The effect of blending industrial hemp as an Eco-friendly material with cotton to produce jeans clothes

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Abstract:

This research aims to study the effect of using industrial hemp (Cannabis sativa) as an Eco-friendly material in jeans fabric, as it is the most popular and preferred fabric for many men, women and children. Attention to environmental protection is the reason for the interest in these fibres. Industrial hemp (Cannabis sativa) is one of the best fibres with a high content of cellulose. Attention to environmental protection is the reason for the interest in these fibres, it is almost a challenge for cotton fabrics in some properties and advantages.

In this study, five samples of jeans fabric were produced with different blending ratios for the raw materials used in each of warp (100%cotton, 70%cotton:30% hemp) and weft (98%cotton :2%spandex, 48%cotton :2%spandex:50%hemp, 68%cotton :2%spandex:30%hemp), with weave structures (twill 3/1z). Tests were done to the produced samples (tensile strength tear strength, stiffness, Fabric Weight, growth, Spray test (wettability) and Air permeability). The result of the research showed that increasing the percentage of hemp improves the tensile strength, tear strength and air permeability of the samples produced, in addition reducing weight and increasing the stiffness of the fabric. Three different clothing products were implemented from sample no. (5) with blending ratios (70% cotton: 30% hemp in the warp // 48% cotton: 2% spandex: 50% hemp in the weft) due to the results of the tests, which showed the suitability of the sample properties and the availability of its comfort properties and its superiority over the cotton material in some properties when blending industrial hemp with cotton.

Key words:

Hemp fibers- spandex - Denim Fabric -Cotton

Research Problem

Why blending hemp with cotton is more environmentally sustainable than comparable cotton textiles?

How can the functional performance of jeans fabrics be improved by using hemp and cotton fibers?

Research Aim

Improving the functional performance of jeans, using hemp and cotton blending yarn of hemp and cotton.

Determine the best proportions of blending hemp with cotton in line with the nature of use.

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Research Importance

Take advantage of the distinctive properties of hemp in the production of environmentally friendly jeans clothes.

Methodology

Analytical experimental methodology.

Search limits

- The experimental study is limited to making five samples of denim fabrics (jeans) with different blending ratios for the raw materials used for warp and weft (cotton - hemp - spandex), as follows:
- Warp: (100% cotton) (70% cotton: 30% hemp).
- Weft: (98% cotton: 2% spandex), (48% cotton: 2% spandex: 50% hemp), (68% cotton: 2% spandex: 30% hemp).
- Implementing 3 different clothing products for denim clothes (jeans) that match the resulting characteristics.

Experimental Work

- In this study, five samples of jeans fabric were produced with different blending ratios for the raw materials used in each of warp and weft. Explained in Table (1), with weave structures (twill 3/1z) with different specifications under study and application.
- The goal was to produce 3 different clothing products (women clothes, jeans). According to the properties obtained in relation to the comfort properties.

Table (1) specification of the samples produced under study

S.NO.	material / blending ratios	
	weft	Warp
1	98% cotton: % 2 spandex	100 %cotton
2	48% cotton:% 2 spandex: 50% hemp	100 %cotton
3	98% cotton:% 2 spandex	Cotton70% hemp30%
4	68% cotton: 2% spandex: 30% hemp	Cotton70% hemp30%
5	48% cotton: 2% spandex: 50% hemp	Cotton70% hemp30%

Table (2) the percentages used in processing

SOFTNER	GR/LT
ADALIN DE	50
BELSOFT 200	25

Table (3) Laboratory tests carried out and standard methods

test	**standard method**
Tensile strength (N)	ASTM D 5035
Spray test(wettability)(degree)	AATCC22-2005
Fabric Weight (Gr/M^2)	ASTM D3776
Tear	ASTM, D1424
Growth	ASTM D3107
Air permeability (cm3/cm2.sec	ASTM, D737- 97
Stiffness(kg)	ASTM, D4032

Table 4) Results of all tests applied to samples

S. No.	**Tensile strength (N)**		**Tear**		**Fabric Weight (Gr/M^2)**	**Growth**	**Spray test(wettability)(degree)**	**Air permeability (cm3/cm2.sec)**	**Stiffness Kg**
1	**weft**	**WARP**	**weft**	**WARP**	479	5	70	3.7	0.79
2	341.27	1159.2	4057	5525	462	4.5	70	4.7	0.91
3	486.4	1243	4564	5569	470	4.9	70	4	0.85
4	379	1296.7	4057	5571	458	4.5	70	6	0.89
5	522.2	1353.8	4570	5770	450	4	70	7.5	0.95

Results and Discussions

1- With the increase in the ratio of blending hemp with cotton, the tensile strength of the cloth increases in both the warp and weft directions. This is due to the increased tensile strength of the hemp material, which ranges between (580-1110 Mpa), which depends on the dimensions of the fibers and as an average higher than cotton, which is a good characteristic of denim clothes (jeans).

2- With the increase in the rates of blending hemp with cotton in both the direction of the warp and the weft, the tear strength increases and this may be attributed to the increase in the tensile strength of the hemp fibers. Which in turn led to the strength of the threads, as with the increase of the thread strength, the strings clustered together in the rupture region support the higher load. Which led to an increase in the tear strength, and this means that with the increase of the thread strength, the tear strength of the fabric increases in the case of the stability of the textile structure and the number of the thread.

3- With the increase in the percentage of blending hemp with cotton, the stiffness of the fabric increases, which is a negative characteristic of denim clothing (jeans). The roughness of hemp fibers has a higher diameter that ranges between (23: 17 μm Mμ) (18) while the diameter of the cotton fiber ranges (20: 8) Mμ (25), which in turn increases the hardness.

4- By increasing the percentage of blending hemp with cotton, the weight of the cloth decreases, which is a positive characteristic of denim clothing (jeans). The specific density of fiber is defined as the mass of a unit volume, and is expressed in grams per cubic centimeter. (G / cm3), so there is a direct relationship between the specific density of the material and the weight of the fabric. Hemp is considered to have a lower specific density (1.4-1.5 g / cm3) compared to the specific density of cotton (1.5 -1.6) g / cm.

5- All samples came within the permissible limits in the growth test, as the average acceptable percentages for the growth characteristic of denim clothing (jeans) range between 3-6%, and this is due to the addition of 2% of the spandex material.

6- There were no differences between the scores of the five samples in the spray test (wettability), where the results came with a value of 70 for all five samples.

7- With the increase in the percentage of mixing hemp with cotton, the ability of the cloth to permeate air increases due to the irregular cross-section nature of hemp fibers which contains a multi-celled structure that appears as a composite material containing many lumens next to each other, which makes its air permeability higher.

8- Executing 3 different clothing products (women's clothes, jeans) from sample No. (5) due to the results of the tests, which showed the suitability of the sample's properties, the availability of comfort properties, and its superiority over the cotton material in some properties when blending with cotton.

The implementation of the clothes

3 different apparel products have been implemented for denim clothing (jeans) according to the characteristics:

In light of the specifications and properties of the produced fabrics, sample No. (5) was selected with mixing ratios (70% cotton: 30% hemp in the warp // 48% cotton: 2% spandex: 50% hemp in weft), due to its preference over the rest of the samples under study.

In terms of the properties of (weight - tensile strength - tearing - elongation - air permeability - water absorption and good growth rate), where a set of designs for women's jeans (3 different designs for women) were proposed that highlight the characteristics of the sample as they were employed in products that suit their characteristics, from the proposal of the designer.

1- Design description (1):

The design is a jumpsuit (the general concept of the word, any design in which the pants connect to the blouse is a jumpsuit design):

It is a jeans blouse with Pompe-sleeves from the shoulder line, and a long zipper at the back, attached to the pants at the waist.

Figure (1) illustrates design 1

2- Design description (2):

The design is a wide pants (pants) with an elastic sleeve at the waist, and connected to a part of the lines of knitting the side of the pants (skirt).

Figure (2) illustrates design 2

3- Design description No. (3):

The design is a short dress at the knee connected with sleeves and has pleats starting at the waist, and a shawl collar, the dress is open from the front and closed with a push button.

Figure (3) illustrates the design 3

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