The use of neoprene fabric evaluation in terms of comfort in child tracksuit production

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REZUMAT – ABSTRACT

Evaluarea confortului țesăturilor din neoprene destinate producției de treninguri pentru copii

Țesătura din neopren, utilizată la fabricarea echipamentelor pentru scufundări, wind surfing și pescuit, și-a făcut o intrare rapidă în industria modei. Această țesătură este rezistentă la produsele petroliere, la apă și la vânt. În același timp, este, de asemenea, rezistentă la temperature cuprinse între –50°C și + 120°C. A fost utilizată la confecționarea îmbrăcămintei de zi cu zi datorită structurii sale flexibile. În acest studiu, au fost comparate țesăturile din neopren cu proprietăți diferite privind caracteristicile de confort și fizice pentru a determina dacă o țesătură din neoprene este adecvată în producția de treninguri pentru copii.

Cuvinte-cheie: neopren, țesături tricotate, îmbrăcăminte funcțională, confort termic, confort în mișcare

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Neoprene fabric, which used in the manufacture of diving, wind surfing and fishing clothes, made a rapid entry into the fashion industry. This fabric is resistant to petroleum products, water and wind. At the same time it is also resistant to temperatures between –50 ° C and +120 ° C. It has been used in daily wear because of the flexible structure. In this study, neoprene fabrics having different properties are compared in terms of comfort and physical properties in order to determine whether a neoprene fabric is suitable in the child tracksuit production.

Keywords: neoprene, knitted fabrics, functional clothing, thermal comfort, motion comfort

INTRODUCTION

People for centuries use their textile products in almost every aspect of daily life. Previously only used for protecting and veil textiles, then it was used for the purpose of appealing to the beauty of the human spirit as fashion [1].

Many companies operating in the textile and apparel industry in the world and Turkey, products have begun to turn to 'high value added'. Smart and technical textiles with functionality in clothing are between the expectations. Waterproof and sunlight, anti-bacterial and breathable fabrics can be given as examples of functional textiles (figure 1).

Textile materials which are used depending on the time and fashion are changing the direction of raw and the structural characteristics frequently. Neoprene fabric is used in daily life in the examples of this situation.

Neoprene is the trade name of polychloroprene material developed by Dupont [2]. In 1931, the United States, Arnold Collins, discovered synthetic rubber neoprene. Neoprene was produced first commercially by the Dupontcompany under the name of Duprene and 1 pound as the main $ 1,250 tonnes in 1932. In the early years people were not interested with this rubber because of insufficient properties of synthetic rubber. But in 1934, Dayton Rubber Manufacturing Co. company mentioned that the rubber can be used in car tires and its usage increased in industry [3].

In this study, a variety of tests made to decide whether it is appropriate for the child tracksuit production of neoprene fabric which is in functional textile groups. For this purpose fabrics are compared and evaluated for physical and thermal comfort properties.

Neoprene in garment production

Neoprene was worn for the first time in 1950 as a garment. Brothers Bob and Bill Meistrell discovered neoprene to keep their body temperature warm and protect them from the cold in the water during surfing. Neoprene with Dive N 'Surf name has begun selling in Southern California. Thus the modern neoprene wetsuit was born [13].

Later, the brothers created swimmers, sports bras and accessories which name was Body Glove in increasing popularity in the 1980s. Thus, neoprene, which used in wetsuit, has been used in different areas and brands. Anymore, neoprene represents textures which are easily accessible to everyone and may be preferred in everyday wear. Neoprene, which has become the most comfortable part of everyday clothing, is considered as an alternative to leather fabric surfaces [13].

Neoprene fabric is produced open width. In this way, fabrics crease does not occur in the tube knitted

Fig. 1. Neoprene garment samples [12]

fabrics and fabric utilization efficiency considerably increased. Neoprene fabric has a more stable structure than the other knitted fabric and so there is not turning aside problem. Therefore, sewing process can be made more comfortable.

In order to obtain a flexible structure vivid color in the collection and laser-cut details, have come to the fore in recent years. Neoprene skirt, sweatshirts, dresses, skinny cigarette pants, vests and jackets as products were studied in the winter collection intensively [14].

Neoprene's technical specifications are as follows:

- Neoprene is resistant to atmospheric conditions, the petroleum products in the form of liquids and gases, ozone, water and salt water [5].
- Neoprene can resist to temperatures of –50 °C to 120 °C [4].
- Neoprene is a synthetic elastomer such as latex or solid state within the flexible foam. Rather than sülfür, it is vulcanized with metal oxide. It raises the flammability modified isocyanate [6].
- Non flammable characteristic is good [7].
- Washable, tensile strength is high. Cold, heat conductivity is poor [8].
- Neoprene is resistant to oil, chemicals, light, high temperatures and electric current [9].
- The coloring of neoprene is difficult. Digital printing can be done on all products [7].

Today, neoprene is used in a variety of fields. Usage areas of neoprene are as follows:

- The solid state of neoprene used in the manufacture of mechanical rubber parts, fuel hoses, electric cables, and the coating of special equipment, as a binder in rocket fuel, in the manufacture of gaskets and seals, conveyor belt and production of protective material [6].
- Neoprene used in air bags, life jackets, protective clothing and aircraft interiors [7].
- Neoprene used in sports clothing and garments, such as diving, wind surfing, fishing and the manufacture of medical products such as vests and knee braces [5].
- Neoprene used in cooking gloves, cup cooler, computer bag, mobile phone pouch, bottle cap, mouse pad, the American service production [11].

PREVIOUS STUDIES

Neoprene studies about smart textiles, multi-functional textiles, wetsuit are as follows. Vahapoğlu V. (2006) gave information about the historical development of the synthetic rubber industry and the current the general characteristics of most consumption synthetic rubber [3]. Bulut and Sülar (2007) has made work about coating and lamination methods, uses, production techniques and performance testing of coated laminated fabrics [6]. Halaçeli (2008) gave information about high-performance textiles, which sports clothes and space research results developed, use together breathable, waterproof fabric in daily wear [16]. Bulgunand Yılmaz (2009) has done tests on the structure of fire suits, thermal protection within the scope of performance evaluation and have explored firefighter clothing innovation in the design [17]. Karahanet et al. (2009) gave information about textile structures used in space applications and the latest studies in this area [18]. Öndoğanet et al. (2014), evaluated the clothing, the fabric, the fit to the body, their production techniques and models of athleticism, taking into account the characteristics of athletics sport the environmental requirements [20]. Erdoğanet et al. (2014) did collection work about diving suits, characteristics, uses, accessories, materials used in the clothing [21].

MATERIALS AND METHOD

Material

Neoprene knitted fabrics were used in this study. Neoprene production is made to form double face circular knitting machine. Both sides of the neoprene fabric may be manufactured in different contents or the same color. Thus, it is possible to produce a double face fabric. For example polyester-elastane, both sides; a face gray melange dark gray melange, other side; polyester-elastane face as the other side of viscose-elastan. In between the monofilament structure that connection will provide air circulation, improves volumetric structure and provides the breathing of the fabric.

Yarn in the production of neoprene fabric is used approximately two times more than the production of other knitted fabrics. Neoprene fabric production yield is 50% lower than the other knitted fabric [10].

Four different types of fabricsare selected in the scope of this research. Neoprene fabrics approved for use in the production tracksuit is preferred in the choice of fabrics. All of the fabrics have been formed double faced fabrics. All fabricscontained elastane, fabrics according to the fibers type andratio are given in table 1 below.

Method

In this study, the structural characteristics and specifications, which are effective on thermal comfort properties of the fabrics used in this study, were measured with using objective methods and in accordance with the relevant standards and device instructions.

Especially, due to abrasion of knee area of children tracksuits, abrasion properties of fabric, which is used in production tracksuit, are important. Therefore the fabric abrasion resistance was measured under pressure 9kp according to EN ISO 12947-2 standard

Table 1

Fabric code	Type of fabric (%)	Weight (gr/m^2)	Thickness (m)	Front/back side content
1	90 PES -10 EA	340.06	0.002080	Front/Back: PES-EA
2	60 PES-30 COTTON-10 EA	402.48	0.003151	Front/Back: PES-COTON-EA
3	70 PES-20 VİSCON-10 EA	390.58	0.002660	Front: PES Back: VISCON
4	95 PES-5 EA	305.14	0.000967	Front/Back: PES-EA

in the Martindale abrasion tester. One of the most important properties of comfort is also air permeability. Air permeability measurements were made according to TS 391 EN ISO 9237 standard (and 20 cm^2 test area). The pressure difference is 100 Pa in the Textest FX 3300 device. The fabrics used in this study should not hinder the movement, but it should fit properly on the body at the end of the movement. So the ability of the stretch-return is expected to be good. This reason, stretch-return characteristics of the fabric were tested to determine stretching and deformation. A mechanism is prepared according to ASTM D 2594-04 standard. Two nails are mounted on a flat surface. Nails distance between was determined according to standard by calculating the stretch ratio of the fabric sample size. Fabric samples were sewed in the form of a tube and passed to the hanger and hanger are also attached to nails and tension was provided. Samples of fabric were tested for comfortable products by considering the width and length elongation value. All of the fabric is knitted. Bursting strength was measured in order to assess the effect of stress caused by wear versatile force. Measurement was performed in Truburst Bursting Strength Testing device according to TS 393 EN ISO 13938-1 standard.Dimensional change of the fabrics was evaluated after washing. Therefore, the fabrics were washed with liquid detergent at 40 °C in daily wash programme. The fabrics were centrifuged at 800 rpm and dried in the air. Width and height measurements were made with a tape measure. In order to evaluate the attitude of the fabric, circular flexure test was made according to ASTM D 4032 standard. The average of forces, pushing the fabric circle, was calculated. The weight of the fabric according to the TS EN 12127 standard was determined on sensitive scales. Average value was multiplied by 100 and g/m^2 weight was determined. Alambeta and MMT devices have been used to determine the thermal properties of the fabric. Thermal resistance, thermal conductivity and heat absorbance values were found with Alambeta tester. Thermal properties of the fabric are evaluated according to the obtained data were compared. The body temperature of the daily clothing such as tracksuit is expected to keep the balance. Therefore, the liquid caused by body heat is very important in terms of outer surface to move quickly and give people a feeling of dryness for thermal comfort. MMT (Moisture Management Tester) tester was used to measure the moisture transport properties of the fabric.

EXPERIMENTAL RESULTS

Abrasion and thread breakage in the fabric samples wasn't observed on the results of 50,000 abrasion cycles. Therefore, the fabrics were analyzed to evaluate the test results whether weight loss. Abrasion test results are shown in table 2. Maximum weight loss was observed in the number 1 fabric.
Air permeability test results are shown in figure 2.

Table 2

Fabric code	Previous weight (gr/m^2)	Next weight (gr/m^2)	% Weight loss
1	37.8	36.4	3.7
2	45.7	45.2	1.09
3	44.7	44.2	1.11
4	35.2	34.8	1.13

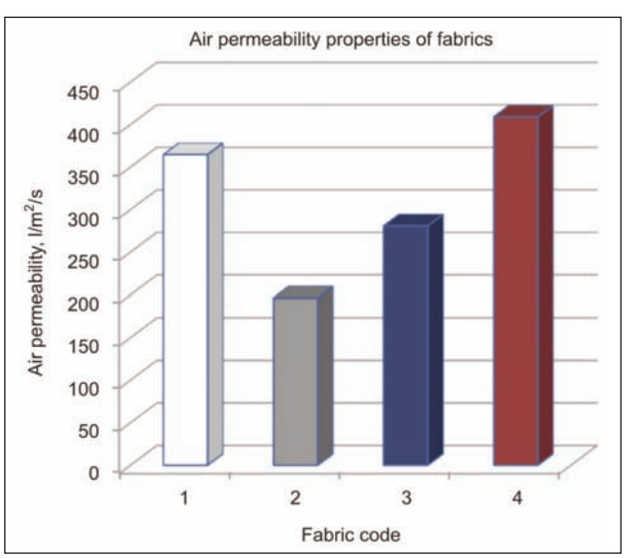

Fig. 2. Air permeability properties of fabrics

Width and length stretch-return values of the fabrics are shown in table 3.
Burst or deformation wasn't observed in any of the fabrics according to the pressure 800 kpa in the burst strength measurement test conducted.
The dimensional change wasn't observed according to test results of the washing dimensional exchange on all fabrics at the end of the measurements.
The force, which is required to push the number 2 fabric, was the maximum level value of 18.9 Newton according to the circular flexure test result. This was followed by respectively 3, 1 and 4 fabrics (figure 3).

Table 3

Fabric code	Width stretch (cm)			Length stretch (cm)		
	Initial length	Recent length	% Change	Initial length	Recent length	% Change
1	15	15	0	15	15	0
2	15	15.15	1	15	15	0
3	15	15	0	15	15	0
4	15	15.25	1.66	15	15.1	0.66

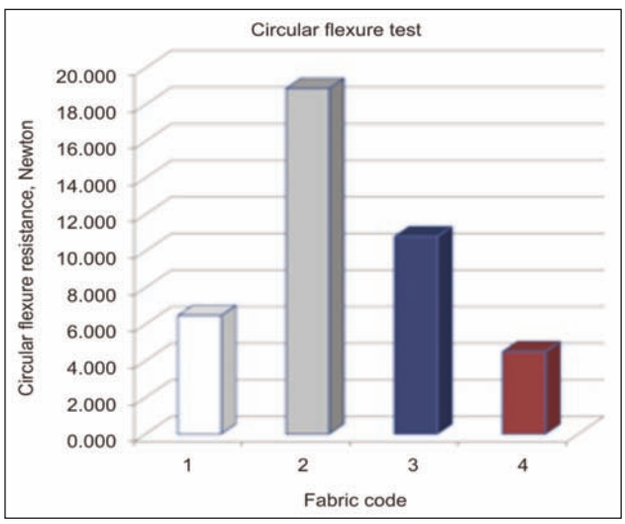

Fig. 3. Force values applied to fabric (Newton)

The results of the Alambeta device are shown in table 4. The thermal resistance of number 2 fabric, which is the thicker fabric, is highest (figure 4). Values of thickness, weight, and thermal resistance are linearly as expected.

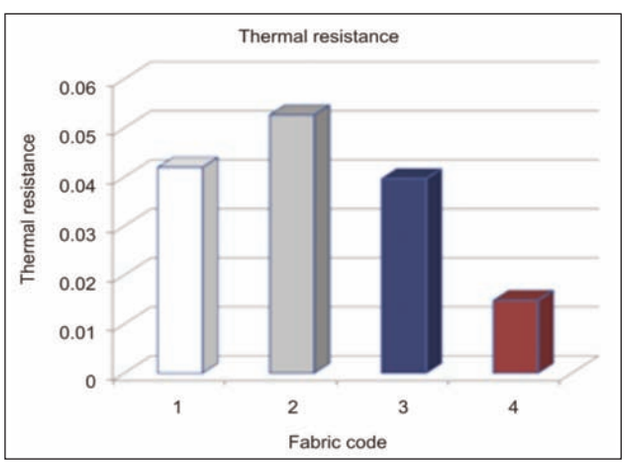

Fig. 4. Thermal resistance values of fabrics

Table 4

Alambeta	Thermal resistance	Thickness	Thermal absorbance	Thermal conductivity
1	0.042	0.00208	87.42	0.049
2	0.0527	0.003151	107.966	0.0599
3	0.0397	0.00266	120.466	0.067
4	0.01487	0.000967	153.79	0.065

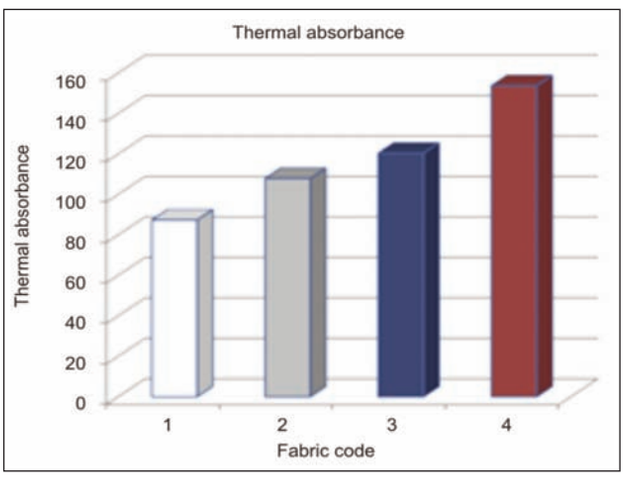

Fig. 5. Thermal absorbance values of fabrics

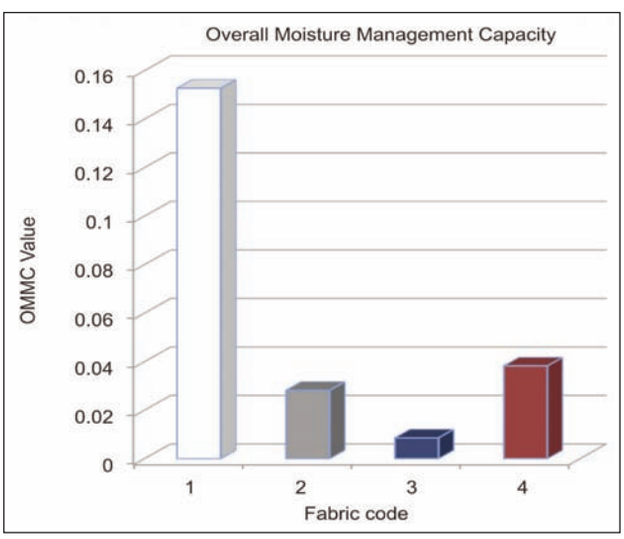

Fig. 6. OMMC Graph

Thermal absorbance values of all the fabrics were below than 400 (figure 5). During the initial contact of the skin with the fabrics, it was found that it does not give a very cold feeling.

Overall Moisture Management Capacity (OMMC) value is shown in figure 6, according to MMT test. Four number fabric has the best moisture transmission fabric as shown in figure 6.

CONCLUSIONS

Four different fabrics were analyzedin this study. It was planned to be used in the production of

children's tracksuit, and so assessments were made according to the criteria sought in tracksuit.
Abrasion of child tracksuits especially can become much in the knee area. Therefore, it was made test to determine abrasion of the fabric and it was observed that no abrasion on the test results. This is among the expected results in the production of a tracksuit. This is advantageous in children's products and this provides the possibility for longer use.
The air permeability values of the Neoprene fabric are good generally due to monofilament which is an intermediate layer between the front and back surfaces of the fabric. It was determined that there is the linear ratio between air permeability with fabric weight-thickness on the test results. Fabric content of %95 PES-5EA is thinner than other types of fabrics. Due to both thinner fabric and the least weight, code 4 fabric has got the highest the air permeability value. For this reason the code 4 fabric can be advisable for warmer climates.
When the stretch-return ability test results in the study was conducted to evaluate fabrics, any distortion wasn't observed in the fabrics. In this case it can be said that neoprene fabrics have a good return feature. Thus, occurring deformation willnot happen frequently in the knee or elbow area of the tracksuit. In this study, although the criteria are evaluated in children tracksuit, the same criteria are also required in the adult tracksuit. Even, the visuals in this direction, has a far greater significance for adults. The load on the knee is higher in adults and the knee trail is much more pronounced. This problem is possible to eliminate with neoprene knitted fabrics, content of %10 elastane. Voluminous soft touch fabric also shows a soft barrier between the surface of the knee. For this reasonparticularly, it can be reduced pain sensation of feeling with the design double-layer models of the child tracksuits for the knee area when children fall on the ground. When the rate of %5 elastane fabric, the return wasn't also about %1 at the end of the width-length stretching. Therefore %10 elastane is more suitable for tracksuits fabric. Thus, tracksuits, which are produced neoprene fabric, will keep a long time in the visual aesthetics of everyday wear. And thus the use of neoprene fabric can get round their everyday outerwear design.
When looking from the circular resistance test results, it was observed that %60 COTTON-30PES-10EA content of fabrics showed largest load bending. When the weight of neoprene fabric increases, the circular bending resistance increases. In recent years, joining heavy weight products are possible with advanced sewing machines without any problems. Rigid properties of the fabrics also provide ease of manufacture.
When the thickness of fabric was increased, it was determined to the thermal resistance increased, according to Alambeta test results to the thermal conductivity, which is an important factor for child garment fabric. Especially, due to the code 2 fabric, which is the thickest fabric, hashigh thermal resistance and low air permeability, it will increase the preference for cold climates. Because of heat absorbance values below 400 of examined, all fabrics will not becold feeling in contactwiththe first skin, it means that childrenfeel good during wearing their clothes.
Another important factor is moisture absorption children's clothing items. Best moisture absorption was observed %60 COTTON-30PES-10EA containing fabric. This is probably because of the relatively low weight compared to other fabrics and fine fabric. In fact, all of OMMCvalues were below 0.2. Therefore, OMMC of neoprene fabric used in this study is not good. It is expected to say to be well that the values of moisture transmission is above 0.4. Therefore it mustn't be preferred neoprene fabric in areas where there is intense physical activity.
Neoprene fabric can easily be used in the manufacture of clothing or tracksuit due to advantages asan aesthetic in normal daily life, easily not to be deformed, the usage is durable and printing process is applied with vivid colors.

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