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Study on Moisture and Durable Properties of Cotton/Hemp Blends Knitted Fabric

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***Abstract*: The production of hemp is generally cheaper than cotton. The process of blending the hemp with other conventional natural fibres helps to achieve the textile cloth softer and more durable. The factors influencing moisture management properties of plain knitted fabrics are fibre type, yarn geometry and fabric porosity levels. The study conducted on cotton/hemp blended fabric to analyze the moisture management level of the cloth and to verify the role of fibre type in enhancing the moisture management of fabric.**

***Keywords*: cotton/hemp blend, knitted fabric, durability, moisture management, fabric porosity.**

1. Introduction

Hemp fabric is lightweight, absorbent, and more durable and shows three times higher tensile strength than cotton fabric. Hemp fabric is deliciously soft on the skin and is known for increasing softness with each subsequent wear. Hemp fibre is naturally resistant to bacteria and provides natural UV protection. This antibacterial property emphasis its application along with its unique softer quality on usage in apparel for avoiding stickiness and making stronger and longer-lasting cloth than cotton. Hemp plant consumes about 5% of the amount of water consumed by the cotton plant to grow while cultivation. Hemp grows extremely fast as it takes about 120 days to be ready for harvesting which can give production of 250% more than cotton and 600% more than flax with the same amount of land. In this paper, to study the property enhancement in moisture properties of cotton fabric using hemp fibre, hemp, cotton and cotton/hemp blended yarn has been prepared and knitted into fabric, a comparison is made.

2. Work Methodology

A. Yarn making process

Cotton blends with hemp fibre in three different proportion to check the yarn spinnability. The hemp increases stability and strength to cotton yarn, making the fabric stronger and slightly lowering its shrinkage. It also enhances the dye retention capacity of cotton fibre. The first process in the manufacture of cotton/hemp blended yarn is the retting process of hemp fibre. The Retting process is done by applying an oil and water mixer to hemp fibre. The oil used for the retting process is maxtray. The ratio of oil and water is 1:20. The required quantity is fixed at 33 kg cotton/hemp blended fabric. However, the required cotton and hemp fabric to be produced is fixed at 37.5 kg. It is because the efficiency attained in the spinning mill is 88% since wastages are an unavoidable occurrence in the spinning process.


Fig. 1. Hemp fibre before treatment


Fig. 2. Retting process


Fig. 3. Storing can


Fig. 4. Oil used for retting process

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Fig. 5. Cotton hemp blended yarn cones

B. Cotton and hemp blended knitted fabric production

According to GSM determined for producing knitted fabric, the count of the yarn in the spinning mill is decided and produced. GSM stands for Gram per square metre and represents the weight of one square meter of knitted fabric in grams. GSM is an important parameter in the process of negotiation between the buyer and the supplier. Quite changes are made in knitting machine for producing the cotton and hemp blended knitted fabric. The texture of the fabric depends on the width of the knitting machine. Finally, the fabric is produced for the required length.

Fig. 6. Cotton Hemp Blended Fabric

Table 1
Fibre details

Fibre Details		
First trail	MECH cotton	Hemp fibre
Staple length	28mm	28mm
CSP	up to 1320	
Blend proportion	60:40	
Yarn count	30s	
Second trail	MECH cotton	Hemp fibre
Blend proportion	80:20	
Yarn count	20s	
Third trail	DCH cotton	Hemp fibre
Staple length	34mm	34mm
CSP	up to 2550	
Blend proportion	80:20	
Yarn count	20s	

Fabric details	
GSM	154
Thickness	0.4mm
Strength	378kPa
Porosity	7.92%

C. Testing

Moisture transmission test for 100% cotton fabric and cotton hemp blended knitted fabric is carried out. Moisture transmission test is done using water method which requires water and beaker. Sample fabric is mixed with water and kept in a beaker for 24 hours. Then the weight of fabric before treatment and after treatment is noted for calculating the rate of water vapor transmission.

3. Result and Discussion

A. Yarn formation trials

1) First trial

Cotton and hemp blend ratio initially considered as 60:40 and yarn to be produced in the 30s count for the first trial. The cotton fibre variety used for the first trial is MECH cotton which has a staple length of 28mm and can give CSP up to 2000. The hemp used has a higher denier value compared to cotton fibre. The spinning process is done in the spinning mill which does not possess a Relative Humidity plant and Yarn Conditioning plant and the process is carried out in summer. The proportion of blend ratio for cotton and hemp is 60:40. To maintain the blend ratio, 15kg hemp fibre is mixed with cotton for 37.5 kg fabric. A sample run carried out with 3kg of hemp fibre for the retting process followed by the opening process by blow room. In the retting process 500ml, oil and 2-litre water is applied and followed by 3 days wet conditioning process before blow room operation as it is summer season and due to lack of RH plant and YRC plant. At the end of the blow room, the mixing process takes place with MECH cotton fibre and the spinning process is carried out. Help fibre performs well up to carding individualization process, and hemp fibre losses its moisture, and in subsequent processes and the desired yarn formation could not be reached.

2) Second trial

Since the hemp fibre is thick and rough, the first trial where the blend proportion is 60:40 for the cotton/hemp fibre blend leads to improper formation of yarn. It is decided to reduce the proportion of hemp fibre for producing yarn. Hence the cotton and hemp blend ratio is changed from 60:40 to 80:20 and a coarser count is tried as the finer count is not able to spin. The same parameters are followed in this second trial. With this blend ratio, the roving strand processed as per the desired level, but in the ring frame, yarn formation becomes difficult with the required TM (twist parameter) value for producing hosiery yarn. TM value for producing hosiery yarn is 3.6. Yarn formation occurs only when the TM value is given 5.2 which is not suitable to run hosiery fabric.

3) Third trial

The reason for the failure of the second trial is the staple length of the cotton and hemp fibre is smaller and the denier of hemp is higher which makes processing difficult. Hence DCH cotton is chosen and hemp fibre with higher cut length and lesser denier value is chosen. The required CSP for hosiery yarn is 2000. The DCH cotton is showing a 3000 CSP value. Thus 80% DCH cotton can contribute up to 2300 CSP and 20% hemp can contribute up to 60 CSP. Finally, the obtained CSP was 2360 with the required TM value of 3.6.

B. Moisture transmission

Moisture transmission of 100% cotton fabric = 16.524g/hm^2. Moisture transmission of cotton hemp blended fabric =25.234g/hm^2. Due to the higher moisture regain of hemp the absorbency characteristics of the fabrics using hemp blended yarn is higher. Cotton/hemp blended yarn knitted fabric absorbs and transmits more water vapour through the fabric due to the higher absorbency property of the hemp.

4. Conclusion

The cotton/hemp blended yarn with coarser count leads to the loosely structured yarn, which in turn the cotton knitted fabric was characterized by the lowest free open surface (micro porosity) exhibiting the lowest water vapour and liquid permeability. As hemp having the highest macro porosity, the water vapour and liquid transport of the fabric was greater than 100% cotton fabric. Therefore, the moisture management properties of textile materials can be guided in the desired direction by the appropriate selection of fibres and careful design of the yarn structure. This study reveals that, due to its good moisture management property, hemp fibre blended fabric is very comfortable for wearing during summer as it absorbs sweats and prevents microorganisms.

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