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Effect of Different Stages of Processing of Jute Yarn at Varying Counts

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ABSTRACT:Jute fibre was known as the golden fibre of Bangladesh. It is consisting of varieties of qualities such as eco-friendly, biodegradable, and multipurpose of end uses. The problem arises whenever the jute is processed in a different count then the strength decreases. In this paper, the effect of Woolenization of jute yarn is focused to observe the physical properties of chemically processed jute yarn. In this investigation, firstly 100% jute yarns of 3 counts (8,10 & 12 lbs/spindle) were prepared for post spinning process in different stages by the collected banglatossa jute fibers and different properties of 100% jute yarns such as count, twist, and the moisture content ratio etc. were tested. The count changes show that woolenized jute yarn count 11.76, 9.08, 7.568 lbs/spyndle (12,10,08 lbs/spyndle) which is higher than bleached jute and dyed jute yarn. The number of twist per inch of woolenized jute yarn at different count (12,10,8 lbs/spindle) exhibits 4.9, 4.6, 4.5 which is also higher than bleached yarn and dyed yarn except some special cases. The moisture content ratio results show that in the different count of woolenized yarn (12,10,8 lbs/spindle) gives 3.4% which is better than bleached and dyed jute yarn. Finally, different count of processed yarn and 100% jute yarn study shows that the woolenized jute yarn can be used for further application and decorative purposes.

KEYWORDS: Yarn, count, spinning, caustic soda, woolenization, twist, quality ratio.

I. INTRODUCTION

Jute is verily wide known and cash crop in our country [1]. Nowadays, its accessibility is increasing in a wide range to the follower of eco-friendly cost-effective product users. Hence, the fibre of this jute yarn is accepted as a golden fibre. However, the modification of jute yarn is trending toward the diversified application of the end uses [2]. One of the top research is to make the jute yarn as woolenized form to increase its versatile application [3]. It is bast fibre as a form of two species such as Tossa jute and white jute. Jute is consisting high specific properties, less abrasive behavior, good dimensional stability and good drapability. Presently, it is used as a zeo-textile product in road and highways also rural pavement construction. The use of this product is increasing day by day to save the environment from the effect of synthetic products [4].The most significant natural fiber in the world is wool [5]. Complicated proteins make up the hair on animals. For textile wool, the hair of sheep and goats is especially crucial. Animal fiber is therefore of paramount importance. It derives from the woolly coats of sheep, goats, camels, etc [6]. When we first enter the world, one of the things we encounter is wool. Baby wears woolies because they are cozy and breathable. Wool clothing is durable and healthy [7]. Each fiber in a crimp stands apart from its neighbors and is used to make blankets, carpets, jackets, suits, and other clothing, as well as other items. As a result, wool is widely used in textile items around the world. The demand for wool fiber is enormous in our expanding globe [8]. The method of woolenizing jute involves treating the fiber with a potent alkali to significantly enhance its look, grip, and blend-ability. Its physical structure undergoes significant alterations, such as lateral enlargement and significant length shrinking. This happens as a result of the fiber's high degree of crimp or waviness and its softness to the touch [9]. The crimp gives the fiber a wool-like

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look, and the finished fiber is known as woolenized jute fiber. The effect of woolenization on jute yarn has shown a remarkable change in physical and chemical properties and the structure of jute that turned into nearly as wool. As a result, the yarn becomes soft to touch and develops a high degree of crimp or waviness. Shahid et al. [10] reported that the physical properties of the yarn are very important for post-spinning operations. Datta et al. [11] also reported that the sulphonation of jute fiber is more beneficial than other existing procedures in modifying the properties of jute fiber. However, the main limitation of jute is its stiffness, and also the yarn is coarse compared to wool [12]. Wool is widely used in the world as textile product. In our growing world, wool fiber is very much needed [13]. The price of wool yarn is much higher than jute yarn. So, if some wool can be replaced by woolenized jute yarns, it would be a better-diversified use of jute. But the systematic study of the different physical properties of jute fibers, 100% jute yarns &woolenized jute yarns is yet to be known.

II. MATERIALS AND METHODS

In this study, white tossa jute was selected to produce 8,1,10/1, and 12/1 Ib/spindle yarn. Fiber processing and spinning were performed in the BJRI laboratory Bangladesh. Jute fibres were opened manually, and after sandwich hand blending, the feed lattice was used to open and blend the fibers to be spun, followed by jute softener, breaker card, and finisher card. The four types (100% jute yarn, woolenized jute yarn, bleached jute yarn and dyed jute yarn) of sample were prepared according to the desired shape for the physical tests. 100% jute yarn: 100% jute yarns, prepared in the flyer spinning machine of the experimental spinning mill of BJRI, were collected in the bobbin form. Then they were used for the next process.

Preparation of woolenzed jute yarns: Our ultimate end product of the investigation is woolenized jute yarns. For this purpose, at first, the 100% jute yarns, prepared of the bobbin form in the flyer spinning machine, were turned into hank form by the hank machine in the experimental spinning mill of BJRI. Then the 100% jute yarns of hank form were used for the preparation of woolenized jute yarns. Then the woolenized jute yarns were prepared in the wet processing laboratory of BJRI. The jute yarns of hank form collected from the hank machine of the experimental spinning mill in BJRI, were treated with caustic soda in the caustic bath of wet processing department of BJRI for a batch of 50 kgs jute yarns. The caustic soda was mixed about 15%-20% according to water. The water in the bath was 3500 liter. The process was done in the room temperature for about 20 minutes. As a result, the jute yarns became soft to touch & developed some feeling as wool. In the caustic treatment process, the main part of woolenization was completed. The 100% jute yarn was treated under bleaching medium to bleach the jute yarn as a collection of bleached samples. The jute sample yarn was dyed under dyeing lab to bring out the sample size according to the mechanical test parameter. All yarn samples were kept under standard laboratory conditions (20 ± 2 °C and 65 ± 2% RH) for 24hrs before testing as per ISO 139. The sample were tested to measure the count, twist per inch, and moisture content.

III. RESULTS AND DISCUSSION

The physical properties is divided into three parts. We discussed the variation of the count, twist, and moisture content of the yarn at four different stages for different counts. This study enables us to understand the effect of the four different stages on the count, twist, and moisture content of the yarn. They are discussed below:

Count: Count is the numerical expression that expresses the coarseness or fineness of the yarn. The Textile Institute defines the yarn count as the “number indicating the mass per unit length or the length per unit mass of yarn. There are two types of yarn count systems, i.e., direct, and indirect count; jute yarn count belongs to the direct count system.

The number of weight units per length unit is the yarn count in this system. The mass per unit length is indicated by the count number. As a result, the greater the count, the coarser the yarn. The length of the yarn is fixed under the direct count system, but the mass of the yarn fluctuates depending on its fineness.

The formula for deriving jute count is given below:

"N=“l×W" /"L" ×100%

Here, N = count of yarn.

W = The weight of the sample (pounds).

L = The length of sample(yards).

l = The unit length of the sample (yards).

The count of every step of yarns was measured by the count measuring instrument of the experimental spinning mill of BJRI. The mean counts of jute that were prepared show slight variation from their actual count as shown in Figure 1. But this variation is not too high as the coefficient of variation suggests(5.509%, 7.243%, 5.683% for 8, 10, and 12 counts respectively). This also indicates

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the precision of our estimates is within range and the overall count is consistent throughout the sample.

The mean count significantly reduces for Woolenized jute yarn. During the woolenization process, jute yarns were treated with NaOH. As a result, wax, lignin & other foreign materials were removed from the yarn as they form compounds after reacting with the NaOH. So the Woolenized yarns became lighter than the jute yarn. From the formula of jute count, we see that if the weight of the jute yarn decreases, the count of the jute yarn decreases. Therefore the mean count drops for each count of jute yarn after the woolenization process.

The mean count for Bleached jute yarn drops slightly from Woolenized jute yarn. During the bleaching process, jute yarn is treated with H2O2 to make the yarn white, which further removes various chemicals.So the weight of yarns is reduced. Using Hydrogen Peroxide causes a very slight decrease in weight that is why the count is decreased by a small amount.

During the dyeing of yarns, the dyeing chemicals and the amorphous molecules are set in the yarns. So the weight of the yarn increased. Hence the count of dyed yarns also increased.

Out of all the counts of jute prepared only during woolenization of the yarn, we saw the coefficient of variation is the least out of all the counts. We observed that the value of the coefficient of variation to be the least for 12 counts of yarn at 1.795%. All the other counts showed more butacceptablelevels of C.V. which signifies that the woolenization process produces the most favorable outcome. More C.V. means more variation from the mean count of jute. So it is ideal for the C.V. to be as small as possible as low C.V. ensures integrity and consistency of the yarn count.

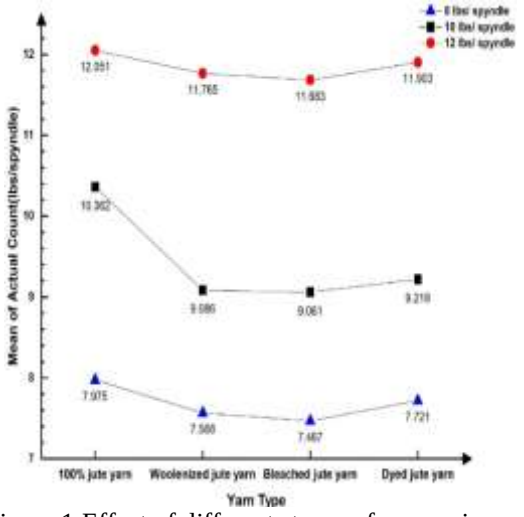

Figure 1:Effect of different stages of processing on the mean of actual count of jute yarn at varying counts

b) Twist: Twist is an important physical property of jute yarn. The number of turns per unit length of yarn is expressed as turns per meter (TPM) or turns per inch (TPI). To increase the tensile properties & strength of yarns, the presence of twist in the yarn was needed. The higher the twist more the yarn strength, till the optimum twist is reached. The twist of different types of yarns of 3 (three) counts was measured in a twist tester machine of the JTPDC wing in BJRI.

Figure 2 illustrates the progressive change in twist of the jute yarn for different stages of the yarn processing. After woolenization,the length of the samplewas decreased because the yarn loses weight and becomes bulkier. Due to the bulking up of yarn, it shrinks up a bit. Due to this shrinkage of yarn, the number of twists increases per unit length of the sample. After bleaching of the yarn, the TPI value decreases ever so slightly. After the dying of the yarn is completed, the final twist count is found to be always higher than the start of the process indicating that the strength does not deteriorate over the whole process.

When the count is increased, the weight of the sample is also increased.Sothe number of fibers in the yarn is higher. As a result, twist decreases with the increase of count.

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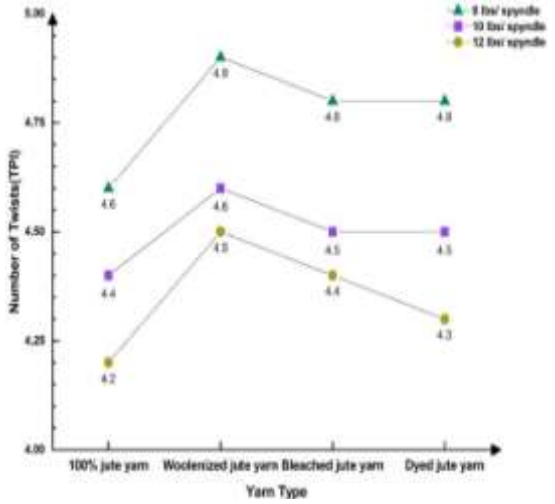

Figure 2:Effect of different stages of processing on the number of twists of jute yarn at varying counts

c) Moisture Content:Moisture content is another important physical property for jute yarn. The amount of moisture present in the yarn at the standard atmospheric condition is calledthe moisture content of the yarn.The moisture content of different jute yarnsof different counts (8,10& 12 lbs/ spyndle) was measured by the moisture content tester instrument of the JTPDC wing in BJRI.

During woolenization of the yarn, weight reduces significantly as the chemical reaction tends to take away the water molecules from the yarn. That is why the moisture content also drops significantly with loss in weight. After the end of dyeing, water molecules are absorbed by the yarns. So the moisture content is increased.

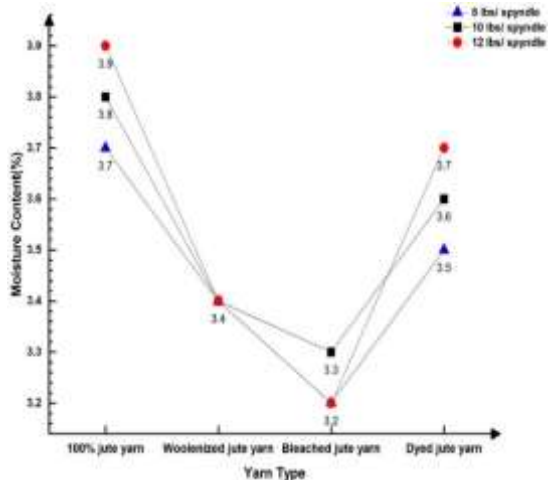

Figure 3:Effect of different stages of processing on the moisture content of jute yarn at varying counts

IV. CONCLUSION

In this study, the result reveals that woolenized jute yarn shows count variation a little bit compared to the 100% jute yarn due to not being processed as like other different count processed yarn. The count changes show that woolenized jute yarn count 11.76, 9.08, 7.568 lbs/spyndle (12,10,08 lbs/spyndle) which is higher than bleached jute and dyed jute yarn. The number of twist per inch of woolenized jute yarn at the different count (12,10,8 lbs/spindle) exhibits 4.9, 4.6, 4.5 that is also higher than bleached yarn and dyed yarn except some special cases. The moisture content ratio results show that in the different count of woolenized yarn (12,10,8 lbs/spindle) gives 3.4% which is better than bleached and dyed jute yarn. Finally, different count of processed yarn and 100% jute yarn study shows that the woolenized jute yarn can be used for further application and decorative purposes.

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