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A COMPARATIVE STUDY OF ASSEMBLING METHODS OF NONWOVEN BAGS TRADITIONAL SEWING VS WELDING SEAMING

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ABSTRACT

Understanding the techniques for joining fabrics together in a way that considers durability, strength, leak-tightness, comfort in wear and the aesthetics of the joints is critical to the production of successful, structurally secure fabric products. For nonwoven shopping bags, two sides of a bag are sewn together, and handles are attached to the body of the bag. Recently the same operation has been replaced by a thermal technology to achieve the operation performed by traditional sewing. The aim of this study was to compare the properties of nonwoven fabrics, when joint with ultrasonically welded seam and with the traditional sewing with different sewing factors, such like; stitch types, stitch length and seam types. The comparison was done throughout examining the bending stiffness, seam strength, seam elongation, seam efficiency and shear rigidity. In general, the ultrasonically welded seam is stiffer than traditional seams. The traditional seam has a mean strength 40 % higher than ultrasonic seams. The lock stitch 301 had the highest value of seam strength. The seam efficiency by welded seam is about 56%, while by the traditional seam is 93.75%. The overlock stitch 505 had the highest values of shear rigidity.

KEYWORDS: Bending Stiffness, Nonwoven Bags, Seam Elongation, Seam Strength, Shear rigidity, Traditional Sewing, Ultrasonic Welding Seam

INTRODUCTION

Shopping bags are most commonly made from nonwoven polypropylene, cotton, laminated materials, polyester or nylon, recycled PET, or natural (jute, bamboo, hemp).

The majority of the inexpensive bags you see at retail stores today are made of nonwoven polypropylene, which is a form of plastic made to look and feel like cloth. This material option is extremely popular because it is, by far, the most economical-making it easier to kick the single-use bag habit. These bags can be strong and mighty, and lay flat for storage (some nonwoven bags fold into little pouches as well).

Nonwoven Fabrics

Fabrics can be made from fibers as well as from yarns. Conventional fabric production process is: Fiber to Yarn to Fabric (knitting or weaving). Nonwoven production process is Fiber to Fabric. It eliminates the yarn production process and makes the fabric directly from fibers. Nonwovens are known as engineered fabrics. They are created with a view to targeted structure and properties by applying a set of scientific principles for a variety of applications.

High-speed and low-cost processes As compared to the traditional woven manufacture nonwovens and knitting technology, a larger volume of materials can be produced at a lower cost by using nonwoven technology. By weaving fabrics, the rate of fabric production is 1 m/min. By knitting fabric, the rate of fabric production is 2 m/min. But by nonwoven fabrics, the rate of fabric production is 100 m/min. The manufacturing principles of nonwovens are established in a unique way based on the technologies of creation of textiles, papers, and plastics, as a result, the structure and properties of nonwovens resemble, to a great degree, to those of three materials [11].

The most common products made with nonwovens listed by INDA include:

• Disposable nappies, • Household and personal wipes, • Laundry aids (fabric dryer-sheets), • Apparel interlinings, • Carpeting and upholstery fabrics, padding and backing, • Wall coverings, • Agricultural coverings and seed strips, • Automotive headliners and upholstery	• Filters, • Envelops, • Tags, • Labels, • Insulation, • House wraps, • Roofing products, • Civil engineering fabrics/geotextiles, • Sterile wraps, caps, gowns, masks, and curtains used in the medical field [11]

Definition of Nonwoven

In ISO 9092, nonwoven is defined as “manufactured sheet, web or batt of directionally or randomly oriented fibers, bonded by friction, and/or cohesion and/or adhesion, excluding paper and products which are woven, knitted, tufted, stitch-bonded incorporating binding yarns or filaments or felted by wet-milling, whether or not additionally needled. The fibers may be of natural or man-made origin. They may be staple or continuous filaments or be formed in situ [12].

In ASTM nonwoven is defined as “a textile structure produced by bonding or interlocking of fibers, or both, accomplished by mechanical, chemical, thermal, or solvent means, and combinations thereof [2]. Today, there are two leading associations of nonwovens in the world, namely EDANA (The European Disposables and Nonwovens Association) and INDA (The North America’s Association of the Nonwoven Fabrics Industry). According to INDA, “Nonwoven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. They are flat, porous sheets that are made directly from separate fibers or from molten plastic or plastic film. They are not made by weaving or knitting and do not require converting the fibers to yarn [10].

Classification of Nonwoven

Nonwoven fabrics can be classified according to many aspects; these aspects are:

- According to the method of production: wet bonded, dry bonded and spun bonded
- According to the technology of raw materials: staple fibers nonwovens, filament
- According to the end use of materials: durable, semi durable, disposable
- According to their properties: flame retardant, water replant, water absorbent [11]

Nonwoven Fabrics Manufacture Principles

Nonwovens are typically manufactured by putting small fibers together in the form of a sheet or web (similar to paper on a paper machine), and then binding them either mechanically (as in the case of felt, by interlocking them with serrated needles such that the inter-fiber friction results in a stronger fabric), with an adhesive, or thermally (by applying binder (in the form of powder, paste, or polymer melt) and melting the binder onto the web by increasing temperature) [11], [13]

Textile Joining Methods

When joining materials together the following areas need to be considered:

Aesthetic appeal - strength

Durability - comfort in wear

Equipment availability - cost [15].

Constructing garment is most commonly done with needle and thread. Alternative Methods for joining textile materials to form garments, other than sewing with needle and thread have existed for several decades and include bonding (thermal bonding, laser enhanced bonding, adhesive bonding), welding or indeed seamless shaping. Figure 1 shows the different sealing methods, which can be used to join any garment [15].

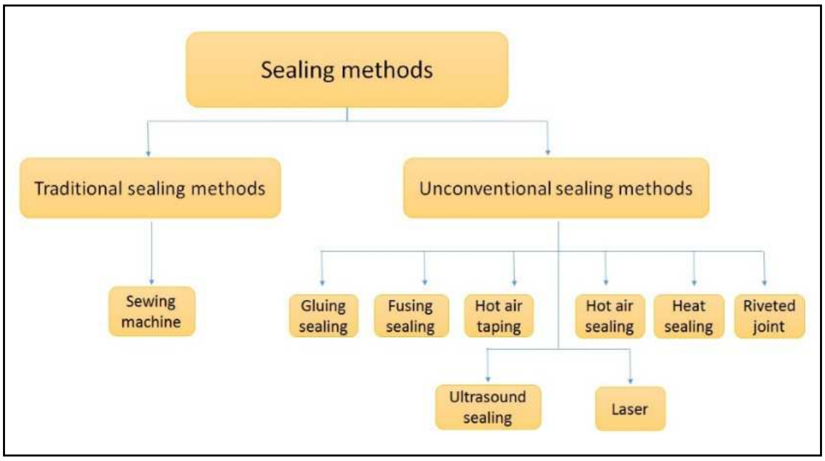

Figure 1: Sealing Methods [8]

There are main methods to join textile fabrics; the traditional sewing method, the bonding method and the welding method.

Traditional Sewing Method

Sewing remains the most popular method of joining fabrics. The lockstitch machine is the standard method used for sewing. A bobbin sits in the middle of the shuttle, which is rotated in synch with the motion of the needle. The needle pulls a loop of thread through the fabric, rises, then reinserts into the fabric. The feed dogs are what move the fabric forward and through the machine. Instead of joining the different loops together as seen in chain stitching, the thread from the machine is joined with a separate spool of thread that is the bobbin. On the machine, a tension wheel is present. The tension must be at the appropriate setting in order for the stitch to form correctly. In a single inch of a seam there are usually 10 stitches per inch. Disadvantages with traditional sewing include discontinuous joints producing perforated seams, sewing thread deteriorating over time, and speed limitations [1]. Figure 2 presents the types of stitch formation in traditional sewing method.

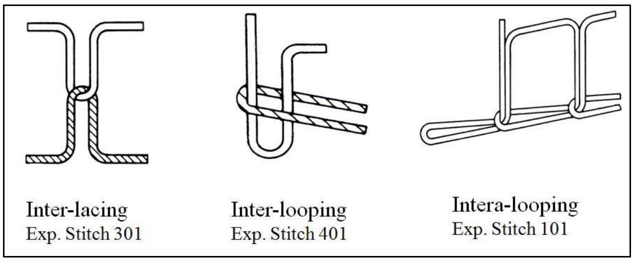

Figure 2: Stitch Loop Formation Types

Bonding Method

There are many kinds of bonding techniques:

Thermal bonding is a process by which materials to be joined is heated individually using several methods, causing the thermoplastic materials to melt. They are then compressed by applying pressure, which causes an intermingling of polymers. A seam is formed as the material cools and solidifies. Disadvantages of this technique are stiffness and fiber degradation caused by excessive heat conducted through the fibers.

Laser enhanced bonding is a process that uses a laser to drive a polymer adhesive into the materials being joined. The nozzle tip of the gun, which discharges the polymer into the seam, is a coaxial window through which a near infrared beam from a laser is focused onto a liquid adhesive polymer as it is applied to the edges of the join.

Adhesive bonding uses four techniques to bond textiles using adhesives: mechanical, hydrogen, chemical, and thermodynamic bonding. Adhesives are used for sealing, providing extra strength to seams, creating stiffness, and water proofing seams. Adhesives can be applied in several ways, including nozzles and tapes. While adhesives may seem simple, the cost and the additional weight of the adhesives are two disadvantages [4]. Nowadays, the use of adhesive film is becoming more and more popular in the production of hi-tech sportswear and/or intimate apparel. Adhesive film is flexible for continuous bonding operation, in which traditional stitching can be eliminated, and has been proven in various clothing design. The most appealing benefit of “No-sew” technology is the soft and low profile promoted [14].

Welding Sealing Method

The developments in both of the production technology and textile materials have resulted in several brands of performance of outdoor clothing offering garments mostly constructed from welded seam. Welding is a thermal process requiring melting of material at the fabric surfaces that are being joined. It is applicable to fully or partially synthetic fabrics with thermoplastic components (e.g. nylon, polyester or polypropylene yarns and PVC or polyurethane coatings), which are compatible when melted together. Generally, the fabrics to be welded must be of the same thermoplastic. The material to be melted may be the fibres of the fabric, a thermoplastic coating or a film added at the joint in combination with the fabric fibres. Heating of the joint interface is achieved using a range of different methods.

Initially welding was applied to garment manufacturing most effectively in the production of short seams or stampings (such as, vents, buttons holes and eyelets, although continuous welding is capable of production of long seams and has seen recent acceptance as a method of joining garments. Ultrasonic seaming could soon replace the needle and thread technique with newer equipment and faster methods. Figure 3 presents the different welding methods.

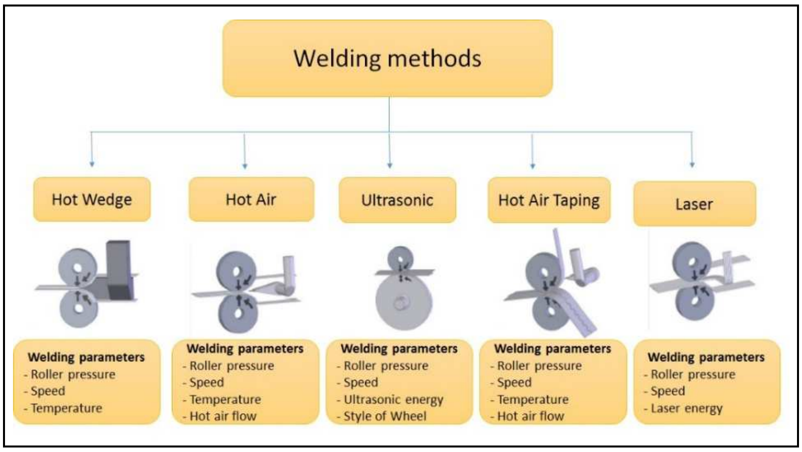

Figure 3: Welding Methods [9]

Ultrasonic Welding Method

Of the various welding techniques, available, ultrasonic welding has become one of the most widely used for thermoplastics, since they burn when heated. Ultrasonic is also the method of choice for these materials, for example for parting fabrics so that there is no thickening of the material along the cut edges [5].

Ultrasonic Seaming is an advanced technique for joining synthetic materials and blends to produce continuous and impermeable seams. Ultrasonic seaming is a fast, clean, and cost effective way to join fabric. Additional advantages to using ultrasonic seaming, such as the “conservation of energy, possibility of precise automated assembly using computer-aided-manufacturing technology, and recyclability of the product, as foreign yarns are not used to make a seam [4].

There are two of ultrasonic welding techniques; plunge welding and continuous welding. Ultrasonic welding is a process that uses mechanical vibrations to soften or melt a thermoplastic material at the joint line. The fabrics to be joined are held together under pressure and subjected to ultrasonic vibrations, usually at a frequency of 20-40 kHz. The mechanical energy is converted to thermal energy due to intermolecular and surface friction [15].

The Functioning Principle of Ultrasonic Welding

Low frequency mains voltage is transformed into high frequency electrical energy. A converter connected in line converts these electrical oscillations into mechanical vibrations. This is done using a piezoelectric transducer having efficiency above 95 %.

The mechanical vibrations are transferred to a transformer element coupied to the converter, the so-called booster. This booster optimizes the amplitude for the horn.

The horn is individually manufactured for each application and transfers the ultrasonic energy to the material to be processed. To build up a mechanical clamping force, a so-called anvil is required enabling the energy to effect melting because of physical processes (internal and external absorption. There are four types of ultrasonic welding optimum process for any applications: Cycle-controlled welding, Fixed Horn/Rotating Anvil, Rotating Horn/Rotating Anvil, and

Fixed Horn/Fixed Anvil. Figure 4 shows this principle and the types of ultrasonic [5].

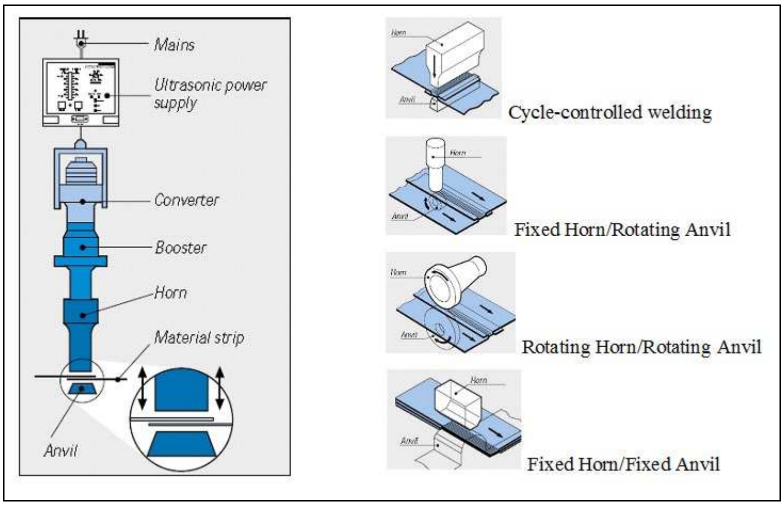

Figure 4: Functional Principle and Kinds of Ultrasonic Welding [5]

Applications of Ultrasonic Welding Method

Ultrasonic welding is a modern, innovative and economic alternative and complementary to conventional sewing technology. If assembling of laminates, clothing fabrics with high share of polymer and technical nonwovens is required and in particular, to get, the use of the Ultrasonic welding is the first choice.

Technical Section

Filter bags, health care articles, medical mattresses and pillows, needle felts, operations sheet, foils, bullet proof vests, blinds and awnings, pleated filter, shower curtains, spacer fabrics, seat covers, MBR-modules and many more

Garment Section

Outdoor garment, Tyvek protective clothing, bras, lingerie, medical garment & drapes, Softshell a, sport garments, clean-room garments and many more

Automotive Section

Vehicle interior and insulation item, Protective car covers, blinds, curtains and many more

Problem Statement

Shopping bags have become inevitable products in our daily lives. Sewing is one of the techniques extensively used to join the separated (cut) parts in the form of stitches to form a useful product. For shopping bags at this stage, two sides of a bag are sewn together, and handles are attached to the body of the bag. The same operation has been replaced by a thermal technology, where a very high temperature is used as a means to achieve the operation performed by conventional sewing. Some bags have become very quickly defected in the area of seam line and could not halt the stuff May be the problem is the applied joining method (traditional seam or welded seam).

Many studies had been done to investigate the performance of adhesive bonded seam [14], [19], other researchers concentrated on the investigation the ultrasonic welding method in comparison with the traditional sewing technique [1], [4], [16], [18]. Some researches tried to compare the three assembling methods (sewing, bonded and welding methods)

[15], [17].

Purpose of Study

This study's purpose is to investigate the functional properties of seamed nonwoven shopping bags, which seamed using ultrasonic welding technique and traditional sewing technique with different sewing factors to achieve the suitable parameters for assembling the bags, throughout measuring the seam strength, seam elongation, seam stiffness, seam shearing and seam efficiency.

MATERIALS AND METHODS

Three different nonwoven polypropylene shopping bags with different weights per unit area and thickness are used for this investigation. The three bags are already seamed with ultrasonic welding method with different anvil geometries. In Table 1 the specifications of the investigated bags with welded seams are presented.

Table 1: Classifications of Investigated Welded Seams of Nonwoven Bags

Bag Code	Weight Per Unit Area [G/M2]	Thickness [Mm]	Used Welded Seams	Type of Welded Anvil Geometry
B	108	0.52		
M	74	0.37		
T	83	0.43		

The selected nonwoven bags have been cut and sewn using traditional sewing machines with different sewing parameters to compare the exist welded seams with traditional seams. Sewing was done on industrial sewing machines under particular sewing conditions that are commercially adopted by apparel manufacturers in apparel manufacturing. Sewing thread spun polyester 40/2 was used for sewing all specimens.

Three stitch types with three different levels of stitch length and three seam types are chosen for the experimental works. In Table 2 chosen sewing parameters are presented.

Table 2: Description of the Sewing Parameters for Experimental Work

Sewing Parameter	Variation	Description
Stitch type	3 types	Lock stitch 301, Multi-chain overlock stitch 504 (Over 3 Thread), Multi-chain overlock stitch 505 (Over 5 threads)
Stitch length	3 levels	Stitch 301 (1 mm, 3 mm, 5 mm) Stitch 504 (3 mm, 5 mm, 7 mm) Stitch 505 (3 mm, 5 mm, 7 mm)

Seam type	3 types	Superimposed seam, Safety seam, Lapped seam

After sewing the nonwoven bags with chosen traditional seams, the three different nonwoven bags with welded seams and traditional seams are cut and prepared for the laboratory tests. Seam stiffness, seam strength, seam elongation, seam shear rigidity and seam efficiency are measured for all tested samples (Nonwoven fabric without seam, welding seams and traditional seams). For seam stiffness, Shirley stiffness device is used and the bending stiffness is calculated according to DIN (53362) [7]. Seam strength and seam elongation are carried out using Instron tensile strength machine according to ASTM (D5035-95) [3] and then the seam efficiency is measured from the strength tester from equation 1:

$$\text{Seam efficiency (\%)} = \frac{\text{Seam tensile strength}}{\text{Fabric tensile strength}} \text{ X } 100 \quad \text{(Equation 1)}$$

For measuring the shear rigidity, the SIROFAST - 3 (Extensibility meter) [6] is used to measure the bias extensibility of the fabric (at 45° to the warp direction) under a low load (5 g/cm width). Then shear rigidity is calculated from bias extensibility.

RESULTS AND DISCUSSIONS

To compare the influence of the traditional sewing and welding seaming on the nonwoven fabrics, bending stiffness, tensile strength, elongation, and shear rigidity were carried out for all samples without seam and with welded seam and traditional seam. Results of each parameter would be separately presented and analyzed.

Effect of joining methods on the bending stiffness:

Results of the three investigated ultrasonically seamed nonwoven bags presented the same behavior of the bending stiffness of traditional seams and ultrasonic welded seam Table 3.

Table 3: Results of Bending Stiffness of Investigated Fabrics with Welding Seam and With Different Stitch Types and Stitch Length

Sewing factors			Bending stiffness [mN.cm] Fabric B	Fabric M	Fabric T
Without seam			10.80	2.86	5.20
Welding seam			142.04	64.05	62.55
Traditional seam	Stitch 301	S.L. 1	44.48	16.70	56.80
		S.L. 3	91.84	37.00	60.51
		S.L. 5	95.50	38.67	62.38
	Overlock stitch 504	S.L. 3	24.96	24.96	41.35
		S.L. 5	67.34	34.26	52.12
		S.L. 7	77.08	40.34	56.12
	Overlock stitch 505	S.L. 3	60.23	28.34	59.75
		S.L. 5	85.78	30.85	63.20
		S.L. 7	90.45	39.67	65.80

Figure 5 shows the results of bending stiffness of nonwoven fabric (Fabric B) without seam and with joining seams traditional sewing (three stitch types with different stitch length levels) and ultrasonic welded seam. The bending stiffness of fabric B was 10.80 mN.cm. With ultrasonic welded seam, it was increased to 142.04 mN.cm. With traditional stitch types, it was also increased. Bending stiffness was between 24.96 to 95.90 mN.cm.

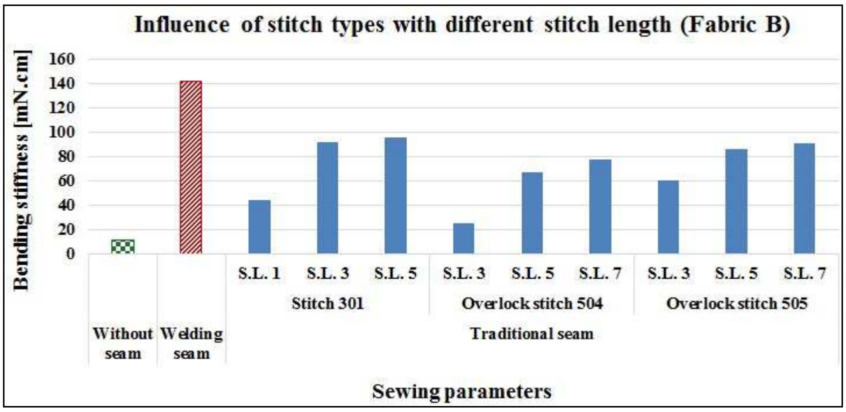

Figure 5: Influence of Stitch Types and Stitch Length on the Bending Stiffness

The results confirmed in general that, the ultrasonically welded seam has significantly a higher effect on making the fabric stiffer than the traditional stitch types in different stitch lengths.

For evaluating the effect of stitch types separately, recorded the lockstitch 301 the higher bending stiffness, then the overlock 5 threads stitch 505 and at the end came the overlock 3 threads 504. This result could be happed because of the seam allowance of the stitch 301, which was 1 cm wright and 1 cm left. That means the seam width was about 2 cm. Although the seam width of the overlock stitches, was 5 to 6 mm. In addition to that, the stitch overlock 505 formed from more sewing threads than the stitch 504.

To analyze the effect of stitch length (stitch density) on the bending stiffness, results indicated obviously, that the stitch length level 3 recorded the higher bending stiffness by the three stitch types. The higher the stitch density is, the stiffer the bending stiffness of the fabric. More stitches mean more thread consumption

In general, the ultrasonically welded seam is stiffer than traditional seams. For that reason, it is better for shopping bags. If wanted to use the traditional seam, then it is better to use a lock stitch 301 with high stitch density to be capable to halt the goods.

The effect of seam types was also been analyzed. Three different seam types (superimposed seam, safety seam and lapped seam) were been applied on the three nonwoven bags. The influence of seam types on bending stiffness the by the three tested nonwoven bags was the same, the seam types have taken the same behavior Table 4.

Table 4: Results of Bending Stiffness of Investigated Fabrics with Welded Seam and Different Seam Types

Sewing factors		Bending stiffness [mN.cm] Fabric B	Fabric M	Fabric T
Without seam		10.80	2.86	5.20
Welding seam		142.04	64.05	62.55
Traditional seam	Superimposed seam	91.84	37.98	37.98
	Safety seam	38.31	17.45	33.94
	Lapped seam	168.73	161.50	108.29

Results of the bending stiffness in Figure 6 show, that the lapped seam, which formed of 4 fabric layers, has recorded the highest bending stiffness between the studied seams. The bending stiffness was 168,73 mN.cm The lapped seam caused more stiffness than the ultrasonically welded seam, which came in the second position, then came the superimposed seam and the safety seam.

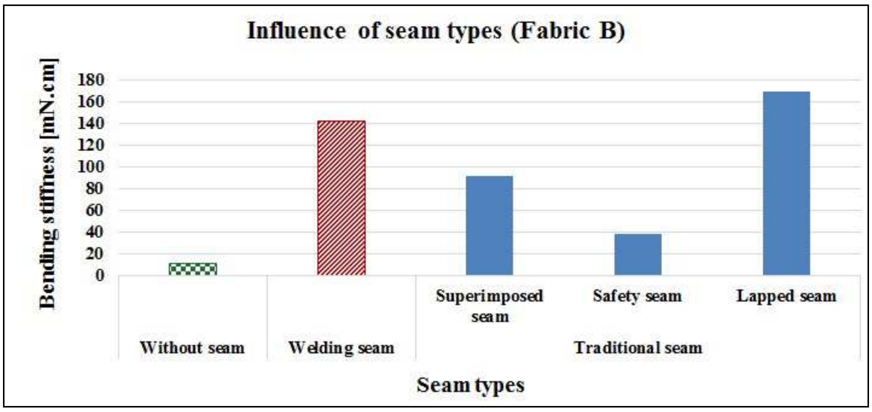

Figure 6: Influence of Seam Types on the Bending Stiffness

It could been concluded, that the ultrasonically welded seam is good for shopping bags, but if it should be interchanged with traditional seam, then the lapped seam is more suitable for sewing.

Effect of joining methods on the seam strength and seam elongation

The tensile strength and elongation were been tested for nonwoven fabrics, ultrasonically welded seams and traditional seams with different seam properties. Results of tensile strength and elongation for the three tested fabrics with ultrasonically welded seams and traditional seams with different stitch types and stitch length were been presented in Table 5.

Table 5: Seam Strength and Seam Elongation with Different Stitch Types and Stitch Length

Sewing factors			Fabric B		Fabric M		Fabric T	
			Strength (kg)	Elongation (%)	Strength (kg)	Elongation (%)	Strength (kg)	Elongation (%)
Without seam			8.0	102.5	7.0	50.0	11.0	78.0
Welded seam			4.5	31.7	4.0	22.5	6.0	33.3
Traditional seam	Stitch 301	S.L. 1	6.5	150.0	8.0	135.0	11.0	185.0
		S.L. 3	7.5	180.0	8.0	155.0	10.0	170.0
		S.L. 5	7.5	150.0	8.5	170.0	9.0	165.0
	Overlock stitch 504	S.L. 3	7.5	142.5	8.5	125.0	9.5	9.5
		S.L. 5	8.0	155.0	8.5	150.0	11.5	11.5
		S.L. 7	7.5	192.5	8.0	165.0	10.5	10.5
	Overlock stitch 505	S.L. 3	8.5	140.0	8.5	170.0	10.0	10.0
		S.L. 5	7.5	137.5	8.0	130.0	10.5	10.5
		S.L. 7	7.5	175.0	6.5	115.0	10.5	10.5

The strength results presented in Figure 7 show that, the strength reduced by welded seams and traditional seams than by fabrics without seams. Results by ultrasonically welded seam seem to be significantly lower in mean strength than the traditional alternative seams. The traditional seam has a mean strength 40 % higher than ultrasonic seams. The lock stitch 301 had the highest value of seam strength. The seam efficiency by welded seam is about 56%, while by the traditional seam is 93.75%.

In opposite to the strength; the elongation by traditional seams has been increased than by fabric. It refers to the sewing threads, which formed the traditional seam. By ultrasonically welded seam still the elongation lower than the fabric without seam, duo to its stability case. The lock stitch 301 recorded also the highest value of seam extensibility. The traditional stitches has a mean elongation 80% higher than the ultrasonically seams.

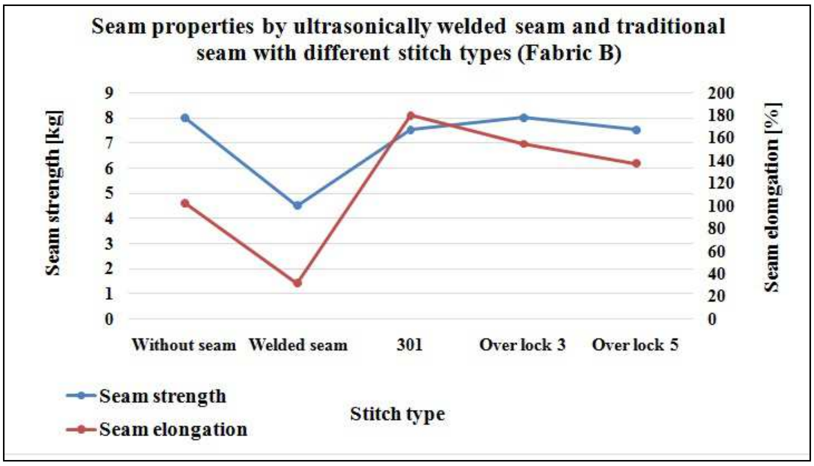

Figure 7: Influence of Stitch Types on the Seam Strength and Elongation

The effect of stitch length level on the seam strength and elongation was been investigated and presented in Figure 8. It can be said, that the more the stitch density (in opposite to the stitch length) is, the higher the seam strength and seam extensibility.

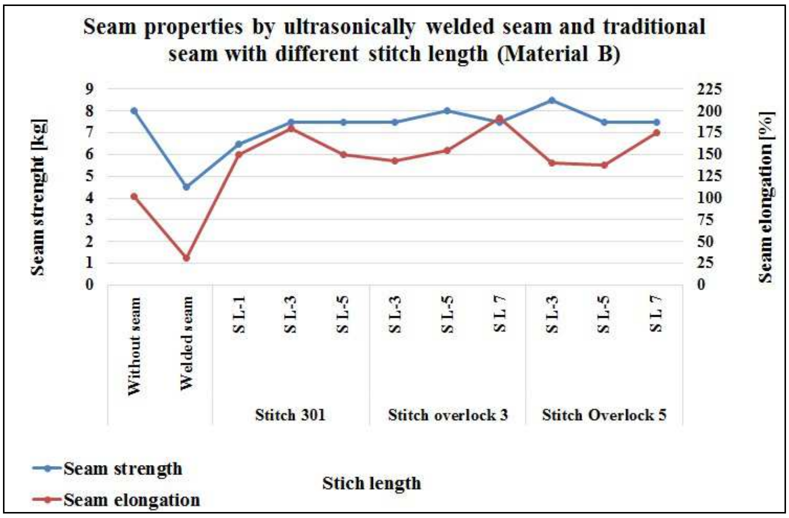

Figure 8: Influence of Stitch Length on the Seam Strength and Elongation

The third sewing factor, which should been investigated, is the seam type. Results of the three fabrics, welded seam and traditional seams are been introduced in Table 6.

Table 6: Tensile Strength and Elongation by Welded Seams and Traditional Seams with Different Seam Types

Sewing factors		Fabric B		Fabric M		Fabric T	
		Strength (kg)	Elongation (%)	Strength (kg)	Elongation (%)	Strength (kg)	Elongation (%)
Without seam		8.0	102.5	7.0	50.0	11.0	78.0
Welded seam		4.5	31.7	4.0	22.5	6.0	33.3
Traditional seam	Superimposed seam	7.5	180.0	8.0	155.0	10.0	170.0
	Safety seam	6.0	145.0	6.0	95.0	10.5	170.0
	Lapped seam	6.0	180.0	6.0	80.0	11.0	125.0

Results shown in Figure 9 confirmed the results of the stitch types and stitch length. The strength of the seam is lower than the fabric without seams. In addition, the strength of the welded seam is lower than the traditional seams. To explain the effect of different seam types (superimposed seam, safety seam and lapped seam), there was a problem accord during the test. It was been expected, that the lapped seam, which consists of four fabric layers, should record the highest strength than the two other seam types. In the opposite of this, it had the lowest value of strength. It was observed, that the damage happened in the fabric not in the seam, thus due to the strong of the fabric. For that reason the two-fabric layers superimposed seam recorded the highest strength between the tested seam types.

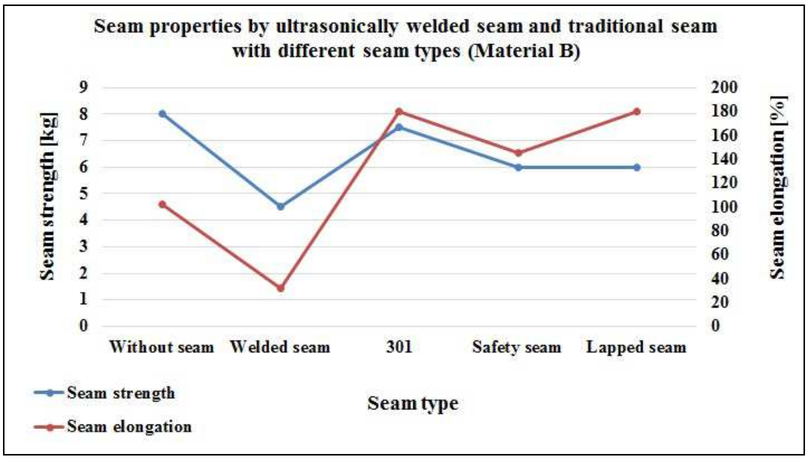

Figure 9: Influence of Seam Types on the Seam Strength and Elongation

Effect of joining methods on the shearing behavior

For determining the shear rigidity of nonwoven fabrics with and without seams, we measured the bias extensibility of fabrics (at 45° and 135° to the warp direction) under a low load (5 g/cm width). Then shear rigidity was calculated from bias extensibility according to the following equation:

Shear Rigidity (N/m) = 123 / Bias Extensibility (%) (Equation 2)

Results indicated that the seam in general has an obviously significant effect on the shear rigidity values of nonwoven fabrics. Almost the two kinds of seams (welded and traditional) had less shear rigidity than fabrics without seam. Ultrasonically welded seam appeared also more shear rigidity than traditional seams. Perhaps it was because the traditional seams consist of sewing threads, which cause more flexibility and allow the fabric to move a little than welded seams.

Results in Figure 10 pointed to, that the stitch types had an obviously effect on the shear rigidity. The over lock stitch 505 had the highest values of shear rigidity, then the over lock stitch 504 and at the last position came the lock stitch 301. For the effect of the stitch length on the shear rigidity, results indicated that the shorter the stitch length is, more the shear rigidity of the seams is, duo to the extensibility of the long stitch length.

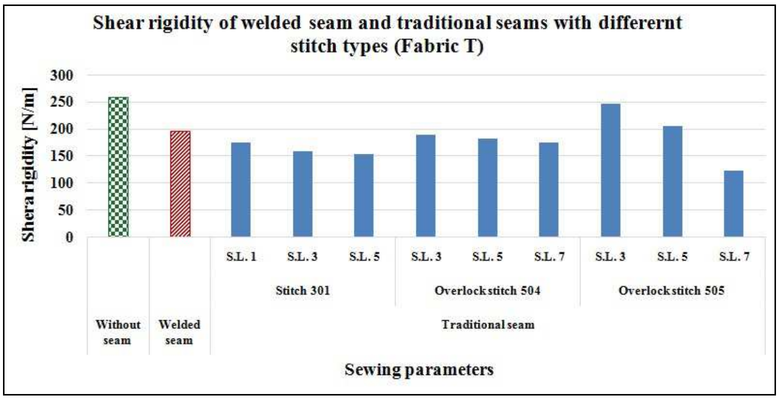

Figure 10: Shear Rigidity of Welded Seam and Traditional Seams with Different Stitch Types and Stitch Length by Fabric T

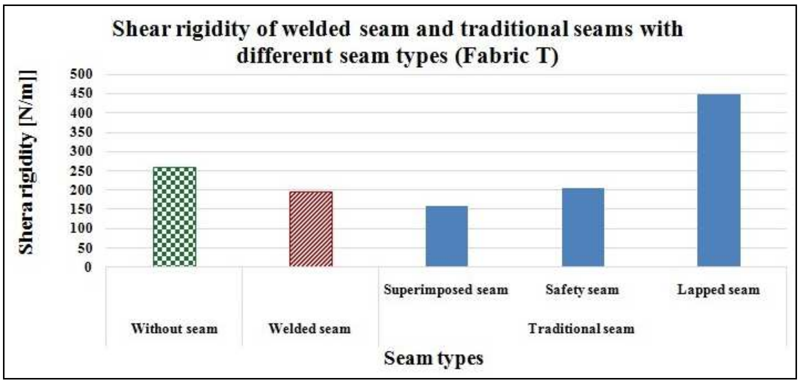

Figure 11: Shear Rigidity of Welded Seam and Traditional Seams with Different Seam Types by Fabric T

The effect of the seam types on the change of shear rigidity was also been investigated and explained. Figure 13 presented the results of the different seam types. As mentioned before recorded the traditional seams smaller valued than the welded seam and the nonwoven fabric without seam. But by the lapped seam, which consists of four fabric layers in the seam area, showed the highest value of the shear rigidity, because it is very stiff and hard than other seams.

CONCLUSIONS

There are main methods to join textile fabrics; the traditional sewing method, the bonding method and the welding method. In this study, a comparison between two joining methods; ultrasonic welding method and traditional sewing with different sewing parameters was done. Three stitch types (lockstitch 301, Overlock stitch 504 and Overlock stitch 505) were used for the investigation with three different stitch length levels. The most famous three seam types (superimposed seam, safety seam and lapped seam) were also used in this study. To achieve the best case of the joining method, some quality properties were tested and evaluated, such like bending stiffness, seam strength and elongation, seam efficiency and shear rigidity.

From the results it could been concluded that, the ultrasonically welded seam has significantly a higher effect on making the fabric stiffer than the traditional stitch types in different stitch lengths. The lockstitch 301 recorded the higher bending stiffness between the three stitches. The ultrasonically welded seam is good for shopping bags, but if it should be interchanged with traditional seam, then the lapped seam is more suitable for sewing.

The strength reduced by welded seams and traditional seams than by fabrics. The traditional seam has a mean strength 40 % higher than ultrasonic seams. The lock stitch 301 had the highest value of seam strength. The seam efficiency by welded seam is about 56%, while by the traditional seam is 93.75%. The traditional stitches has a mean elongation 80% higher than the ultrasonically seams. The more the stitch density (in opposite to the stitch length) is, the higher the seam strength and seam extensibility.

Almost the two kinds of seams (welded and traditional) had less shear rigidity than fabrics without seam. Ultrasonically welded seam appeared also more shear rigidity than traditional seams, because the traditional seams consist of sewing threads, which cause more flexibility and allow the fabric to move a little than welded seams.

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