Study Of Knit Fabric Characteristics Made of Core Spun Yarns

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Abstract

The progress and development of the production of knitting machines led to the expansion of the use of knitted products, not only in the field of traditional clothing, but these fabrics were used in industrial purposes, home furnishings and clothing Sports and medical tools, and others, especially when using core spun yarns by combining the characteristics of different raw materials. It consists of two parts, the core and the sheath, the core is a continuous filament in the center covered with short filaments in the sheath, and this is generally called the core spun yarn.

12 samples were produced (represented by 6 samples of raw weft knitting fabrics + 6 samples of prepared weft knitting fabrics), using a gouge jersey knitting circular machine (28), a rib gouge machine (18) and an interlock gouge machine (18) and using core spun yarns number used 1/24 English and core continuous polyester 50 denier wool/acrylic core in sheath cover.

Laboratory tests were conducted to evaluate the functional properties of the produced yarns, and the cross-section of the spun and core spun yarns produced from cotton and viscose was photographed by microscope, by conducting statistical analysis of the results, the number of rows / inch - number of wales / inch - convolution angle - stitch length - weight per square meter was measured/ Thickness – Bursting strength - permeability - length and width shrinkage - water absorbability capacity. It was concluded that the use of core spun yarns of wool and acrylic improved the functional properties of the produced weft knitted fabrics more than others.

key words

Core Spun Yarns - Weft knitting fabrics - Jersey Structure - Rib Structure - Interlock Structure.

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Introduction

Knitted fabrics of various kinds can be produced to meet different tastes and desired purposes, whatever they are, so that they match in shape and use of any other fabric. Therefore, it is worth noting that the properties of the threads constitute the essential units affecting the quality of the final product, and the performance of the machine is closely related to the quality of the fed thread. (1)

Research problem

Despite the technological progress in the production of weft knitted fabrics using axial threads with a hard core, and their impact on the functional and aesthetic properties of weft knitted fabrics produced with different structural compositions, and the ability to achieve the functional performance and physiological comfort required for the produced clothing fabrics.

Research importance

The importance of the research lies in studying the functional and aesthetic properties of weft knitting fabrics produced with different structural structures on circular weft knitting machines using core yarns with a solid core and different materials in the cover and having distinct mechanical and physical properties, and studying the effect of their use on the functional, aesthetic and comfort performance of the produced fabrics.

Research aims

1. Improving the production of fabrics produced on weft knitting machines by using hard core coaxial threads.
2. Achieving the quality of the functional and aesthetic properties of the weft knitted fabrics produced on circular knitting machines according to the different structural structures.

Research hypotheses

1- The use of different types of materials with different mixing ratios affects the properties of the unwoven pieces produced.
2- The use of different structural structures for weft knitting fabrics directly affects the functional properties of these fabrics.
3- The use of hard core yarns of wool and polyacrylic materials affects the functional properties of the produced weft knitting fabrics.

Research Methodology

This research follows the experimental and analytical method.

1- Previous studies:

The knitted fabric industry in the world has developed greatly, especially in recent years, to the extent that it has become competitive with woven fabrics, and this type of construction has spread in the modern era rapidly in various fields. By studying factors that lead to the prosperity of this industry, it becomes clear that there are many factors, the most important of which is the use of synthetic fibers, and the development of the properties of natural yarns, with the

consumer acceptance of knitted products of all kinds on the basic that they are in line with fashion and give comfort in terms of flexibility and good suitability for the final use, in addition to their cheapness due to the low costs of their production. The progress and development of the production of knitting machines also led to the expansion of the use of knitted products, not only in the field of traditional clothing, but these fabrics were introduced to industrial uses, such as home furnishings, sports and medical clothing, special uses, and others. (2) (3) (4)

Types of raw materials used on machines:

Mixing raw materials using core yarns:

Mixing textile materials and benefiting from the combination of their characteristics and advantages; Because the style of the core yarns is simple, and the materials are varied, whether in the core or the cover, and its end uses are diverse. In addition, the core yarns are used to improve the functional properties of fabrics such as strength, durability, elasticity and comfort. (5) (6)

We find that the core yarn combines the hardness of the supporting material found in the core and other characteristics such as softness, moisture absorption, and aesthetic properties of the Sheath cover materials, where the core is a continuous synthetic fiber and the Sheath cover is natural materials, thus combining the advantages of the two components that are included in its composition, which are composite yarns of two or more components or hybrids. (7) (8) (9)

Aesthetic appearance and comfort are the basic characteristics that consumers expect from their clothes, i.e. improving the functional and aesthetic characteristics. (10) (11)

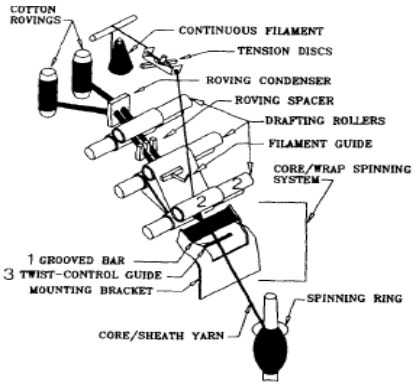

Figure (1) shows the modified axial spinning (9)

Polyester - Wool: Wool - Acrylic (4)

Basic Structures of Weft Knitted Fabrics:

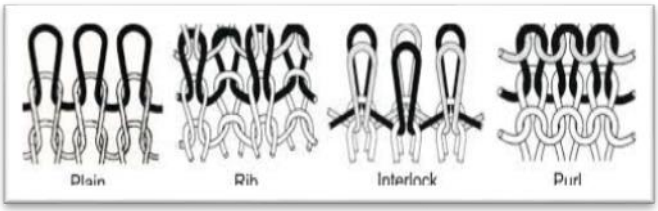

Figure (2) shows the structural structures (bell - rib - interlock - pearl) (5)

Jersey Fabrics: Single Jersey Fabrics (12) (13) (14)
Rib Fabrics (15) (16) (17)
Interlock Fabrics: (18) (19) (20) (21) (22) (23)

2- Practical experiments and laboratory tests:

12 samples were produced (represented by 6 samples of raw weft knitting fabrics + 6 samples of prepared weft knitting fabrics), using a gouge jersey knitting circular machine (28), a rib gouge machine (18) and an interlock gouge machine (18). The number of the core yarn used is

24/1, English, and the core is a continuous polyester 50 denier, of two materials, wool/acrylic in the sheath.

Lab Tests:-

Test number of rows and number of columns

This test was carried out according to the American Standard (ASTMD3887).

Table (1) shows the results of the tests of the produced raw fabrics, and Table (2) shows the results of the tests of the produced processed fabrics as follows: -

Table (1) shows the results of the tests of raw fabrics produced

Material Type	Structural Structure	Stitch Length (mm)	(Number of Raws/inch	Number of wales/inch	Thickness (mm)	Fabric Width (cm)	(Water Absorbaility (sec)
Wool	Persola	٢,٨	٤٥	٣٤	٠,٥١	٧١	١٦,٤
	Rip	٥,٥	٤٣	٢٨	٠,٨٢	٤٣	١٩,٧٨
	Interlock	٣,٢	٣٩	٣١	٠,٩٩	٥٢	٢٥,٥٧
Acrylic	Persola	٢,٨	٤٩	٣٤	٠,٤٣	٧١	٧,٤٦
	Rip	٥,٤	٤٢	٢٦	٠,٧٣	٤٦	١٠,٤٤
	Interlock	٣,٣	٣٨	٣١	٠,٧٨	٥٣	١٤,٥٩

Follow Table (1) showing the results of the tests of raw fabrics produced

Material Type	Structural Structure	Spirality Angle **(spirality)°**	Shrinkage - length%	Shrinkage - width %	Weight per square meter (gm)	air permeability cm3/cm2.S	Bursting Strength kPa
Wool	Persola	٨٢	%١,٨٠	%٥,٢٥	١٦٤,٧	١٠٨,٥	٦١٠
	Rip	٩٥	%٦,١٠	%١,٢٠-	٢٤٦,٢	١٠٢,٢	٦٣٠
	Interlock	٩٤	%٣,٧٥	%٣,٨٠	٢٨٦,٧	٩٦,٧	٩٢٧
Acrylic	Persola	٨٥	%٥,١٨	%٧,١٢	١٦٧,٢	٩٩,٤	٦٨٠
	Rip	٨٦	%٢,٧٠	%٠,٤٤	٢٤٩,٦	٨٩,١	٦٧٥
	Interlock	٩٩	%٦,٥٠	%٣,٧٠	٢٩١,١	٧٧,٤	٩٨٢

Table (2) shows the results of the tests of the relaxed fabrics produced

Material Type	Structural structure	Stitch length (mm)	Number of Raws/inch	Number ofwales/inch	Thickness (mm)	Fabric Width (cm)	Water Absorbability (sec)
Wool	Persola	٢,٦	٤٦	٣٥	٠,٥٣	٦٧	١٢,٢
	Rip	٥,٣	٤٤	٢٩	٠,٨٤	٤٠	١٣,٤
	Interlock	٣,١	٤٠	٣٣	١,٠٣	٤٨	١٤,٢
Acrylic	Perso al	٢,٦	٥٠	٣٦	٠,٤٥	٦٥	٧,٨
	Rip	٥,٢	٤٣	٢٧	٠,٧٥	٤٣	١٠,٥
	Interlock	٣,١	٤٣	٣٣	٠,٨١	٥١	١٢,٥

Follow table (2) showing the results of the tests of the relaxed fabrics produced

Material Type	Structural structure	Spirality Angle (spirality) o	Shrinkage - length %	Shrinkage - width %	Weight per square meter (gm)	air permeability cm3/cm2.S	Bursting strength kPa
Wool	Persola	٨٣	%٠,٨٠	%١,٣٥-	١٨٢,٣	١٠٦,٨	٦٢٣
	Rip	٩٤	%٠,١٤-	%١,٤٠-	٢٦٥,٣	٩٩,٨	٦٤٥
	Interlock	٩٨	%٣,٥٠	%١,٠١-	٣١٥,٢	٩٤,٧	٩٣٦
Acrylic	Perso al	٩٠	%٠,٧٣	%٠,٩٠-	١٨٤,٦	٩٨,٦	٦٩٨
	Rip	٨٨	%٠,٥٠	%٠,٣٠	٢٥٣,٢	٨٨,٣	٦٨٨
	Interlock	٩٣	%٢,٧٠	%١,٩٠-	٣٢٠,٨	٧٦,٦	٩٩٨

Studying the effect of the different type of material on the functional properties of the produced fabrics:

The effect of the different type of material on the functional properties of the produced yarns was studied, and the following was concluded:

1-1- The relationship between the type of material and the stitch length (mm):

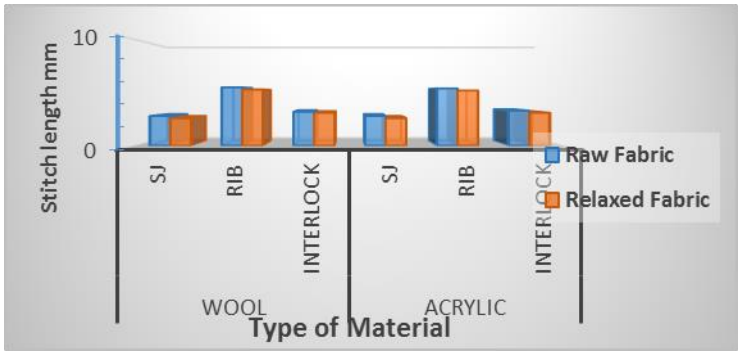

Figure (3) shows the relationship between the type of material and the stitch length (mm).

Where it was found that the minimum stitch length was in the installation of the jersey, followed by the interlock and then the rib in wool and acrylic, while in the raw fabric, the stitch length was longer than the stitch length in the fabric prepared in the three combinations.

1-2- The relationship between the type of material and the number of Wales/ inch: -.

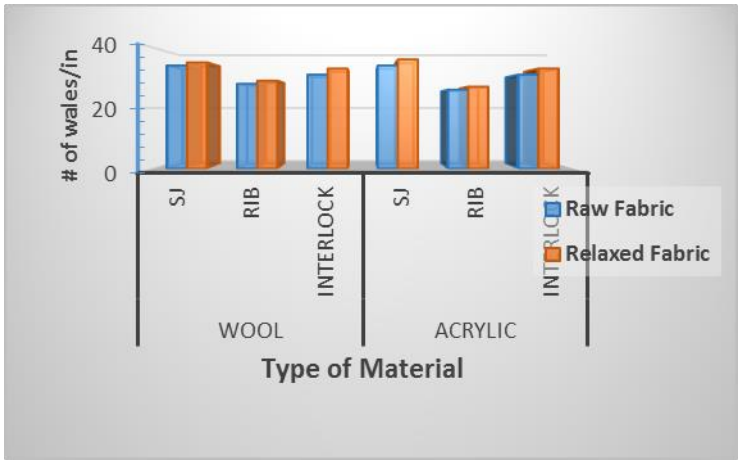

Figure (٤) shows the relationship between the type of material and the number of Wales/ inch

Where it was found that the number of wales in the composition of the rib is less, followed by the interlock and then the jersey, which is the highest number of wales per inch in both wool and acrylic materials, and the number of wales per inch for raw cloth is less than the number of wales per inch in the fabric processed in both wool and acrylic materials.

1-3 The relationship of the type of material and water absorption to the second.

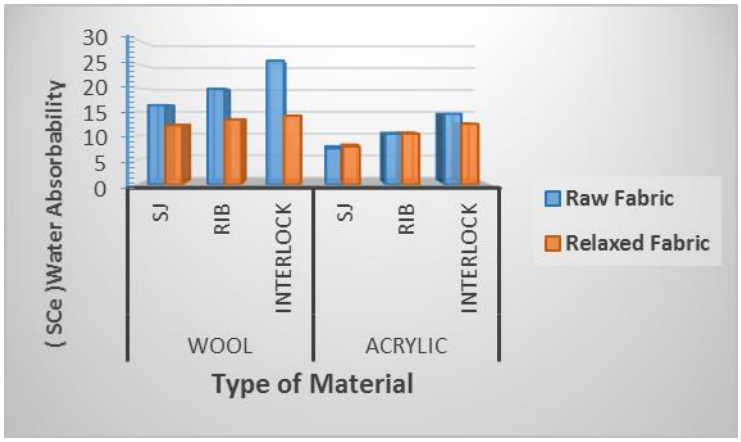

Figure (5) The relationship of the type of material and water absorbability per second.

We find that the relaxed cloth absorbed water in less time than the raw cloth, that is, faster than the raw cloth.

Wool cloth is faster in absorbing water than acrylic cloth, and jersey is faster in absorbing water, followed by interlock, followed by interlock in both wool and acrylic materials.

1-4-Relationship of the material type to the spirality angle (spirality)°

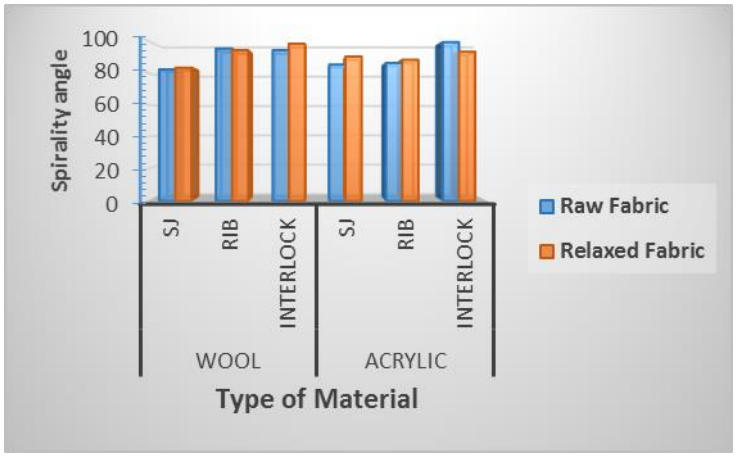

Figure (6) Relationship of the material type to the spirality angle (spirality)°

We find that the installation of the jersey achieved the lowest angle of inclination, followed by the rib, and the highest angle of spirality was in the installation of interlock, in both materials of wool and acrylic, wool and acrylic, for the structural installation where the rib fabric is twice the thickness of the jersey and the interlock is two overlapping rib fabrics.

And the spirality angle of the fitted fabric is less than the spirality angle of the raw fabric in wool and acrylic.

1-5- Relationship Material Type and Shrinkage Width %: -

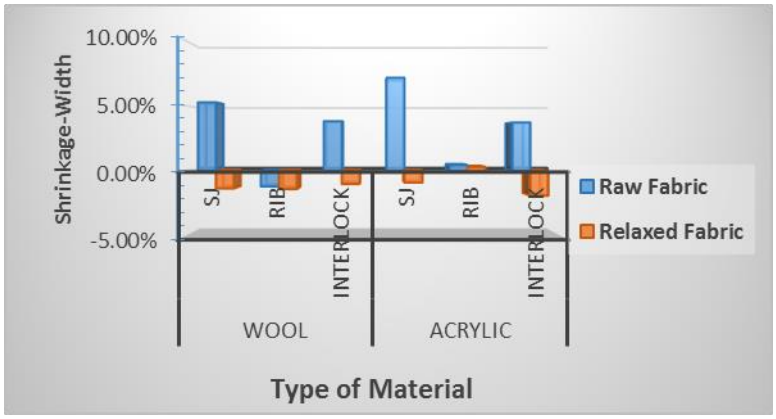

Figure (7) shows the relationship between the type of material and the shrinkage Width %

Where it was found that the Shrinkage Width in the prepared fabric is less than the Shrinkage Width in the raw fabric for both wool and acrylic raw materials for all building structures (jersey, rib and interlock), and the installation of the ribs achieved the highest Shrinkage Width, followed by the interlock, followed by the jersey, which achieved the least Shrinkage Width in both the relaxed and raw fabric. This is due to the structural composition of the rib, as it is twice as thick as the jersey and half as wide as the jersey, and therefore the elongation of the rib fabric in width is twice the jersey, and the elongation of the fabric in the width of the jersey is somewhat similar.

1-6- The relationship between the type of material and the air permeability is $cm^3 / cm^2.S$:-

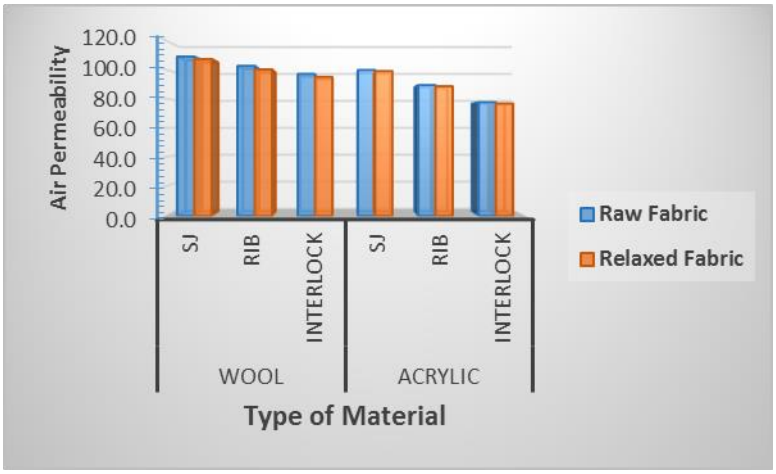

Figure (8) shows the relationship between the type of material and the air permeability $cm^3 / cm^2.S$

Where it was found that the air permeability in the jersey installation was the highest, followed by the rib, followed by the interlock, which achieved the lowest air permeability, and that the permeability in the raw cloth was higher than the permeability in the prepared fabric in all the produced building structures, both wool and acrylic raw materials, because the interlock is twice the thickness of the rib, which is two rib cloths overlapping, and rib twice the thickness of the jersey and half its width.

1-7- The relationship between the type of material and the Bursting Strength (in kPa): -

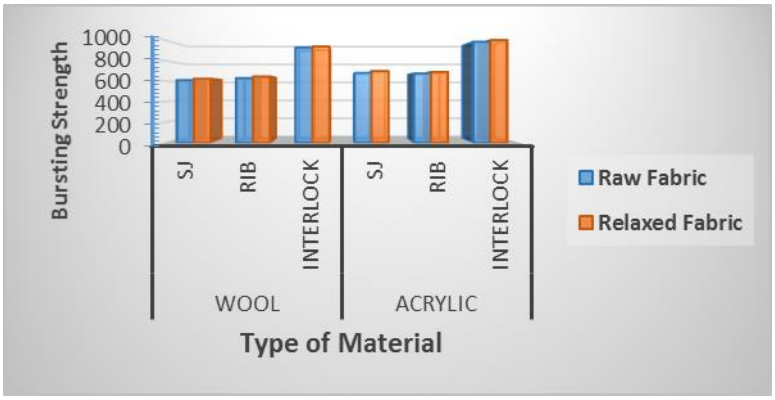

Figure (9) shows the relationship of the type of material to the Bursting Strength(kPa)

Where it was found that in the Bursting Strength of the interlock achieved the highest value, followed by the ribs, followed by the jersey, in both the raw and prepared fabric for both wool and acrylic raw materials, because the thickness of the interlock is twice the ribs and the thickness of the ribs is twice the jersey.

- Study the effect of the study of the effect of a three-way analysis of variance:

A three-way analysis of variance 3Way Anova was conducted to study the significant effect of the material type - the structural composition - the type of fabric on the following properties:

Calculated significant P-value greater than 0.05: non-significant effect (-)

Calculated significant P-value less than 0.05: significant effect of 0.05 (*)

Calculated significant P-value less than 0.01: highly significant effect with statistical significance 0.01 (**)

2-1- Analysis of Variance for Stitch Length Characteristic (mm)

Table (3) shows the effect of study factors on stitch length

Source	DF	SS	MS	F	P-Value	Statistical significance
Material Type	١	0.0008	0.0008	0.37	0.563	-
Structure	٢	15.9717	7.9858	3530.58	0.000	**
Fabric Type	١	0.1008	0.1008	44.58	0.000	**

From the analysis of variance table (3), it is clear that there is an insignificant effect for the type of material on the stitch length, and there is a significant effect to a high degree of the structural composition on the stitch length, and there is a significant effect to a high degree for the type of fabric on the stitch length. **2-2- Analysis of variance of rows/inch**:

Table (4) shows the effect of study factors on the number of rows / inch

Source	DF	SS	MS	F	P-Value	Statistical significance
Material Type	١	5.333	5.333	1.93	0.207	-
Structure	٢	114.000	57.000	20.64	0.001	**
Fabric Type	١	8.333	8.333	3.02	0.126	-

From the analysis of the variance table (4), it is clear that there is an insignificant effect of the type of material on the number of rows, and there is a significant effect of a high degree of

structural composition on the number of rows, and there is an insignificant effect of the type of fabric on the number of rows.

3- Quality treatments for raw and processed fabrics:

Table (5) shows the quality parameters of the produced processed fabrics

Order	Quality Factor	Bursting strength kPa	air permeability cm3/cm2.s	Shrinkage - width%	Shrinkage - length %	Spirality Angle (spirality)°	Water Absorbability (W)	Structural structure	Material Type
٤	%٥٤,٨	%٤٢,٧	%٩٨,٤	%٢٢,٢	%١٧,٥	%٨٦,٧	%٦١,١	jersey	Wool
٢	%٦٥,٠	%٤٤,٢	%٩٢,٠	%١٠٠,٠	%١٠٠,٠	%٧٦,٦	%٥٥,٧	Rib	
٥	%٥١,٩	%٦٤,٢	%٨٧,٣	%٢٩,٨	%٤,٠	%٧٣,٥	%٥٢,٥	Interlock	
٣	%٦١,١	%٤٧,٨	%٩٠,٩	%٣٣,٣	%١٩,٢	%٨٠,٠	%٩٥,٦	jersey	Acrylic
١	%٦٨,٢	%٤٧,٢	%٨١,٤	%٢١,٤	%٢٨,٠	%٨١,٨	%٧١,٠	Rib	
٦	%٤٩,٥	%٦٨,٤	%٧٠,٦	%١٥,٨	%٥,٢	%٧٧,٤	%٥٩,٧	Interlock	

Where it was found that the quality factor of acrylic material is better than that of wool material (due to the presence of thick and thin places in woolen spinning) in both raw and processed fabric.

3- Radar maps for raw and processed fabrics:

3-1Radar map of Relaxed wool fabrics:

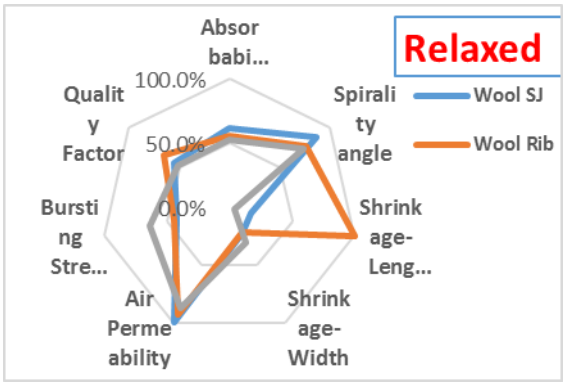

Figure (10) shows the radar map of the Relaxed wool fabrics

We find that the spirality angle has the highest value in the structure of the jersey, followed by rib, and the least of them is the interlock. Absorption of water has the highest value in the composition of jersey, followed by rib and the lowest of them is the interlock. The quality factor has the highest value in the installation of ribs, followed by jersey, which is close to interlock, bursting strength has the highest value in the installation of interlock, followed by ribs, and the least of them is jersey and air permeability the highest value in the structure of the jersey, followed by rib, and the least of them is the interlock. Width shrinkage has the highest value in the structure of rib which is close to jersey and close to Interlock, length shrinkage in jersey, then rib and interlock is closed.

3-2 Radar map of Relaxed acrylic fabrics:

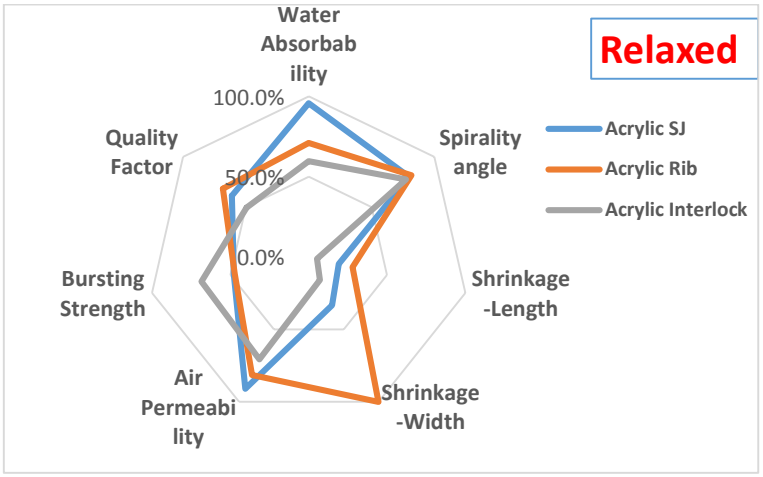

Figure (11) shows the radar map of the Relaxed acrylic fabrics

We find that the spirality angle has the highest value in the structure of the jersey, followed by rib, and the least of them is the interlock, the absorption of water has the highest value in the composition of the jersey, followed by the rib and the lowest of them is the interlock. The quality factor has the highest value in the installation of ribs, followed by jersey, which is close to interlock, and bursting strength has the highest value in the installation of interlock, followed by ribs, and the least of them is in jersey, air permeability has the highest value in the structure of jersey, followed by rib, and the least of them is the interlock. Width shrinkage has the highest value in the structure of rib which is close to jersey and close to Interlock, length shrinkage in jersey, rib and interlock is closed.

Conclusions:-

1- Acrylic material has achieved the best quality coefficient of wool material.
2- The use of core yarns of wool and acrylic improves the functional properties of the produced weft knitting fabrics.
3- Core yarns are characterized by elongation, durability and cut resistance higher than spun yarns, which affect quality, elongation and durability of the weft knitted fabrics.

Recommendations:-

● Using core spun yarns because of their advantages and properties that are better than those of spun yarns with the same materials and the same number in the production of weft knitted fabrics in order to achieve the required functional and aesthetic properties.
● Acrylic core spun yarns are better than spun acrylic yarns, and this is reflected in the properties of the weft knitted fabrics produced from them.
● The wool material did not achieve high quality due to the use of thick and thin places of woolen fibers and filaments. It is preferable to use long, smooth and thin rusted wool fibers and filaments to produce good woolen core spun yarns free of thick and thin places and suitable for the production of weft knitting fabrics with good functional and aesthetic properties.

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