Bending propertiesof cotton fabrics produced from different spinning methods

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Abstract

The tailoring quality of fabrics and design of garment as well as automated handling are greatly influenced by the fabric physical and low stress mechanical properties such as bending, tensile, shear and compression. Objectivemeasurement of these characteristics leads to making accurate decision in selecting fabrics in order to minimize the tailoring problems and improve the quality of finished garment.In this study, it has been focused on bending properties of fabrics produced from different spinning methods. Twenty-seven woven fabrics are produced using different types of spun yarns (combed, carded and open end spinning systems). Three different of woven structures (plain1/1, twill 2/2 and satin4) are used with three different weft densities (18,21 and 24).These fabrics have been tested on FAST-2 *bending meter*. From the results we can observed the fabrics obtained from combed spun yarns have the lower bending length and lower bending rigidity than carded spun yarns. And the fabrics obtained from the open end spun yarns have the highest bending length and bending rigidity.

Keywords: bending length, bending rigidity, ring spinning, open end spinning, bending meter

1. Introduction

Bending is one of the important low stress mechanical properties which contribute the fabric comfort. The bending length is a characteristic property of a woven fabric and is dependent upon the energy required to produce a given bending deformation under its own weight. The bending length, the bending rigidity, which is derived from the bending length and the weight of the fabric form the bending properties of the fabrics that influence the mechanism of fabric deformation.**(Bonde P&AsagekarS.D, 2014.RengasamyR.S,*etal*, 2009)**The anisotropy of the fabrics causes considerable fabric deformation even at low loads, and this deformation is important for tailoring, as well as fitting a garment. While the fabrics with relatively high values of bending rigidity do not generally cause problems in handling during garment manufacturing, low bending rigidity may cause distortion during cutting, seam puckering during sewing, and poor shape

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retention, which interrupts property fitting. **(N. ERDUMLU, 2015. N. Mahmood and M.Q. Tusief, 2010)**

The bending behavior of the material is expressed in terms of bending rigidity. Bending rigidity is a measure of ease with which the fabric bends. The fabrics bending rigidity basically depends on the constituent fibers and yarns from which the fabric is manufactured, the fabric construction and most importantly the nature of the chemical treatment given to the fabric.**(BondeP&Asagekar S.D, 2014.)**

The main purpose of this study is to evaluate the bending properties at low stress for the woven cotton fabrics produced from different spun yarns with different weave structures at different weft densities. The effects of weft density and weave structures on bending properties of these fabrics were investigated.

Each spinning system produces yarns with different structures. Fibers in ring spun yarns are arranged in a helix and the resultant yarn has a uniform fiber core. During formation of open-end rotor spun yarns, core fibers forming the interior part of the yarn become twisted. However, some of the fibers are wrapped around already spun yarn, which forms the identifiable feature of open-end rotor spun yarn. Therefore, physical and mechanical properties of yarns primarily vary on the basis of the different arrangement of fibers in each spinning technology. As well as different cotton varieties have different physic-chemical properties and play a significant role in the quality characteristics of end product. **(ErdumluN.&Bulent O, 2009.MahmoodN.&TusiefM.Q , 2010)**

2. Material and Methods

1.1. Material

Yarn specifications:

Twenty-seven samples of 100% Egyptian cotton fabrics (Giza 86) were prepared using three different types of spun yarns at weft yarn carded, combed and open end. Three different types of spun yarn used have produced by Misr-Iran Co., Al-Suez City, Egypt.

All fabrics have the same Warp yarn combed cotton yarn spun (Giza 86); and the no. of ends 22 thread/cm and that is constant of all working.

Warp yarn- 24s cotton yarn
Weft yarn- 20s cotton yarn

Fabric specifications:

Three different structures of weaves used; plain 1/1, twill 2/2 and satin 4 with different weft spun yarns and different picks densities. All woven cotton fabrics production have produced wove on Sulzer Brothers weaving machine (PU), Machine No. 91182665, Switzerland; by AL- NASR spinning &weaving Co. (Al-chourbagui), Cairo, Egypt. And then have been bleaching bath by MAF Dyeing Co, Cairo, Egypt.

1.2.Methodology:

The fabrics were manufactured from the yarns specified above. The detailed specifications of fabric are given in tables 1, 2, 3.

Table 1: fabrics produced from Plain 1/1 weave

Fabric No.	Weave structure	Weft density	Type of weft spun yarns
1	Plain 1/1	18 yarns	Ring spinning (carded)
10			Ring spinning (combed)
19			Open end spinning
2		21 yarns	Ring spinning (carded)
11			Ring spinning (combed)
20			Open end spinning
3		24 yarns	Ring spinning (carded)
12			Ring spinning (combed)
21			Open end spinning

Table 2: Fabrics produced from Twill 2/2 weave

Fabric No.	Weave structure	Weft density	Type of weft spun yarns
4	Twill 2/2	18 yarns	Ring spinning (carded)
13			Ring spinning (combed)
22			Open end spinning
5		21 yarns	Ring spinning (carded)
14			Ring spinning (combed)
23			Open end spinning
6		24 yarns	Ring spinning (carded)
15			Ring spinning (combed)
24			Open end spinning

Table 3: fabrics produced from Satin4 weave

Fabric No.	Weave structure	Weft density	Type of weft spun yarns
7	Satin 4	18 yarns	Ring spinning (carded)
16			Ring spinning (combed)
25			Open end spinning
8		21 yarns	Ring spinning (carded)
17			Ring spinning (combed)
26			Open end spinning
9		24 yarns	Ring spinning (carded)
18			Ring spinning (combed)
27			Open end spinning

1.3.Evaluation of yarn and fabric properties

Yarn Characteristics:-

- **Tensile Characteristics:-**

The cotton yarns of three types of different spinning have been tested on the tensile strength tester; Pendulum lever instrument, ASTM 2256 standard test method for tensile properties of yarn by the single strand method.

- **Unevenness:-**

Yarn evenness deals with the variation in yarn fineness. This property measured the variation in mass per unit length along the yarn. Cotton yarn spun from staple fibers contains imperfections. They are also referred to as frequently occurring yarn faults. They can be subdivided into three groups (thick places, thin places and neps).

These three groups and coefficient of variation (C.V.) values of three different types of cotton spun yarns can give awareness by using the Uster-3 evenness tester instrument which depends on condensing units able to read data of yarn when it's passing throw it. The Uster-3 instrument can give also another data of yarn like hairiness ratio.

Fabric Characteristics:-

- **Bending properties:-**

The bending test was carried out on FAST-2 (Bending Meter) which measures the bending length of the fabric using the cantilever bending principle described in British Standard Method (BS: 3356(1961)).

The instrument has a smooth upper surface and it is designed to measure the bending length of a 50mm wide strip of fabric. The fabric strip is positioned on this surface and the platen is placed firmly on top of the strip leaving the leading fabric edge free. The fabric is then moved with platen towards and over the edge of cavity where it is allowed to drape. The fabric bends under its own weight until its leading intercepts a plan at angle of 41.5 degrees from the horizontal. The length of the fabric pushed over the edge till it bends to 41.5◦is called the bending length which in conjunction with fabric weight gives bending rigidity.Figure1 had shown the principle of FAST-2.

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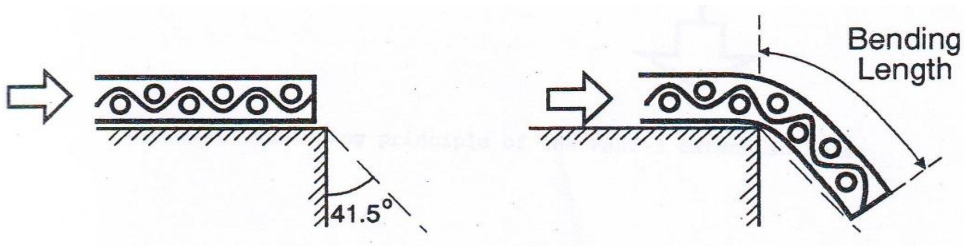

Figure (1) Measuring principle of the FAST-2 Bending Meter

The procedure for carrying out the test is as follows:-

In order to obtain consistent results, fabrics were conditioned overnight in a standard atmosphere (20ºC,65% RH) before cutting;

1. Before cutting out each sample, an arrow was marked on the fabric indicating the warp direction, the weft direction.
2. Keeping at least 5cm from the selvedges, four squares of 13cm x 5cm were cut by using standard square scale.
3. The FAST manual recommends the following;
    - FAST-2 bending meter – 3 in the warp direction and 3 in the weft direction replicates; The FAST instruments are interfaced with a computer which doses the data handling automatically.

3.Results and Discussion

3.1. Yarn Characteristics

The characteristics of yarns used for manufacturing the fabrics are summarized in the table 4.

Table 4, Yarn specifications

Parameters	Ring spinning yarn		Open end spinning yarn
	Carded yarn	Combed yarn	
Yarn twist /inch	17.8	17.5	24.1
Twist direction	Z	Z	Z
Twist factor	3.98	3.91	5.85
Yarn strength/ N	6.4	6.7	3.5
Yarn elongation %	5.78	5.97	5.42
The coefficient of variation c.v.%	12.97	12.81	17.91
The irregularity U%	9.07	7.5	14.18
Thin places (-50%)	13	0	83
Thick places(+50%)	15	2	40
Neps	10	5	30

3.2. Fabric Characteristics:

Bending characteristics:

The bending length and bending rigidity are measured at the low stress mechanical properties of the fabric which are related to the handle of fabric. The bending properties of fabrics are summarized in table 5.

Table 5, Fabric specifications

Fabric cod no.	weaving structure	Methodof weftyarn spun	no. ofpicks/cm	Weight g/m^2	BL2 mm	BR2 μNm
1	plain 1/1	carded spun	18	116	16.5	5.11
10		combed spun		114	16.13	4.69
19		open end spun		122	18	6.98
2	plain 1/1	carded spun	21	121	17.8	6.69
11		combed spun		125	16.13	5.14
20		open end spun		140	19.7	10.50
3	plain 1/1	carded spun	24	136	18	7.78
12		combed spun		130	17.5	6.83
21		open end spun		152	19.9	11.75
4	twill 2/2	carded spun	18	119	16.14	4.91
13		combed spun		114	15.93	4.52
22		open end spun		118	17.9	6.64
5	twill 2/2	carded spun	21	137	15.1	4.7
14		combed spun		128	15.6	4.77
23		open end spun		136	17	6.5
6	twill 2/2	carded spun	24	141	16.3	5.99
15		combed spun		147	16	5.9
24		open end spun		147	18	8.41
7	satin 4	carded spun	18	111	16.36	4.77
16		combed spun		120	16.17	4.73
25		open end spun		116	17.4	5.99
8	satin 4	carded spun	21	123	17.17	6.11
17		combed spun		120	15.75	4.60
26		open end spun		134	19.4	9.60
9	satin 4	carded spun	24	132	16.67	6.00
18		combed spun		128	17.17	6.35
27		open end spun		145	19.6	10.71

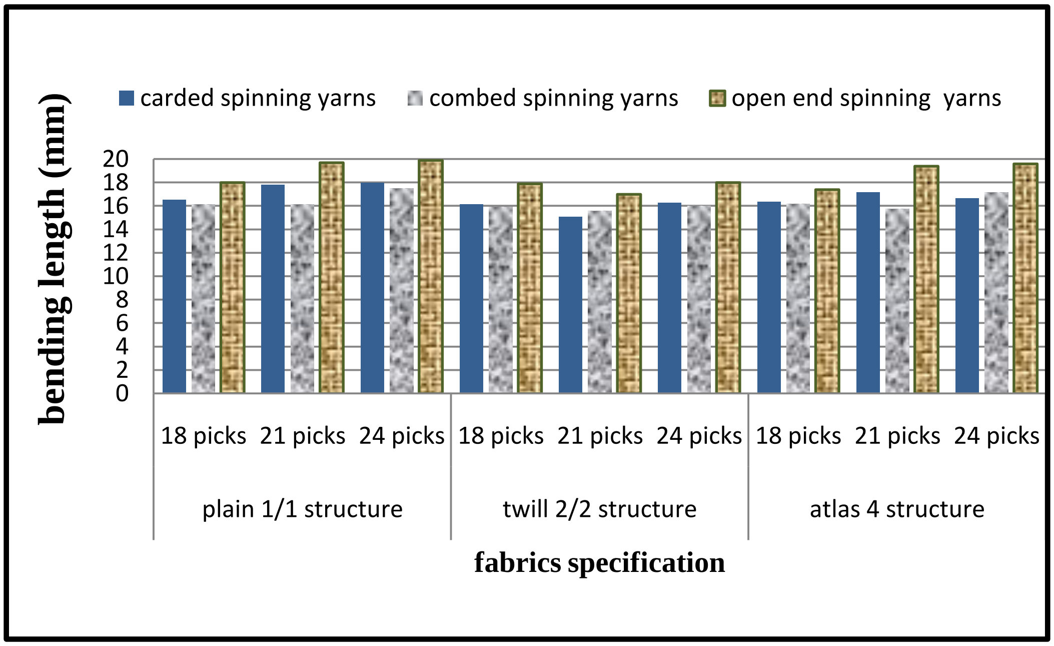

Figure2, bending length of three fabrics weaves produced from card, combed and open end spun yarns

The figure 2 shows the bending length values of fabrics that producing from three different types of spun yarns carded, combed and open end; each type of spun yarn has produced with three different woven structures plain, twill and satin as well as three different of picks numbers 18, 21 and 24. Generally, the figure shows highest bending length values at fabrics producing from plain 1/1 woven structure at any types of spun yarns. On the other hand, the bending length of woven fabrics that produced from open end spun yarns has the highest values than other spinning types (ring spinning whether carded or combed yarns). The bending length values of fabrics produced from carded spun yarns are higher than fabrics produced from combed spun yarns.

Study of the effects of different woven structures on bending length property of fabrics that produced from different spinning systems

Figure(3) shows results of bending length of woven fabrics that produced from different spinning system carded, combed and open end yarns with varies woven structures plain, twill and satin but the same number of picks 18 yarn/cm.The relations between bending length

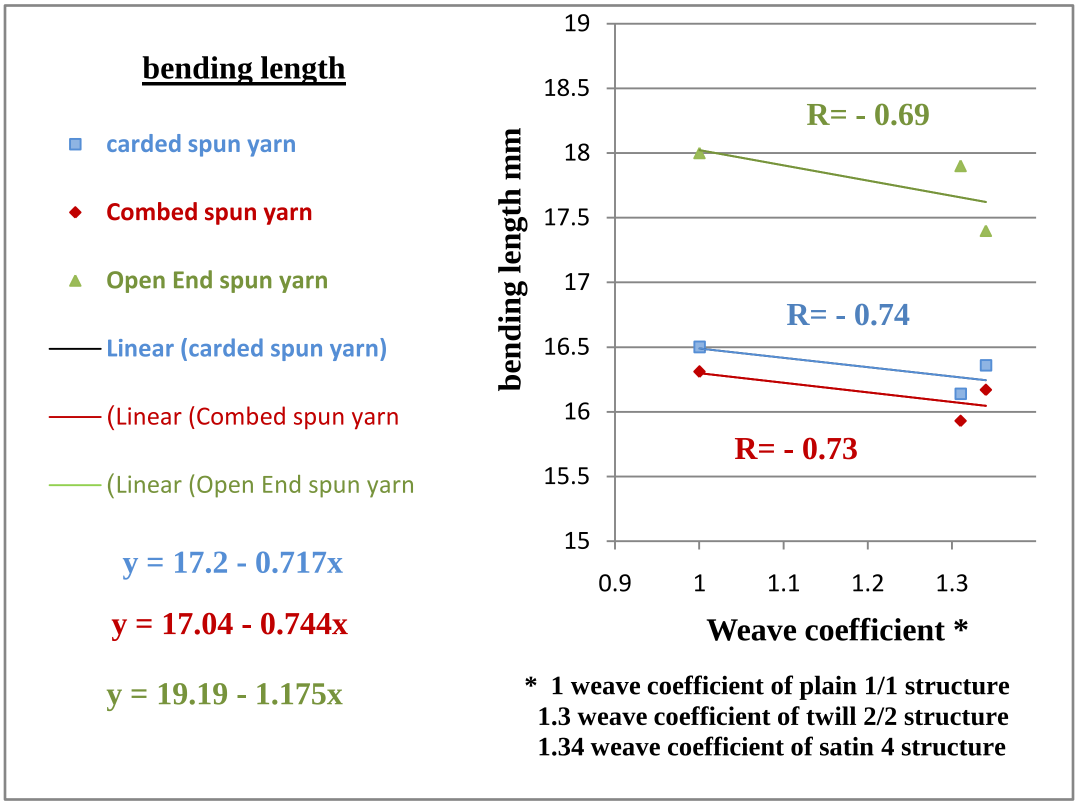

Figure 3, relationship between weave coefficients and bending length of different spinning system at 18 picks

values and the different weave coefficients represented by three linear equations then have been compared to each others. The figure illustrates that bending length value of fabric decrease with the increase the weave coefficient. In another words, the fabrics that produced with plain structure show in general the higher values of bending length than twill and satin structures. This is back to the weave structure of plain fabric that marked by great interlacing between warp and weft threads than twill and satin structures.

On the other hand, the linear equation of fabrics bending length results that produced with spun yarns from open end system having higher values at bending length than fabrics that producing from ring spinning system. As shows in the figure, the correlation between bending length property and weave coefficient at the carded and combed spun yarns are closed to each other as well as higher than the correlation at the open end spun yarns.There are decreases at fabric bending length with increase at fabric weave coefficients due to increase the length of floating yarns inside the woven structure. The test results are significant at the 0.05 level.

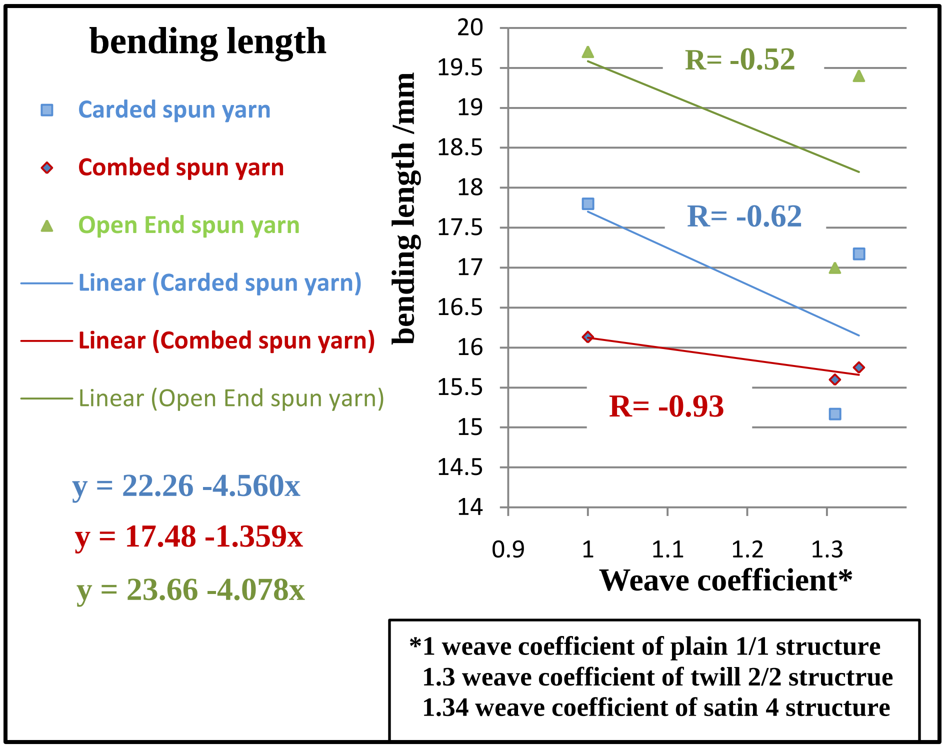

Figure 4, relationship between weave coefficients and bending length of different spinning system at 21 picks

Figure(4) shows results of bending length of woven fabrics that produced from different spinning system carded, combed and open end yarns with varies woven structures plain, twill and satin but the same number of picks 21 yarn/cm.

As noted above; this figure also shows reverse relation between the fabric bending length and the weave coefficient of the fabrics. Meaning that; the bending length values decrease with increase the weave coefficient; the fabrics producing from plain structure have higher bending length values than that producing from twill and satin structures. This because that increasing interlace between the warp and weft yarns that leads to fabrics more stiffness. The figure illustrates higher intense correlation at combed linear equation. The test results are significant at the 0.05 level.

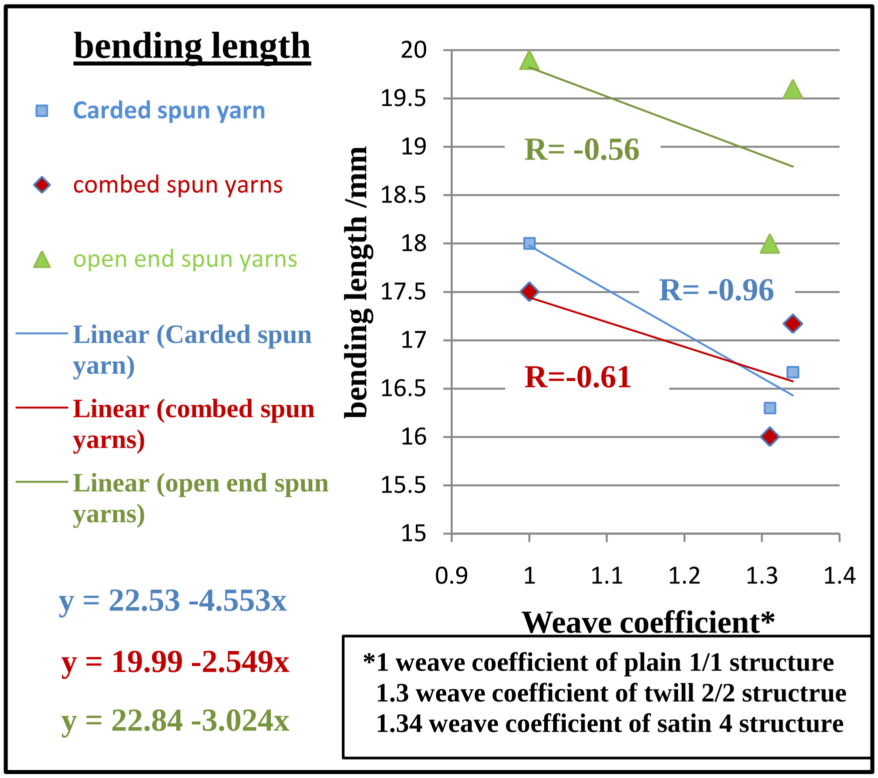

Figure 5, relationship between weave coefficients and bending length of different spinning system at 24 picks

This figure shows results of bending length of woven fabrics that produced from different spinning system carded, combed and open end yarns with varies woven structures plain, twill and satin but the same number of picks 24 yarn/cm.From three linear equations that represented the relationship between the fabric bending length value and the weave coefficient of fabrics; we can noted that there are reverse relation between them. The fabrics produced from plain structures have higher bending length than that produced from twill 2/2 and as well as at satin 4 structures. The figure illustrate that there are closed values at fabrics produced from carded and combed spun yarns. While the bending length values of fabrics made by open end spinning yarns shows the highest results.The figure illustrates higher intense correlation at linear equation of carded yarns. The test results are significant at the 0.05 level.

Study of the effects of different weft density (picks numbers) on bending length property of fabrics that produced from different spinning systems

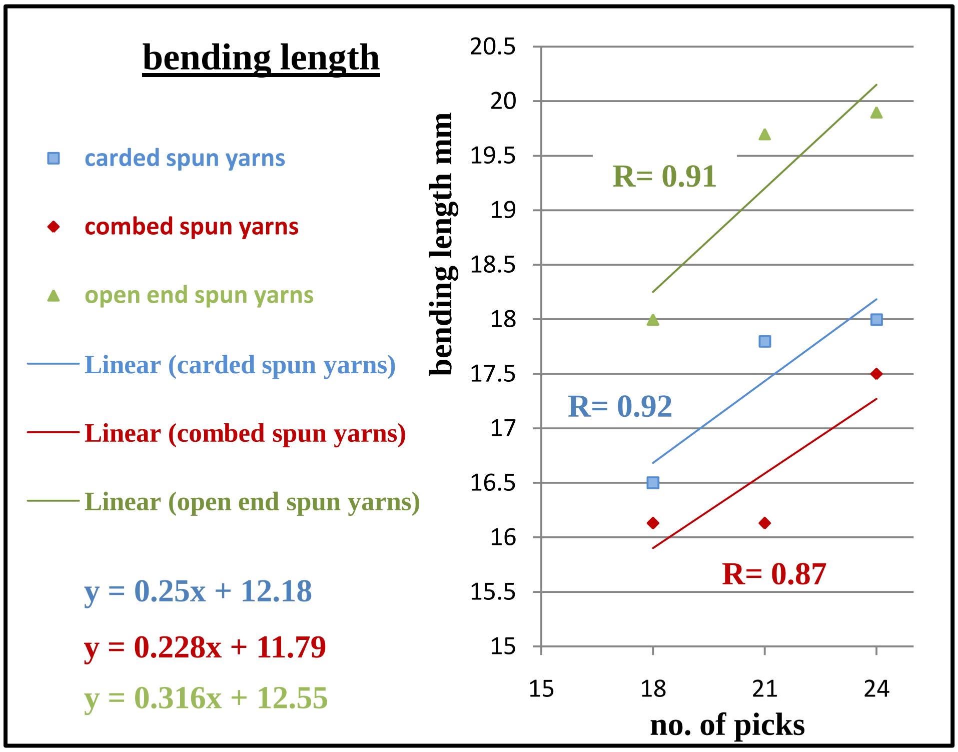

Figure 6, relationship between different picks numbers on fabric bending length of different spinning system using plain 1/1 structure

Figure (6) shows the three linear equations that represent the relation between the fabric bending length and weft density (picks numbers). Each linear equation is composed of the one type of spinning yarns. All fabrics in this figure have produced from the same woven structure (plain 1/1) but with different weft density.

The figure shows that there are direct relation between fabric bending length and the weft yarns density. In another words, increasing the picks number of fabric lead to increasing the fabric bending length value. So, increasing the weft density lead to increase the cover factor of fabrics that causing high stiffness handles.The correlation between the bending length of fabrics and the number of picks are high especially at the linear equation if carded spun yarns. All three linear equations results of the three different types of spun yarns are significant at 0.05 levels.

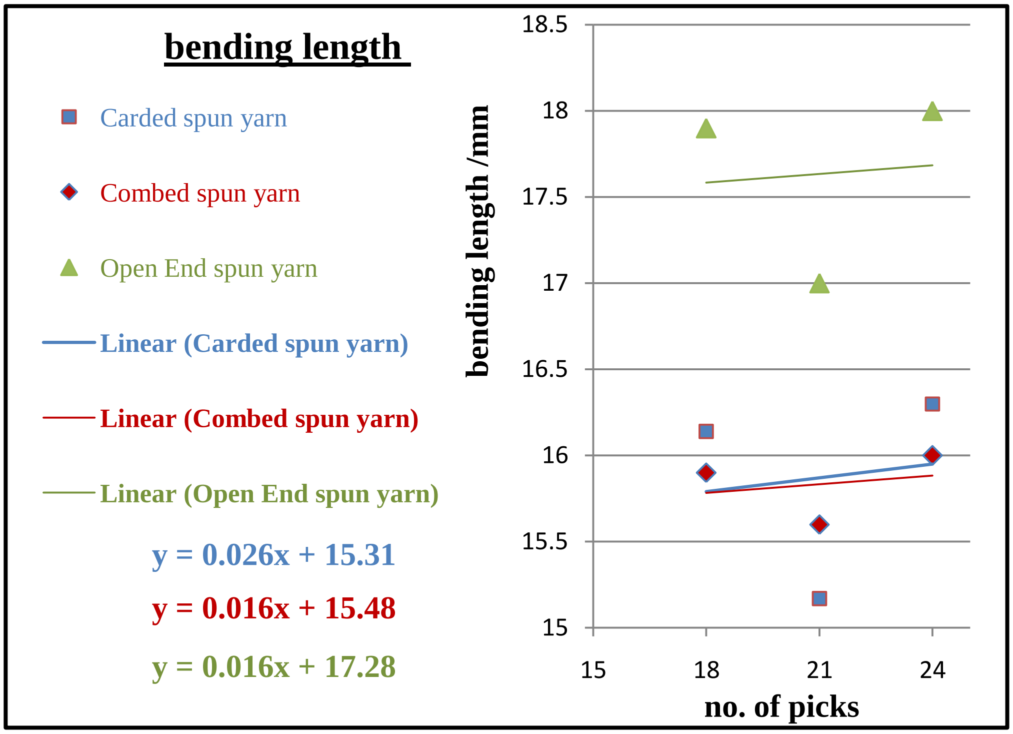

Figure 7, relationship between different picks numbers on fabric bending length of different spinning methods using twill 2/2 structure

This figure shows the relation between the fabric bending length and its weft density by using linear equations. Each linear equation composed from fabrics has the same type of spinning yarns produced at three different picks 18, 21 and 24; but all the same woven structure twill 2/2. There is direct relation between the bending length value and the number picks. Fabrics producing from picks24 have higher bending length values than producing at picks 21 then 18.

On the other hand, the fabrics producing from open end spun yarns have higher values at bending length than fabrics producing from ring spinning system (carded and combed). From the values of weakly relation between the bending length and number of picks; the test are no significant.

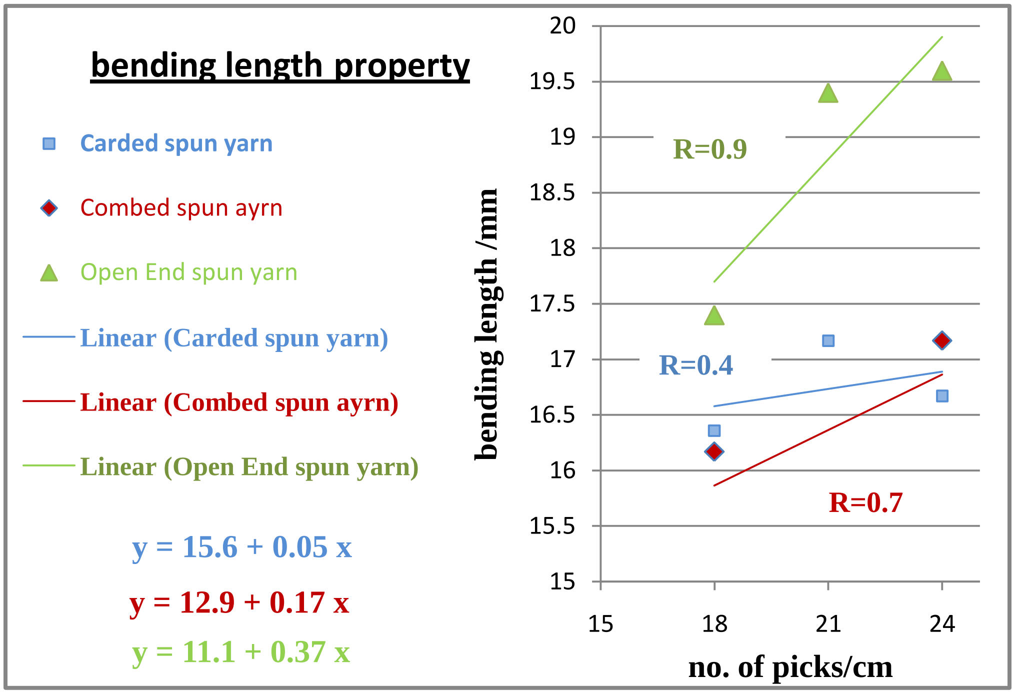

Figure 8, relationship between different picks numbers on fabric bending length of different spinning methods using satin 4 structure

This figure illustrate the linear equations of correlation between fabrics bending length and the weft density at three different type of spinning carded yarn ,combed yarns and open end yarns. All woven fabrics of the three different spinning types are woven with the same structure (satin4) with three weft density variables (18 picks, 21 picks and 24 picks).

The figure shows that fabrics bending length increase with increase the fabric weft density. So, there is direct relation between bending length of fabric and its picks number per cm. That back to increase the cover factor of the woven if the number of picks increase. So, the fabric will be stiffer. On the other hand, the values of the fabric bending length produced from open end spun yarns have higher results than that produced from ring spun yarns (carded or combed). This test is significant at 0.05 levels. Especially at open end spun yarns tests that have the highly value of relation.

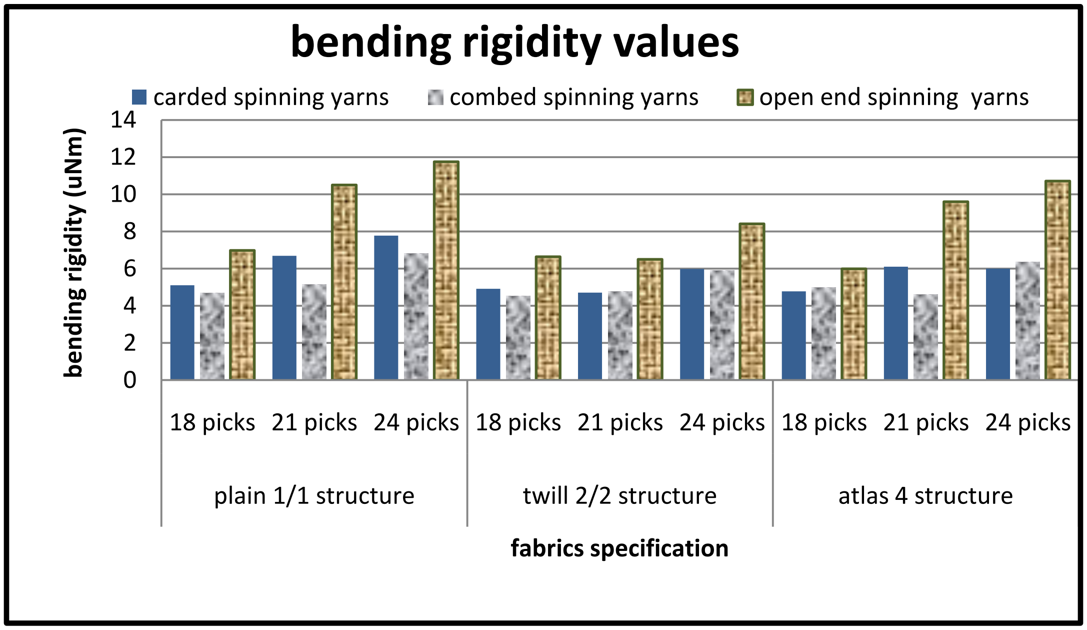

Figure 9, bending rigidity of three fabrics weaves produced from card, combed and open end spun yarns

Figure 9shows the bending rigidity values of fabrics that producing from three different types of spun yarns carded, combed and open end; each type of spun yarn has producing with three different woven structures plain, twill and satin as well as three different of picks numbers 18, 21 and 24 yarns per centimeter. Generally, the figure shows highest bending rigidity values at fabrics producing from plain 1/1 woven structure whether at any types of spun yarns comparing to the same variables of others structure (twill or satin).

On the other hand, the bending rigidity of woven fabrics that producing from open end spun yarns has the highest values than other spinning types (ring spinning whether carded or combed yarns). Generally, the card yarns have higher bending rigidity values than comb yarns. On the other side, if the picks yarns per centimeter increase the value of bending rigidity of its fabric increase especially at the fabrics obtained from open end spun yarns.

Study the effects of different woven structures on bending rigidity property of fabrics that produced from different spinning systems

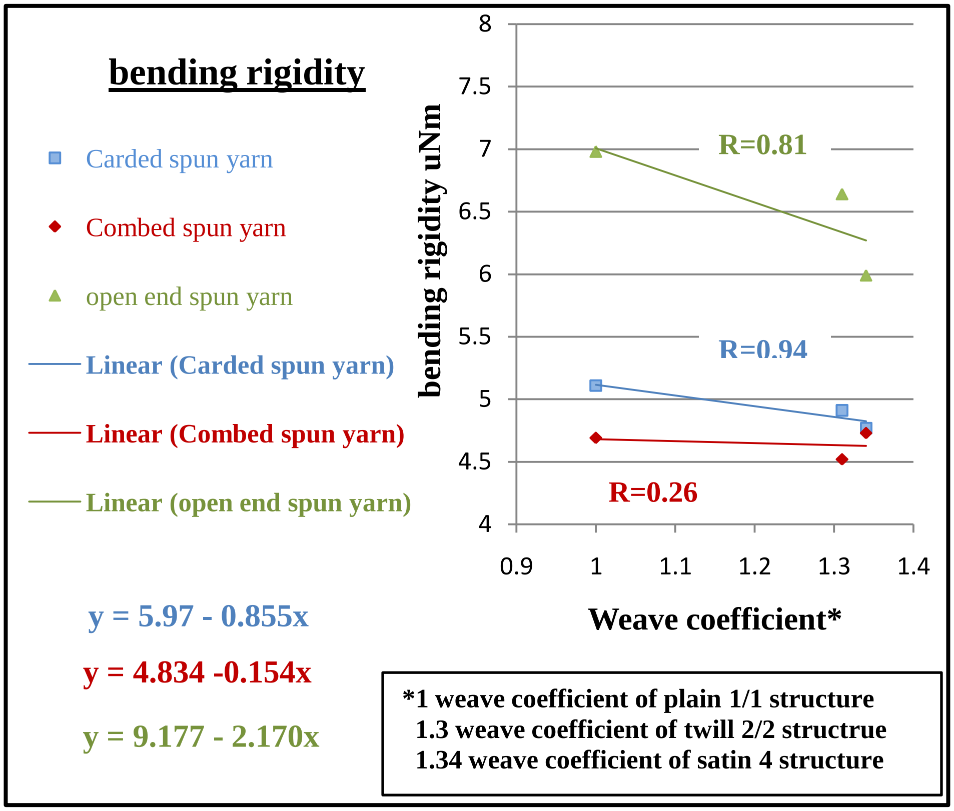

Figure 10, relationship between weave coefficients and bending rigidity of different spinning methods at 18 picks

Figure (10), shows the results of bending rigidity of woven fabrics producing from different methods of spun yarns represented as linear equation correlate to weave coefficients. All these woven fabrics have the same weft density (number of picks 18 yarns/cm). In general, the bending rigidity of fabrics produced from plain structures higher than that producing from twill or satin structures. So; there are reverse correlation between fabric bending rigidity and its weave coefficient.

We can note that results of the fabrics producing from ring spinning systems have closed to each other's; whether carded or combed yarns) and lower than values obtained from open end yarns. The test is significant at the 0.05 level. Especially at card spun yarns then open end spun yarn which have higher correlation.

The bending rigidity of fabrics producing from ring spinning are lower values than bending rigidity of fabrics producing from open end spun yarns.

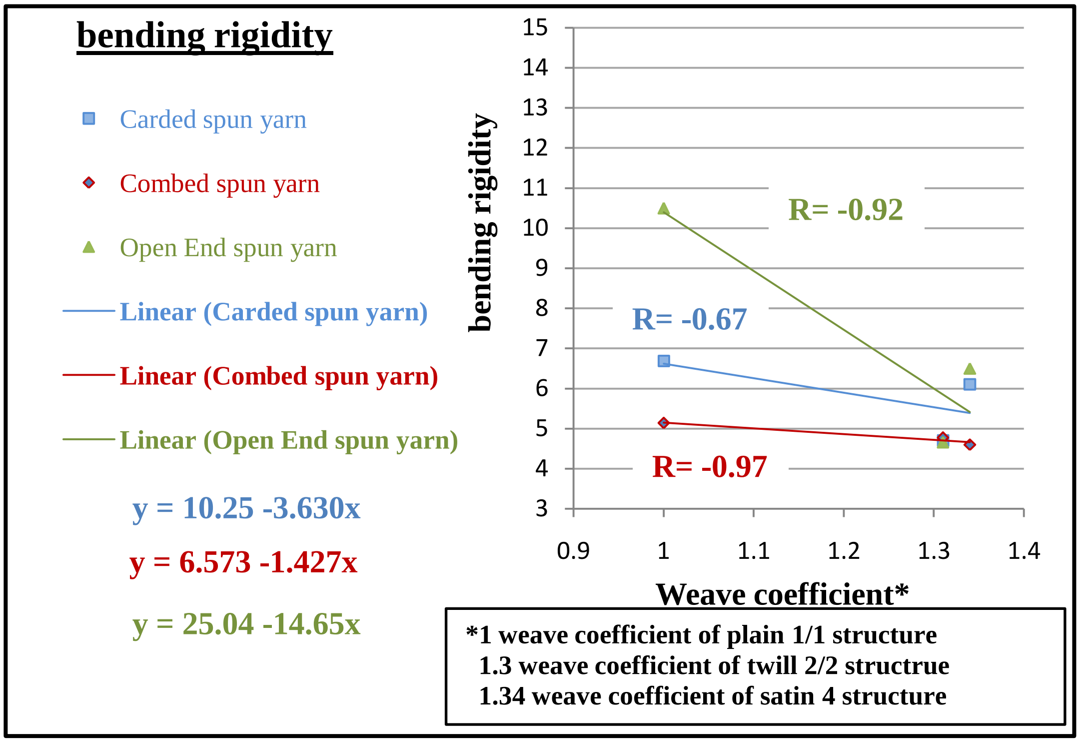

Figure 11, relationship between weave coefficients and bending rigidity of different spinning methods at 21 picks

Figure (11) shows the results of bending rigidity of fabrics producing from three different types of yarns spun; these results represented in three linear equations of each spun yarn type and relate to the weave coefficient. We can note that fabrics produced from plain structure have high bending rigidity than fabrics produced from twill as well as satin structure. That's back to increase interlacing between the yarns in plain structure than twill and satin; that cause increase in fabric stiffness.

On the other hand, bending rigidity of fabrics producing from open end spun yarns has higher values than fabrics values produced from carded or combed spun yarns. The correlation between the fabric bending rigidity and its weave coefficient are high at the combed spun yarns and open end spun yarn; so the test is significant at these two yarns types. While the correlation at the carded spun yarns is zero; so the test is no significant at carded yarns.

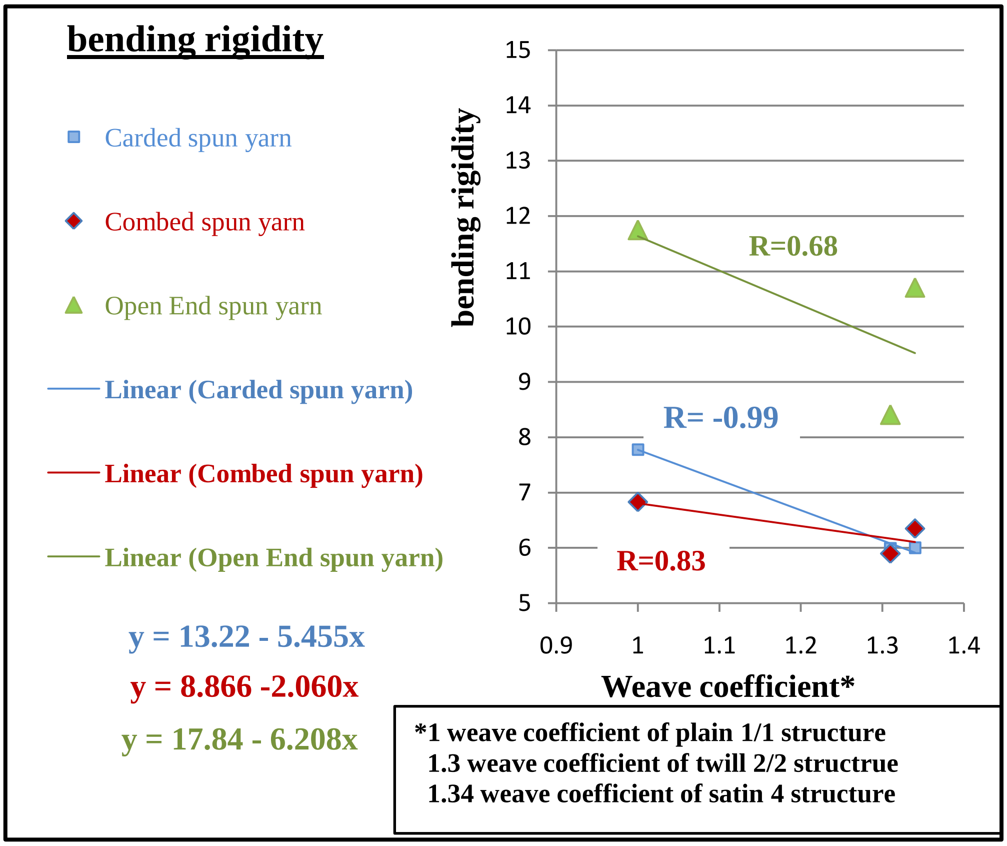

Figure 12, relationship between weave coefficients and bending rigidity of different spinning methods at 24 picks

Figure (12); shows bending rigidity values of fabrics which produced from three different types of spun yarns (open end, carded and combed) as well as three different woven structures (plain 1/1, twill 2/2 and satin4) but all fabrics producing at the same weft density (24 picks). The results represented as linear equations of three types of spun yarns relate to weave structures.

The figure illustrates the bending rigidity values of fabrics produced from carded and combed are closed to each others. While the bending rigidity values of fabrics produced from open end yarns are highest.On the other hand, the figure shows reverse relationship between bending rigidity of fabrics and its weave coefficient. So the bending rigidity values of fabrics producing from plain 1/1are higher than bending rigidity values of fabrics producing from twill and satin4whether at three types of different spinning and this back to increase the interlacing between the yarns of plain weave structure than of twill or satin structures. From the values of correlation between the fabric bending rigidity and its weave coefficient, this test is significant at 0.05 levels.

Study of the effects of different weft density (picks numbers) on bending rigidity property of fabrics that produced from different spinning systems

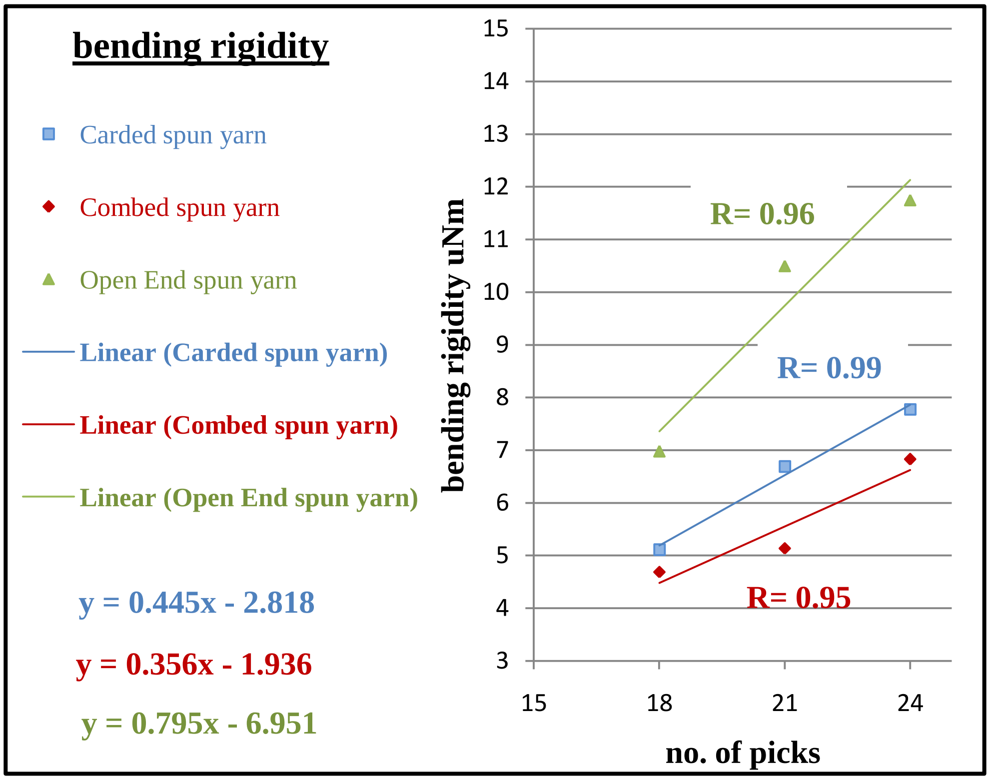

Figure 13, relationship between different picks numbers and fabric binding rigidity of different spinning methods using plain 1/1 structure

The figure illustrate the fabric values of bending rigidity at three different types of spinning yarns that produced at three different weft density (18,21 and 24 picks) but all woven fabrics have produced from the same structure (plain 1/1). Statistically, the bending rigidity values have represented as linear equations of each type of spun yarn related to the weft density.

It noted that there are direct relation between the bending rigidity values and the number of picks.

In another words, the fabrics producing from low weft density (18 picks) have low bending rigidity values; while the fabric produced from high weft density (24 picks) have high bending rigidity values. As a result, the fabrics become stiffer. In addition to that, with increasing the weft density or the picks numbers lead to the decrease of the mobility between yarns in the fabric so that, the bending rigidity increase.

The bending rigidity results of fabrics that produced from carded and combed spun are closed to each other; although that made from combed spun yarns has a lower bending rigidity than that made from carded spun yarns.

It's obvious that bending rigidity of fabrics producing from open end spun yarn are highest values.The figure shows that tests are significant at 0.05 levels.

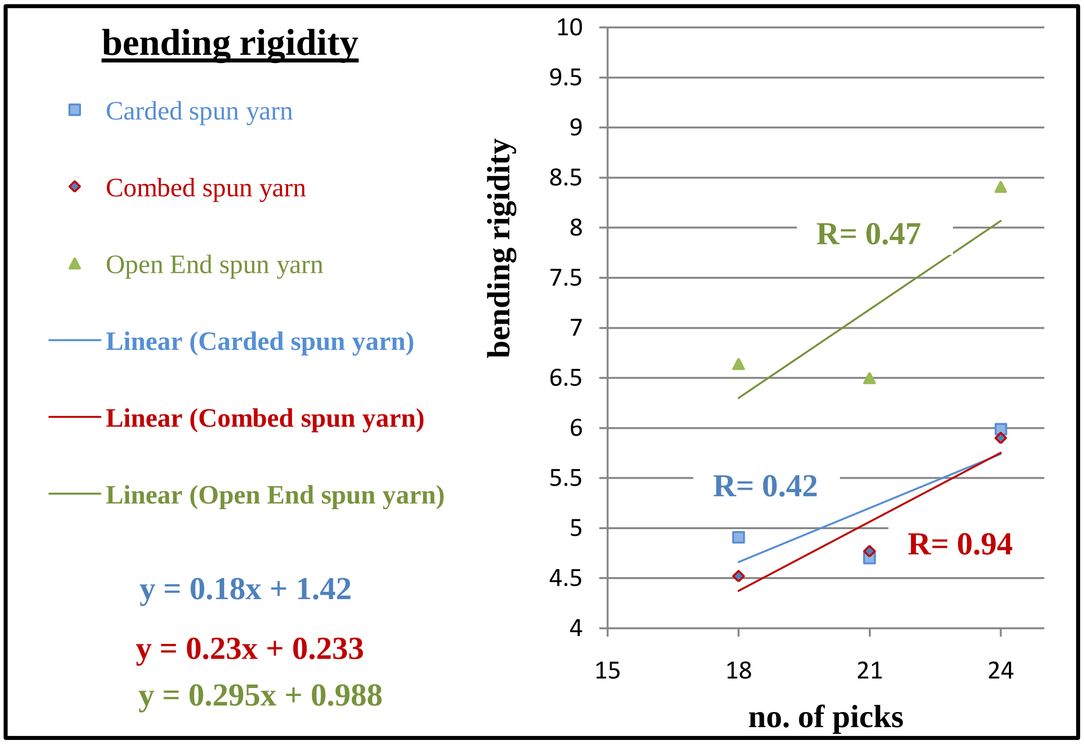

Figure 14, relationship between different picks numbers and fabric binding rigidity of different spinning methods using twill 2/2 structure

Figure (14) shows the bending rigidity values of fabrics at three different type of spinning yarns (card, combed and open end spun yarns); they are produced at three different weft density (18picks, 21picks and 24picks). All fabrics that have compared in the figure have the same woven structure (twill 2/2). The results have presents as linear equations of these three different spun yarns.From figure we can noted that bending rigidity values of fabrics that produced from combed spun yarns have the lower bending rigidity values than other two types whether at 18picks or 21,24picks.On the other hand, there are direct relation between the bending rigidity of fabrics and itspicks numbers.If the weft yarns increase in a fabric, the bending rigidity increases. The test is significant especially at the comb spinning which is the correlation is 0.94.

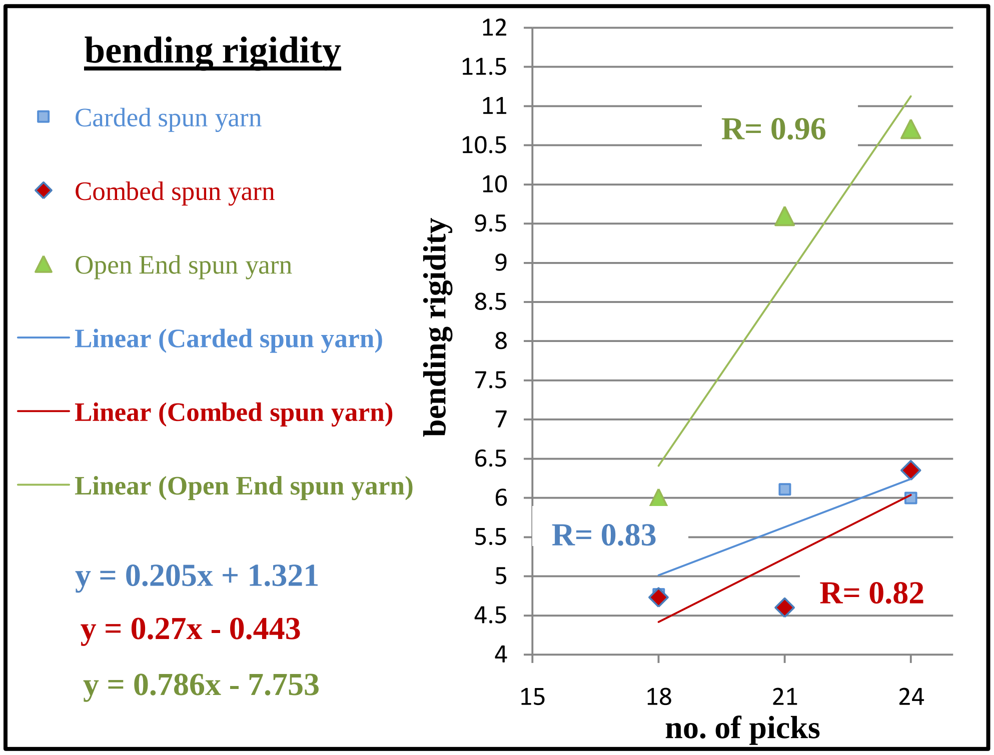

Figure 15, relationship between different picks numbers and fabric binding rigidity of different spinning methods using satin 4 structure

The figure (15) shows the three linear equations that represent the relation between the fabric bending rigidity and weft density (picks numbers)of three different spun yarns. Each linear equation is composed of fabrics bending rigidity values produced from one type of spinning yarns. All fabrics in this figure have produced from the same woven structure (plain 1/1) but with different numbers of picks per centimeter. We can note that all linear equations have direct relation between bending rigidity of fabrics and its weft density (number of picks). The values at fabrics produced from card and combed yarns are closed to each other while that produced from open end spun yarns are highly bending rigidity. All three correlations at three different spinning types are highly; especially at the open end spinning yarns; so the tests are significant at 0.05 levels.

4. Conclusions

The fabric samples have been produced with 3 types of weaves as plain, twill and satin with three types of weft yarns as card, comb and open end with three levels of picks per cm. the bending propertieshave been measured. From the observation and results, the following conclusions can be drawn:

- The bending length and bending rigidity of fabrics for all cases is high at fabrics produced from open end spun weft yarns followed by card spun weft yarn and comb spun weft yarns. So, the fabrics which produced from combed spun yarns at weft direction are lowest values of bending properties.Forsakeof that Yarn produced on different spinning methods have different structures, especially fiber arrangement and twist distribution in the yarn. Due to change in yarn structure, the properties of yarn are varied significantly.

- By study the effects of different fabrics weaves on the bending properties at three different spun yarns, we can conclude that Plain weave fabrics have highbending length and bending rigidity followed by the twill and satin weaves. Whether at any three weft densities. Those because plain weave gives more compact structure, to other weave fabrics because of more yarn-to-yarn interlacing in the fabric with smaller float. The twill and satin weave fabric behaves differently to the plain weave fabrics because of less interference between warp and weft threads.

- By study the effects of different weft densities on the bending properties at three different spun yarns, we can conclude that bending length and bending rigidity will be increased with increase the number of picks yarns per centimeter at the three different spun yarns. Fabric stiffness increases considerably if the cover factor of the fabric is increased, which, in turn, changes the bending length of the fabric.

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الملخص باللغة العربية

خواص الإنثناء للأقمشه القطنية الناتجه من أساليب غزل مختلف

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تتأثر جودة حياكة الأقمشة وتصميم الملابس كذلك التعامل معها بالخواص الطبيعية والفيزيائية لهذه الأقمشه كما تتأثر بالخواص الميكانيكيه عند الإجهاد المنخفض لهذه الأقمشة كخصائص "الإنثناء ، الإستطالة، اجهادات القص و الإنضغاط".

القياسات الموضوعية لخصائص الأقمشه من خلال الاختبارات الميكانيكيه للنسيج تؤدي الى تصور دقيق في اتخاذ القرار لإختيار القماش المناسب لإنتاج الملابس من ناحية تقليل مشاكل الحياكة وبالتالي تحسين جودة المنتج النهائي .

ارتكز هذا البحث على دراسة خصائص الإنثناء لأقمشة منسوجة تم انتاجها من خيوط مختلفة الغزل وتراكيب نسجيه مختلفة كما تضمن اختلافات في عدد اللحمات كمتغيرات في البحث.

شملت الدراسه سبعة وعشرون عينة قماش منسوجة منتجة من خامة القطن المصري 100%(جيزة 86) بإستخدام خيوط مغزولة بطرق مختلفه (غزل حلقي مسرح- غزل حلقي ممشط- غزل طرف مفتوح) واشتمل كل نوع غزل على ثلاث تراكيب نسجية مختلفة (ساده 1/1- مبرد 2/2 – اطلس 4) كما اشتمل كل تركيب نسجي على ثلاث حدفات خيط لحمه مختلفة (18 حدفه- 21 حدفه - 24 حدفه) مع ثبات عدد خيوط السداء وذلك لدراسة تأثير كل من نوع الغزل والتركيب النسجي وكثافة اللحمات على خواص الإنثناء في الأقمشة. تم اجراء الاختبارات باستخدام جهاز الفاست- 2, وبتحليل نتائج الاختبار نجد ان الاقمشه الناتجه من غزل خيوط ممشطه اقل انثناء من الاقمشة الناتجه من غزل خيوط مسرحه ؛ كما

تتميز الاقمشه الناتجه من غزل خيوط الطرف المفتوح بانها الاعلى صلابه في انثناءهامن الاقمشة الناتجه من الغزل الحلقي.