J. Basic. Appl. Sci. Res., 2(10)9970-9977, 2012
© 2012, TextRoad Publication

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Absorption of Different Methods of Bonding Nonwoven Fabrics Used for Lining and Interlinings

Sanaa S.Saleh, Elham M. Kamal

Women's College for Arts, Science and Education, Ain Shams University, Egypt.

ABSTRACT

In this paper the effect of time & temperature on fabric absorption have been investigated. Six nonwoven interlining fabrics, produced using different fabric bonding, which are chemically bonded, Hydroentangled bonded, thermally bonded and chemically-Hydroentangled bonded fabrics.
An instrument, which can be used to test the amount of moisture absorption, has been designed and used to test the amount of absorption for these fabrics. The fabrics used can be made into either linings or interlinings of clothing. The fabrics were tested at 3 different temperatures; 70, 85 and 100°C and the amount of absorption were calculated after 7, 15 and 20 minutes respectively.
Keywords: Absorption – Nonwoven - Interlinings - Designed instrument

1- INTRODUCTION

In many cases, interlining serves as an additional layer of insulation. For example, drapes are often interlined with flannel or a similarly thick material to keep rooms warmer in winter and cooler in summer, while many winter coats and pants use a thick layer of interlining to protect the wearer from the elements. Some of these garments also feature removable interlinings, so that they can be worn in warmer weather as well [1].

The generic term “nonwoven interlinings” defines materials based on nonwovens that are incorporated into articles of clothing during production to fulfill a range of functions.

The processing methods used can be divided into sewn and bonded interlinings (fusible interlinings).

Sewn interlinings are incorporated between the shell and the lining material during the sewing process. Bonded interlinings are fused to the shell, lining or another inlay material by a bonding process (heat sealing process). The ratio of sewn to bonded interlinings is currently approximately 20:80 [2].

Interlining fabric is a soft, but thick fabric which is inserted between the dress fabric and the back lining. Interlining fabric helps the main fabric to drape gracefully. It improves the shape retention quality of the fabric. It gives strength and the padded fabric gives warmth or bulk to the fabric **[3].**

The interlining can be insulation, padding, or stiffening fabric, either sewn to the wrong side of the lining or the inner side of the outer shell fabric. The interlining is used primarily to provide warmth in coats, jackets, and outerwear

Nonwovens are new players in the world of fashion design. Traditionally involved in the apparel industry for interlinings, clothing, accessories, insulation and shoe components [4].

Interlinings improve the shape of garments, ensure that they keep their shape better, and strengthen the top cloth. They are used as full interlinings or in small pieces, and are made almost exclusively from synthetic fibers, chiefly polyester, polyamide and viscose. The basic prerequisite is that they must be resistant to wear, laundering and dry cleaning [5].

1-1 History of nonwoven interlinings used for garment & other applications:

The use of nonwovens as interlinings goes back to the years 1947/48. While the first sewable nonwoven interlinings were available in sheet form in 1947, in 1948 production began of yard goods, the form commonly used today. These were fibrous nonwovens bonded by means of an aqueous binder.

Nonwoven interlinings are therefore one of the oldest successful applications of nonwovens. Even by 1960, they were dominant on the nonwovens market in the Federal Republic of Germany, with a share of over 60%.

In the mid to late 1950 s, the winning streak of fusible nonwoven interlinings began, which today, as we have seen, have a share of around 80% of the total market. The first fusible products were

***Corresponding Author:** Sanaa S.saleh, Women's College for Arts, Science and Education, Ain Shams University, Egypt.

nonwovens bonded with binders until at the start of the 1960 s; the first binder-free nonwoven interlinings were developed.

They were bonded with thermoplastic fibres by full-width calendaring and had a stiff, rather brittle hand. Spun laid nonwovens, which appeared in the mid-1960 s, gained importance in the interlinings sector as “adhesive nonwovens”. They were made from spun melded filaments and served as a processing aid for bonding textile fabrics. At the start of the 1970 s, the first binder-free nonwoven interlinings came onto the market that were bonded by the thermobonding principle. Unlike the previous flat calendered products, they had a soft, plump hand. In 1973, the development of the spot calender bonded nonwoven enabled interlinings to breakthrough to other end-use sectors. With this technology, it was possible to expand the possible variations in the construction of nonwovens, giving nonwoven interlinings a previously impossible soft, plump, textile hand. So-called spunlaced nonwovens, developed around the same time, had similar aims. These are conventionally laid card webs that are bonded without binders by means of water jets. The first wet-laid nonwovens for use in the interlinings sector also go back to 1973.

Here, the fibers are deposited from an aqueous suspension onto a screen fabric in a similar way to paper manufacture and then bonded like a dry-laid nonwoven using binders. In 1988 came the breakthrough to warp-knitted interlinings produced by knitting a pillar stitch construction into a nonwoven. Here, a heatbonded nonwoven is normally fed into a warp knitting machine and stabilized in the longitudinal direction.

Practically the whole range of possible and required nonwoven interlinings is now produced using the two main technologies for this purpose, full-width bonding using binders and binder-free spot bonding [2].

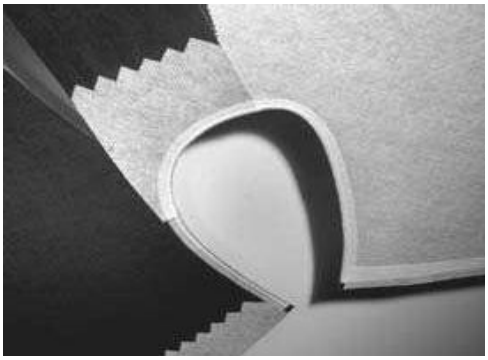
.  …… 

Figure 1: some nonwoven fabrics used as interlinings [2]

1-2 Absorbency of Nonwoven Fabrics

A large fraction of nonwoven products are used in applications in which the capacity to retain large volumes of fluids (body or otherwise) under pressure and rapidity of imbibitions are highly important. Absorbency being the result of absorbate/absorbent interaction, optimum ultimate performance of an absorbent product should depend upon an effective interplay of three groups of variables. These are the material and geometry related, the fabric structure related, and the end-use related variables. The most important of the variables of the last group is the nature of the fluid absorbed [6].

In another study made by Shishoo [7], He stated that the inter-fiber liquid transport in fluff absorbent is the most effective distribution mechanism because of the capillary flow system built in the absorbent structure by appropriate fiber arrangement. Inter-fiber absorption will be influenced by a number of parameters such as fiber length, fiber orientation, fiber thickness, fiber stiffness, and surface properties [7].There are now a vast number of varied end uses, almost too numerous to mention, for thermal bonded nonwoven fabrics across all sectors of the industry including both single use hygiene disposable products and durable building and construction materials. A major application is in hygiene, for example PP coverstock found in sanitary and incontinence products as they have high ability to absorb liquids.

A traditional thermal bond application is in the manufacture of linings and interlinings ranging in weight from 25–150 g/m2 using either calendar or through-air bonding methods.

In some applications, point bonding using a calendar follows mechanical bonding to produce the final product. Powder and thermo-dot bonded, fusible and non-fusible nonwoven fabrics for garment interlining applications, from polyester and EVA are also made [8].

2- Method of production & Specifications of the 6 fabrics:

Four different fabrics have been produced using different fabric bonding and fiber type. Fabric 1 is chemically bonded fabric using 30% PET, 70% Viscose fibers, fabric 2 is Hydroentangled-chemically bonded fabric using 100% PET fibers, fabric 3 is Thermally bonded fabrics using 100% Nylon fibers, fabric 4 is Hydroentangled bonded fabric using 100% PET fibers, fabric 5 is Thermally bonded fabric using 100% PET fibers also and fabric 6 is Chemically bonded fabric using100% Viscose fibers.

2- Method of production & Specifications of the 6 fabrics:

Fabric Number	Fabric weight g/m^2	Fiber type	Thickness (mm)	Type of Entanglement
1	86.5	30% PET, 70% Viscose	2.31	Chemically bonded
2	81.5	100% PET	1.02	Hydroentangled-chemically bonded
3	54.5	100% Nylon	2.04	Thermally bonded fabrics
4	54.5	100% PET	0.46	Hydroentangled bonded
5	56.5	100% PET	1.6	Thermally bonded fabrics
6	48.5	100% Viscose	0.56	Chemically bonded

3- The absorption instrument used:

In a previous work, an instrument used to test the absorption has been designed and examined [9]. Other instruments that can be used to test the amount of absorption have also been designed by other researchers [10].

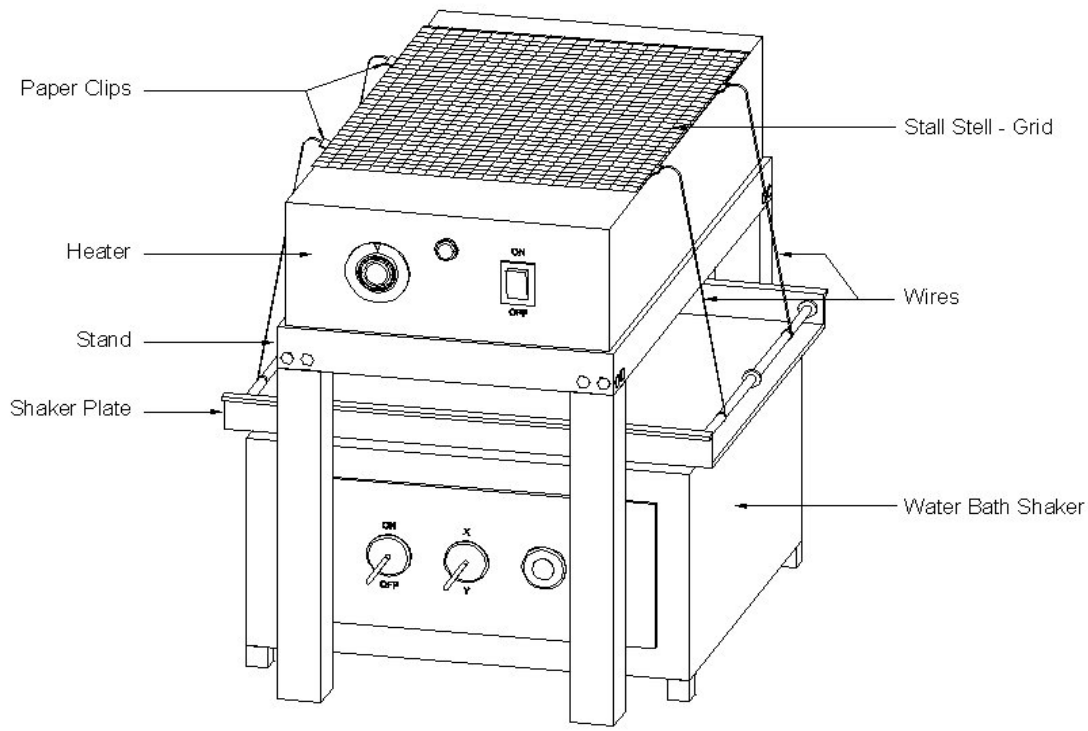


Figure 2: The absorption instrument

3-1 Description of the designed instrument:

An instrument was fabricated which tested the fabrics as they would perform when rubbed against a sweating skin. For this purpose a rectangular steel container was made of dimensions inch: 6 inches × 12 inches × 4 inches.

A geyser heating element was fixed on the inner side of the container so that water could be heated inside the container. A thermostat was attached to the element so that temperature was maintained at the boiling point and different temperature from 100 ^{o}C to 30 ^{o}C.

A cross grid was fixed on the face of the container and it covered the container. On the grid is placed a thin synthetic sheath. This sheath was taken from the upper dry weave covering of whisper sanitary napkin. This particular sheath was selected because it simulated the human skin with pores. Secondly, it was strong enough to with stand the rubbing action against the fabric.

The whole assembly was placed on the aluminum stand. Only the water bath shaker was used in order to have a constant movement of the skin assembly.

The water bath shaker was placed under the stand of the whole assembly (heater). Water bath shaker had two iron strips at each side of the shaker.

Two vertical wires was attached to each two vertical wires was attached to each iron strips ends to hold the fabric sample. Therefore, the fabric was held in two position of each side of the heater on the top while the whole skin assembly fixed and the fabric sample moved against it causing, sweating, and sweat absorption [9].

The samples were tested in two conditions with fan and without fan, i.e., with air movement on the fabric and without any air movement on the fabric. For the air movement, a portable fan was put just above the skin assembly. The speed of the fan was kept constant. For testing in no air condition, the fan was removed from the assembly.

For testing the conditioned sampled were weighed. The water was filled in the container and was set for heated. The grid was fixed along with the sheath. Once the vapors started forming, the shaker is set in motion. The fabric rubbed against he sheath and the grid. This process was carried on for 15 minutes.

After 15 minutes the sample was removed and weighed immediately. The percent absorption was then calculated using the formula: [10]

$$\text{Absorption\%} = \frac{\text{Find wt} - \text{original wt}}{\text{Original wt}} \times 100$$

4- RESULTS & DISCUSSION

Six nonwoven interlining fabrics, produced using different fabric bonding, which are chemically bonded, Hydroentangled bonded, thermally bonded and chemically-Hydroentangled bonded fabrics have been tested under different temperatures for a certain periods of time to investigate their absorption properties.

An instrument, which can be used to test the amount of moisture absorption, has been designed and used to test the amount of absorption for these fabrics. The fabrics used can be made into either linings or interlinings of clothing applications. The fabrics were tested at 3 different temperatures; 70, 85 and 100 ^{o}C and the amount of absorption were calculated after 7, 15 and 20 minutes respectively

Fabric 1:

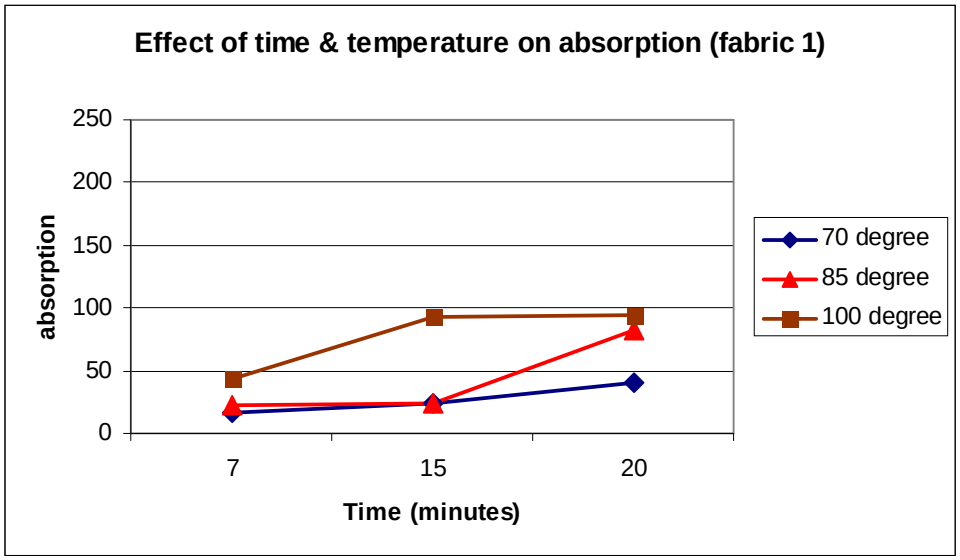


Figure 3: Effect of time and temperature on absorption for fabric 1

In figure 3, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 1. The maximum amount of absorption is about 100.

Fabric 2:

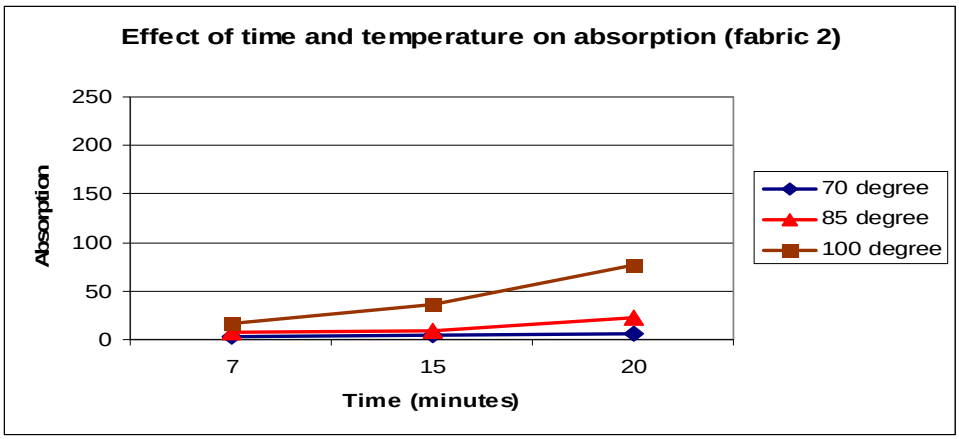


Figure 4: Effect of time and temperature on absorption for fabric 2

In figure 4, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 2. The maximum amount of absorption is about 77.

Fabric 3:

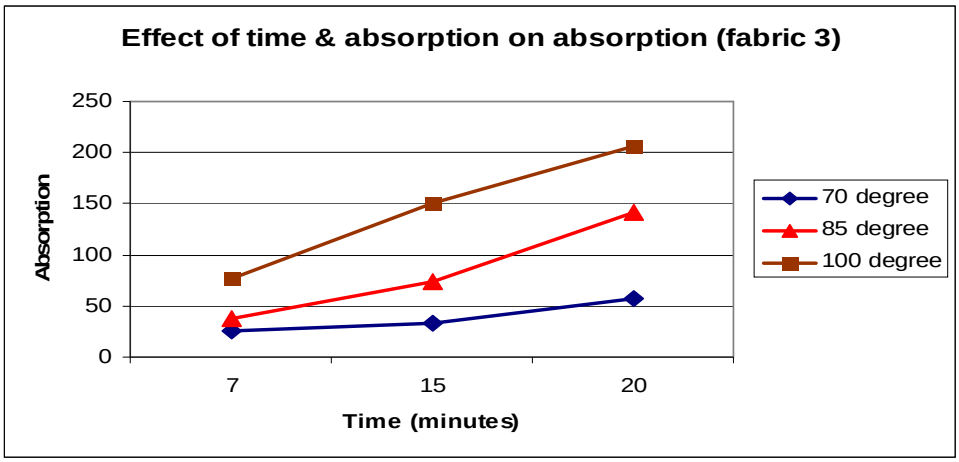


Figure 5: Effect of time and temperature on absorption for fabric 3

In figure 5, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 3. The maximum amount of absorption is about 207.

Fabric 4:

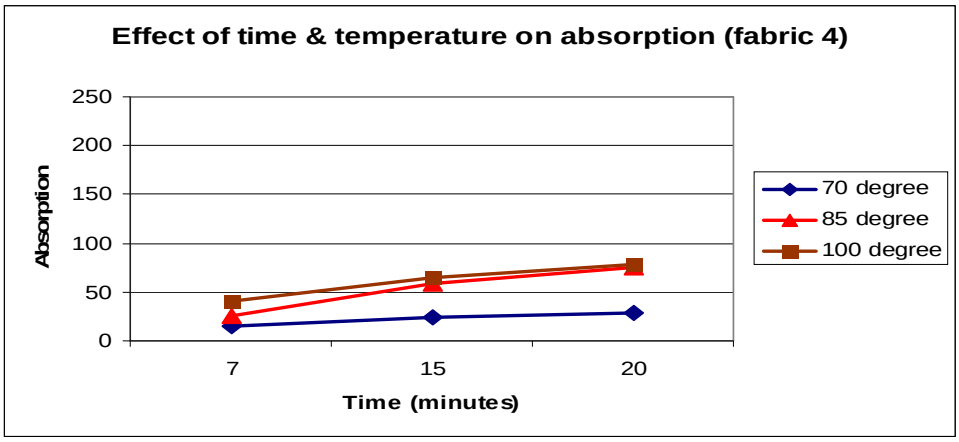


Figure 6: Effect of time and temperature on absorption for fabric 4

In figure 6, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 4. The maximum amount of absorption is about 79.

Fabric 5:

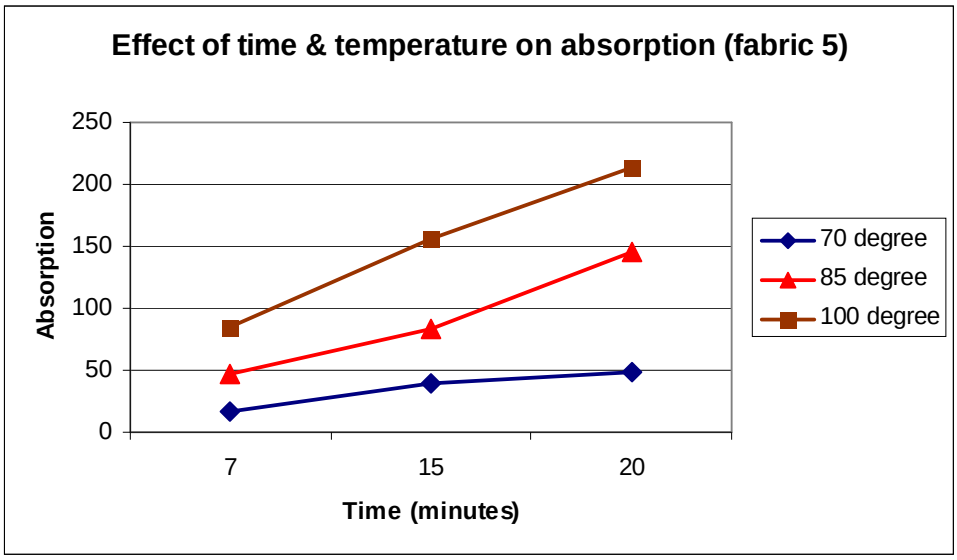


Figure 7: Effect of time and temperature on absorption for fabric 5

In figure 7, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 5. The maximum amount of absorption is about 213 which is the highest amount of absorption reported amongst all the fabrics.

Fabric 6:

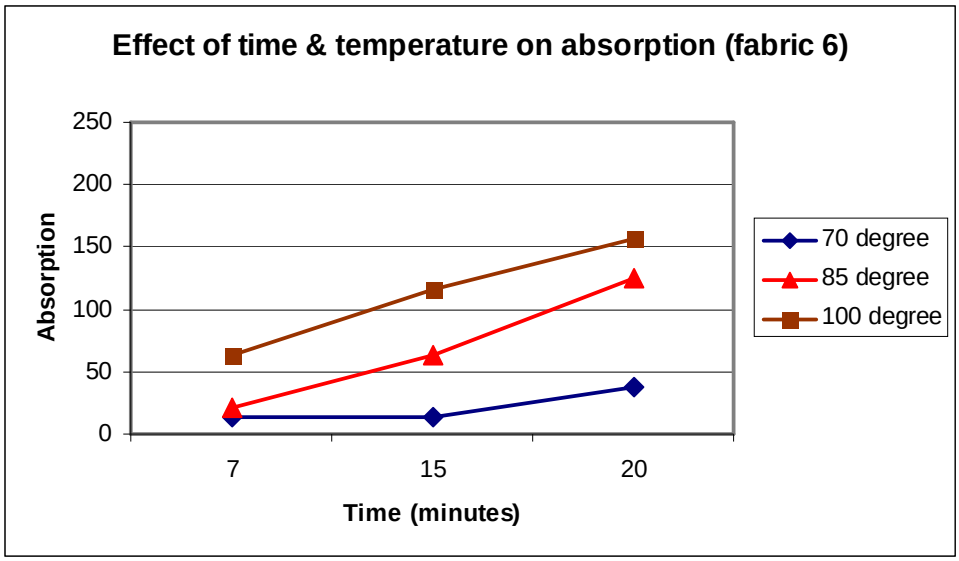


Figure 8: Effect of time and temperature on absorption for fabric 6

In figure 8, it can be noticed that increasing both the time and temperature results in increasing the amount of absorption for fabric 6. The maximum amount of absorption is about 157. Other results show similar results obtained by testing microfiber fabrics [9] and other fabrics [10].

It is clear that increasing the temperature results in the increase in the amount of absorption according to the increase of the ability of water steam (e.g. body sweat) to penetrate through the fibers within the fabric thickness and get over the bonding force between the fibers. Also, the increase in the water temperature helps in producing more water steam or body sweat which pushes forward through the fabric thickness. Accordingly, more liquids accumulate within the fabric thickness, and more liquid absorption took place.

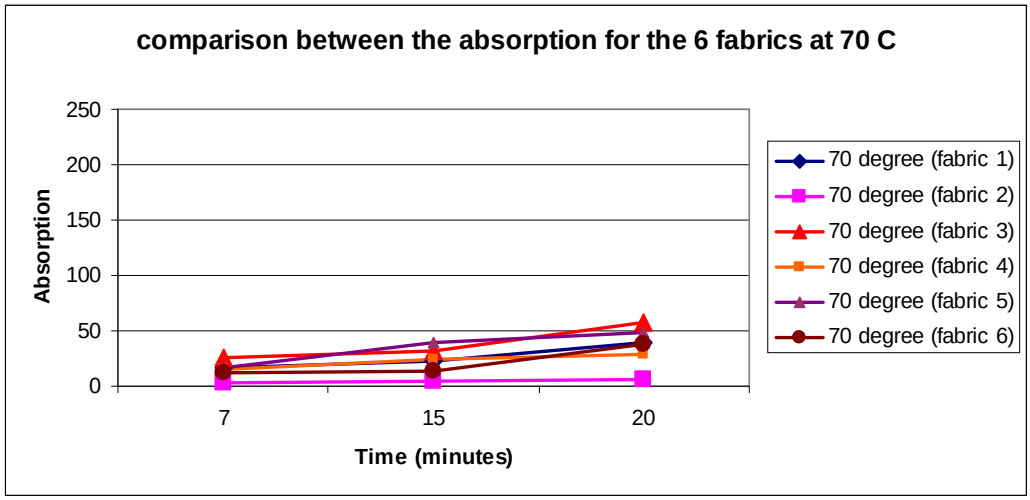


Figure 9: comparison between absorption of all the fabrics at 70 º C

Figure 9 represents a comparison between absorption of all the fabrics at 70 º C. It can be seen that both fabrics 3 and 5 share the highest amount of absorption, but the maximum amounts reached after 7 and 20 minutes were for fabric 3. Whereas, the maximum amount of absorption reached after 15 minuets was for fabric 5.

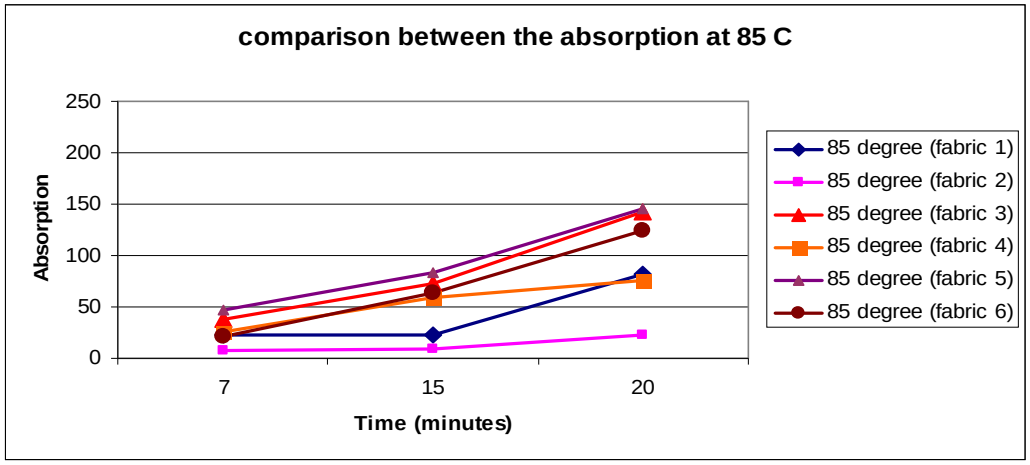


Figure 10: comparison between absorption of all the fabrics at 85 º C

Figure 10 represents a comparison between absorption of all the fabrics at 85 º C. It can be seen that fabrics 5 has the highest amount of absorption after 7, 15 and 20 minutes, followed by fabric 3. Fabric 2, has the lowest amount of absorption obtained after 7, 15 and also after 20 minutes.

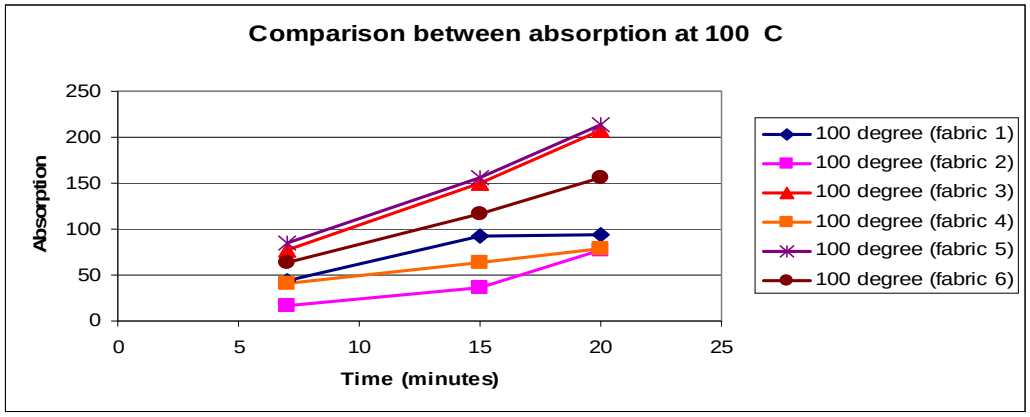


Figure 11: comparison between absorption of all the fabrics at 100 º C

Figure 11 represents a comparison between absorption of all the fabrics at 100 º C. Similar results obtained as in figure 10. It can be seen that fabrics 5 has the highest amount of absorption after 7, 15 and 20 minutes, followed by fabric 3. Also, fabric 2, has the lowest amount of absorption obtained after 7, 15 and also after 20 minutes, followed by fabric 4 at 100 º C. This shows that the thermally bonded fabrics gave the highest amount of absorption obtained in this research, whereas Hydroentangled or chemically-Hydroentangled fabrics gave the lowest amount of absorption.

The relationship between the amount of absorption and fabric structure is clear. As we can see that both fabric 5 and fabric 3 are made from thermally bonded fabrics. These fabrics are characterized with high ability to absorb liquids, as these fabrics used very successfully in the production of most of the coverstock found in sanitary and incontinence products as they have high ability to absorb liquids. Also, a traditional thermal bond application is in the manufacture of linings and interlinings ranging in weight from 25–150 g/m2 using either calendar or through-air bonding methods [9].

So that, the results obtained in this paper came to assure that the thermally bonded fabrics are the most suitable method for the production of linings & interlinings nonwoven fabrics because it provide the fabrics with high ability to absorb liquids (e.g. human sweat) with the increase in the body temperature and time.

5- Conclusions:

1- Increasing the time results in increasing the amount of absorption for all the nonwoven fabric structures.
2- Increasing the temperature results in increasing the amount of absorption for all the nonwoven fabric structures.
3- Thermal bonded fabrics gave high amount of absorption with the increase of both time & temperature compared with other fabrics especially Hydroentangled or chemically bonded or both chemically and Hydroentangled fabrics regardless of fabric thickness or fiber type.
4- It is recommended to use thermally bonded fabrics in the production of linings & interlinings because of their high abilities to absorb liquids (i.g. body sweat) which play an important role in providing comfort to human bodies.

REFERENCES

1- www.wisegeek.com/what-is-an-interlining.htm

2- www.fabrics-manufacturers.com/interlining-fabric.html

3- www.highbeam.com

4- Schmalz, E., Sauer-Kunze, M. and Bergmann, L., 2003, "Nonwoven Fabrics, raw material, Manufacture, Applications, Characteristics, Testing Processes", ISBN 3-527-30406-1

5- Tischer, K., 1985 “Non Woven Bonded Fabrics”…ISBN 0-85312-636-4, Ellis Horwood Limited.

6- Gupta, B., 1992, " A Study of Absorbency in Nonwovens: The Role of Structural Factors and Fluid Characteristics", Papers of international conference on nonwovens, The Textile Institute, North India Section.

7- Shishoo, R., 1992, "Analysis of Structure-Absorbency Relationship in Disposable Hygienic Products", Papers of international conference on nonwovens, The Textile Institute, North India Section.

8- Anand, S.C., Swarbrick, G. and Russell, S.J., 2007,"Handbook of Nonwovens", the textile institute, Woodhead Publishing ISBN-10: 1-84569-199-7

9- El-enany , E., Saleh , S., Anwar, W., and Abd el-latif, S., 2011, "Comfort properties of microfiber fabrics absorption properties", Scientific Research Journal of Science, Faculty of Arts, Science & Education for girls, Ain-shams university, Cairo, Egypt

10- Wang, F. , Zhou, X. ,and Wang , S. , 2009, "development processes and property measurements of moisture absorption and quick dry fabrics", Fiber &Textiles in Estern Europe.