specialized material areas, which incorporate car materials, for example, vehicle seat and dashboard covers; modern materials like composites; clinical materials, for example, antidecubitus covers; sports materials; and establishment pieces of clothing. As talked about in numerous past investigations, spacer textures enjoy various benefits in segment material. Higher breathability with the goal that dampness can be delivered, along these lines decreasing the chance of skin impregnate. Accordingly, the degree of solace expansions in examination with different materials like neoprene, froth, and overlay textures. It is light and has high solidness and solidarity to-weight proportions . What's more, on the grounds that spacer textures are recyclable, they are viewed as a harmless to the ecosystem material looked at with polyurethane (PU) form.

Other than environmental issues, vehicle seats of present day ought to fulfill some necessities. The vehicle seats ought seem alluring as well as excellent mechanical properties as to strength and have the option to secure travelers in case of mishap. Vehicle seats should be agreeable as well. This comfort should consolidate both the mechanical assistance that the seat accommodates the body similarly as extraordinary climatic conditions, which are head for a driver's show. Climatic comfort infers extraordinary thermoregulation, which can change the body's energy and offer incredible microclimate around the human skin. Studies have been directed to evaluate the driver's rectal temperature with different kinds of vehicle seats.

On the other hand, a couple of sorts of seats, which offer poor climatic comfort, will make the driver feel clumsily warm quickly, as the rectal temperature rises to 37.5°C in about 40 min. After 2 h, the rectal temperature may climb to 38.2°C, which is the limitation of okay strain for a normal person. Driving in an especially abnormal seat, the driver ought to endure a coronary episode; else, he may have a setback achieved by debilitated physical and mental pressing factor. As of late, the utilization of specialized materials has become quick. These stringy materials, which have an assortment of specialized end utilizes, may likewise substitute some ordinary materials with advantage in explicit applications . Spacer textures present great strength to pressure, high mass with generally lightweight and excellent dampness porousness for thermoregulation. Likewise, spacer textures are acceptable at pressure alleviation . Twist weaved spacer textures have pressure properties not the same as those of typical textures as a result of the spacer yarn. Twist sewed spacer textures show excellent direct versatile compressibility in the principal pressure stage, which is of extraordinary interest for seats. The constraint of the principal pressure stage fluctuates with the bowing unbending nature and design of the spacer yarn .This unique situation, it is not difficult to plan sufficient WK spacer textures with reasonable pressure trademark for utilize in vehicle seats. Moreover, twist weaved spacer textures are greater at lessening top pressing factor than polyurethane froth. Utilizing thicker twist weaved spacer textures with fitting spacer yarn design and material, pressing factor can be tremendously decreased. Since there are cutoff points to the thickness of twist weaved spacer textures, a few layers might be utilized to thickness is higher and expanded pressing factor help. Vehicle seats with pads of the twist sewed spacer texture are greater at diminishing pinnacle pressures than seat pads from polyurethane froth. In this unique situation, the previous will cause drivers to feel more great. Air penetrability of twist weaved spacer textures is far superior to polyurethane froths. Air porousness relies upon the design of the twist sewed spacer textures. Twist sewed spacer textures have higher warm conductivity and lower warm opposition than polyurethane froths. In this way, twist sewed spacer textures can move heat all the more successfully away from the driver's body thus these textures have preferred thermoregulation properties over polyurethane froths for warm climatic conditions. Twist weaved spacer textures have great and similar dependability on thickness with polyurethane froths. As a rule, vehicle seat pads made of twist sewed spacer textures can offer great mechanical help and actual solace to the driver's body. These textures are more grounded than polyurethane froths, can be utilized for longer timeframes and can even be reused with new seats covers. Thusly, these textures utilized for seats are simpler to reuse than polyurethane froth ones.

Neoprene fabrics mostly used in lot of applications based on their properties and behaviour.

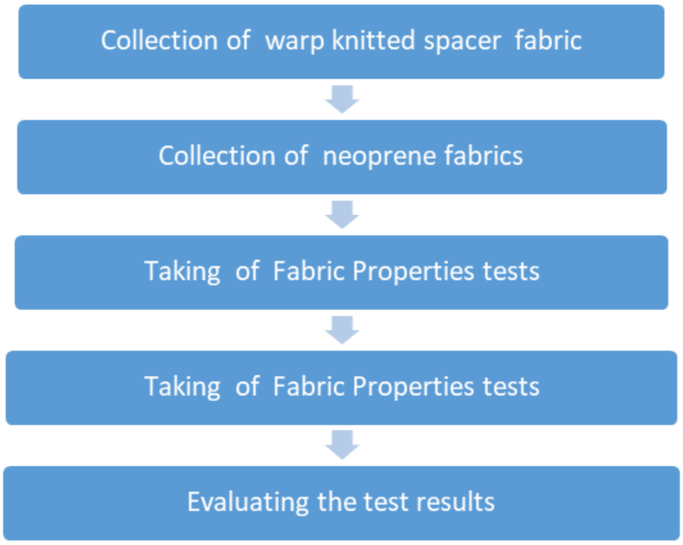
- Apparels
- Appurtenances
- Sports
- Materials
- Military

2. MATERIALS AND METHODS
2.1 MATERIALS

100 denier polyester multifilament yarn consist of 36 filament was selected as the raw material for producing warp knitted fabrics. The polyester filaments have good abrasion resistance and functional properties preferably used for wetsuits.

- Three-dimensional warp knitted spacer fabric
- Neoprene fabric

2.2 METHODOLOGY



3. TEST METHODS

Thickness of the fabric is calculated by usage of ASTM D1777-96 standard. Weight of the fabric is calculated by usage of ASTM D3776-96 standard. Bursting strength of the fabric is calculated by usage of ASTM D3787-16 standard. The air permeability of the fabric is calculated by usage of ASTM 737-18 standard. Vertical wicking test of the fabric is calculated by usage of AATCC 197-13 standard.

3.1. PHYSICAL PROPERTIES

3.1.1. Thickness
Measurement of width of the fabric between upper and lower side is thickness of fabric. Fabric thickness test is used to measure. Fabric is placed under flat anvil. Circular pressure foot is pressed by which the dial indicator moves. It is determined in mm. process is repeated and average is taken.

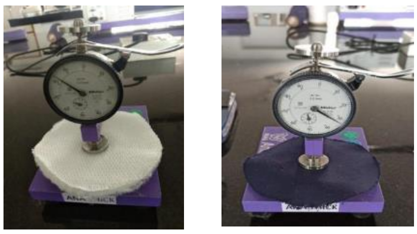


Fig-3.1.1. Thickness Test For Spacer and Sports Fabric

3.1.2. Bursting strength
Bursting strength is the one of the most important property of the fabrics .it is the property of fabric to with withstand the strain and stress when it is applied from both directions.The point at which the fabric get burst or get tear is called it bursting strength.
Bursting strength depends up on

- warp and weft count
- material
- weave
- EPI and PPI

- crimp
- Amount of force.
- Gsm

Bursting strength can be tested by bursting tester in which fabric is clamped from both directions and then the pull is applied.

3.1.3. Fabric weight test

GSM means grams per square meter of the fabric. It is the metric measurement of fabric. GSM is expressed in terms of g/m2. Cutter and weighing machine are the instrument to measure GSM. The sample fabric is cutted using gsm cutter. Weighing machine is used to weigh the sample fabric. Gsm can also be calculated by using the below formula. Weight per square meter (in gram) = (Weight of the sample in gram *10000)/(area of sample in cm2)

Figure 3.1.3. GSM cutter

3.2. COMFORT PROPERTIES

3.2.1.Air permeability

Amount of air flow through the fabric is called air permeability. Air permeability test shows the rate of air flow through the fabric in a specific area under a prescribed air pressure. Air permeability level is affected by the following parameter.

- Type of yarn used
- Property of fibre
- Structure of fabric
- Air permeability can be measured using following formula.
- Air permeability = Average rate of air flow / Area of specimen exposed to air cm3/sec/cm2

Fig 3.21.Air Permeability Test For Spacer and Sports Fabric

3.2.2. Vertical wicking test

Wicking height absorbed in a strip of 3d spacer polyester fabric at an time interval of 2mins, 4mins, 6mins, 8mins, and 10mins. Strip of treated and untreated fabric were cut and kept in the burette stand. Measurement ruler is at back side of the sample and the solution in the beaker is placed at 3mm depth. It is calculated for 2mins, 4mins, 6mins, 8mins, 10mins, are noted. Finally the average value of absorbance level is maintained and wick ability of fabric is measured .

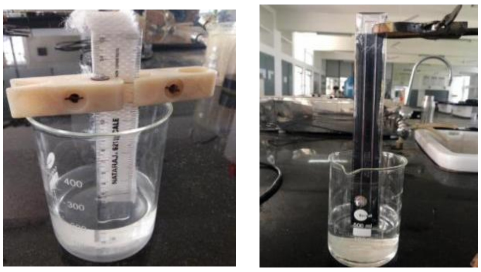


Fig 3.2.2.Vertical Wicking Test for Spacer and Sports Fabric

4.1. FABRIC PREPARATION

3D polyester warp knitted spacer fabric was utilized in this project work. The fabric is collected from south India textile research association. The neoprene polyester sports fabric are collected from the online sources.The spacer fabrics are produced through knitted or weaving technology. Mostly knitted is used to make the spacer fabric. There are two types, warp knitted and weft knitted. Raschel machine is used to knit the first layer with the help of two needle bars, and the another one is weaved on a twofold pullover roundabout machine having a rotatable needle dial. Two individual fabrics which are combine together by pile threads. The front bar 2, 3(holes fabric) is 75 denier polyester, inner layer is plain (bar 6) 75 denier polyester, middle layer bar 4 and bar 5 is 20 denier polyester monofilament. Front needle bar is used for holes fabric, back needle bar is used for inner layer. Course/cm of the 3d spacer fabric is 13.5, 22 gauge machine is used for construct this fabric. Machine width is 130 . Length of yarn required for 480 courses. After collected the fabrics it was changed like as swimsuits with the help of stitching .Then the required properties and needed test was taken in which are need our project.

Fig 4.1.Developed spacer fabric

5. RESULT AND DISCUSSION

5.1. Thickness

The thickness of the 3D polyester spacer knitted fabric and normal Neoprene polyester knitted sports fabric was evaluated and the results are presented in Table.

Table 5.1.Assessment of thickness of fabric

S.No.	Thickness of fabric(mm)	
	Normal polyester knitted sports Fabric	spacer knitted Fabric
1	0.8	2.5
2	0.8	2.8
3	0.9	2.7
4	0.6	2.8
5	0.9	2.9
Mean	**0.8**	**2.74**

From the test results, the spacer knitted fabric is thicker than the normal polyester knitted sports fabric was primarily due to increase in outer dimension of the fibres.

5.2. Bursting strength

Bursting strength of spacer knitted fabric and normal polyester knitted sports fabric was assessed and the results are given in the Table.

Table 5.2. Assessment of bursting strength

S.No.	Normal polyester knitted sports fabric (kgf)	spacer knitted fabric (kgf)
1	64.2	106.4
2	64.0	106.2
3	65.1	105.3
4	69.6	104.5
5	65.9	104.9
Mean	**65.76**	**105.46**

From the test results, the normal polyester knitted sports fabric begins to fail from the lowest breaking extension compared with 3D spacer fabric.The reason for this lower bursting strength was primarily due to the fabric is stressed in all the directions will tend to break first at the lowest elongation point of the fabric.

Consequently, the spacer knitted fabric has higher elongation properties will increased the bursting strength of the fabric drastically as compared with the normal polyester knitted sports fabric.

5.3. Fabric weight test

The weight of the 3D polyester spacer knitted fabric and normal polyester knitted sports fabric was evaluated and the results are given in the Table

Table5.3. Assessment of weight of the fabric

S.No	Normal polyester knitted sports fabric (g/m2)	Spacer knitted fabric (g/m2)
1.	190	373

2.	195	372
3.	188	371
4.	187	368
5.	185	370
Mean	**189**	**370**

From the test results, the spacer fabric has more weight than the normal polyester knitted sports fabric was primarily due to higher micropores structure of the spacer fabric.

5.4. Air permeability

Table 5.4. Assessment of air permeability

S.No.	Air Permeability (cm3/cm2/sec)	
	Normal polyester knitted sports Fabric	spacer knitted Fabric
1	34	42
2	40	44
3	36	40
4	39	43
5	38	41
Mean	**37.4**	**42**

Based on the test results, the quantity of air passed through the spacer fabric was slightly increases the air permeability property compared with normal polyester knitted sports fabric.

5.5. Vertical wicking test

Table 5.5. Assessment of vertical wicking test

S.No.	Time (Min)	Normal polyester knitted sports fabric (cm)	spacer knitted fabric (cm)
1	2	1.5	3.0
2	4	1.8	4.3
3	6	2.0	4.9
4	8	2.8	5.5
5	10	3.2	6.2

From the test results, the length of wicking was increased in the spacer fabric compared with normal polyester knitted sports fabric.

Based on the results the spacer knitted fabric is thicker than the normal polyester knitted sports fabric was primarily due to an increase in the outer dimension of the fibers. The normal polyester knitted sports fabric begins to fail from the lowest breaking extension compared with 3D spacer fabric. the spacer fabric has more weight than the normal polyester knitted sports fabric was primarily due to the higher micropores structure of the spacer fabric. the quantity of air passed through the spacer fabric was slight increases the air permeability property compared with normal polyester knitted sports fabric. The length of wicking was increased in the spacer fabric compared with normal polyester knitted sports fabric.

6. CONCLUSIONS

In this project is developed the spacer knitted structure and analyze physical and comfort properties for wet suits application. Spacer knitted fabrics have excellent compression, mechanical properties, breathability and thermal resistance properties due to their brilliant porous three dimensional structures. The main theme of our project is difference between the utilization of spacer fabrics in wetsuits and normal neoprene fabrics will be investigated and discussed. The tests required for this projects are thickness test, bursting test, weight test, air permeability test, vertical wicking test. The assessments are finished and the results are investigated and compared to normal neoprene polyester sports fabric test results. The developed spacer fabrics are extensively used in the swimsuits, medical, area of aerospace, building and other industrial applications.

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