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ANALYSIS ON THE RESULT OF EXEMPTION PARAMETERS OF THE FINISHER CARD MACHINE ON THE PHYSICAL PROPERTIES OF ALL JUTE AND JUTE-ACRYLIC BLENDED YARN

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ABSTRACT

Mahabubuzzaman AKM, Rashid MR, Ahmed F, Azad AK, Ehsan MN (2012) Analysis on the result of exemption parameters of the finisher card machine on the physical properties of all jute and jute-acrylic blended yarn. *Ins. Engg. Tech.* 2(1), 21-24.

Carding is an important step in processing line of jute spinning. A cylinder is the heart of the whole carding machine due to the carding action, which causes from its cylinder speed and other rollers. This action occurs in breaker card and finisher card machine. This study was carried out to find out the effectiveness of various delivery roller speeds of finisher card cylinder on quality of jute-blended yarn 241 tex (7 lbs/spy). An assessment of the quality of 241 tex (7 lbs/spy) yarns spun from the 100% raw jute and jute acrylic blend were made in terms of their physical properties. The results were compared with those of the 100% jute yarns. Raw jute was blended with acrylic and their blended yarns were manufactured mainly to take advantage of value addition and to produce better yarn of jute fibre. For spinning jute acrylic blended yarn, jute fibre was mixed with acrylic in the ratio of 80% jute and 20% acrylic. Medium delivery roller speed (1830 inch/min) of the finisher card cylinder is better than any other speeds for good quality of jute blended yarn. The physical properties of the produced yarns such as load at break, strain percentage, tenacity at break, textile modulus, and quality ratio were tested. Some empirical relations have been developed between the processing parameters of the machine and physical properties of the yarn. The developed equations are valid within the experimental region.

Key words: *carding, spinning, cylinder, speed, quality and jute yarn*

INTRODUCTION

The most common operated jute-spinning system consists of two stages of carding, followed by three stages of drawing and finally a spinning stage. In the first carding stage the long lengths of fibre are passed through a breaker card, which breaks the continuous mesh of fibre into separate fragments, conveniently called “entities”, which are akin to the single fibres of cotton and wool. In addition to fragmentation, the pins of the breaker card have a cleaning action by removing loosely adhering non-fibrous matter from the fibre proper. Sliver from the breaker card is then passed through the second, or finisher card which causes a little more fibre breakage and provides further opportunity for removal of non-fibrous matter. In addition, the finisher card has an important mixing effect, since a number of slivers are fed to the card in parallel and emerge finally as a single sliver (Goswami *et al.* 1977).

In the three drawing stages, gill pins fixed to faller bars control the movement of fibre. In modern drawing frames, the faller bars move on spiral screws, although some spinners prefer the push-bar method for the first stage. At all stages, drawing is accompanied by appropriate doubling of the input slivers. The output sliver from the first drawing stage then passes to the frame, where its linear density is reduced suitably for the yarn being spun, after which the required twist is inserted. Almost universally in the jute industry, the insertion of twist is performed by overhung flyer, with the yarn a frictional drag. Other methods of inserting twist by ring or pot spinning are available but are little used, and then only for yarns of higher linear density (Mahabubuzzaman 2007).

Before 1940s, jute yarn was mainly spun from rove, the output sliver from the third stage of drawing being given a small twist to hold the fibres together for transport to the spinning frame. Productions of rove in this way is, however, a slow process, and during the 1950s spinning used to be done directly from third-drawing sliver. To hold the fibres together, the sliver is passed into a crimping box, which gives it small crimp. This is just as effective as twist, but is also a much faster process.

Control of fibres on the spinning frames, when sliver spinning was first introduced was by one or more weighted rollers- the “slip-draft” system. More recently, the “apron-draft” system was introduced, whereby fibre control was affected either by a double-apron arrangement or by a single apron pressing the fibres against a lower fixed metal plate in position as previously, when wrapped round a flyer leg. The rigid flyer results in a reduced tension, compared with the two-legged one, also permits large bobbins to be used. In commercial spinning, it is interesting to note that the spinning limit with a slip-draft frame fitted with two-legged flyer is commonly taken as about 210 tex, whereas the combination of apron-draft and rigid flyer lowers the limit to about 140 tex, with similar good quality fibre (Mahabubuzzaman *et al.* 2007).

Careful preparation of fibre before presentation to the breaker card is necessary if the best results are to be obtained from the spinning system. Application of water, to soften the fibre, and oil to lubricate it is essential, except where oil is undesirable for a particular end-use, in that case a non-oily lubricant must be used. The liquids are usually applied in the form of oil-in-water emulsion, the composition and rate of application, being controlled to give the desired add-on of both water and oil.

If the breaker card is to be hand-fed with long jute, the lengths of fibre are first passed through a series of heavy fluted rollers on a just softener, a machine that is also used for preparing cuttings. If, however, the breaker card is to be fed from rolls of fibre spreader is used to from the rolls. This is similar to the Goods machine used in the hard-fibre industry, and emulsion application takes place through either softener or spreader. Jute has long been recognized as a cheap, strong, durable fabric suited for sacks, bags and many other purposes. About 80 percent of all jute finds its way into packing of one sort to another. The actual weight of jute used per ton of transportable materials depends on local variations in sack dimensions, whether the goods are for export, whether the bag is returnable, reusable or not and so on (Mahabubuzzaman *et al.* 2002).

Jute fibre is naturally hard and brittle and breaks off with abrasion; resistance to mechanical wear is low and not durable especially on exposure to moist warm humid conditions. In jute spinning carding plays an important role on whole process. The object of carding is to break down and fleece-out the long strips of jute and to convert them into a continuous broad ribbon of line fibres called sliver. This sliver must be as uniform in size and texture as possible and it must have a definite weight for a definite length. Two main functions, which take place in carding, are (a) carding and (b) stripping. These two main functions are dependent for their activates upon the method of pinning number of pins per square inch, the manner in which the two active surfaces are placed in relation to each other and their surface speeds. As jute is fed in the finisher card machine, the pins of the faster moving cylinder split-up and vigorously comb away the ribbon of fibres so that it is fleeced out and carried on the cylinder. Pins of the cylinder are set at such an angle so that the material is being combed. This combing action plays a vital role for uniform carded sliver i.e., good quality yarn. But excessive speed of cylinder occurs damages of fibres. So, this study is carried out to find a suitable delivery roller speed of cylinder, which involves optimum combing action and parallelization of individual fibre to spin blended jute yarn.

MATERIALS AND METHODS

One type of jute fibre Bangla white B (BWB) grade was procured as raw material for this experiment. Only Jute fibre was piled with the application of 25% normal emulsion (i.e. 20% mineral oil, 79.7% water and 0.3% nonidet) and kept for 48 hours for maturation. The entire piled jute was processed on breaker card machine for producing 241 tex. (7 lbs. /spy) all jute yarn (Miazi 2002).

Fig. 1 Finisher Card Machine

Separately acrylic fibre and BWB grade of jute fibre were taken by weight as per blend ratio (Jute: acrylic=80:20). Jute fibres were piled with required emulsion and kept for 48 hours for maturation. The acrylic fibres were separated and opened up manually by hand teasing and tufts of certain weights were made. After that the blending was carried out by spreading the component fibres i.e. jute and acrylic fibres in desired proportion (jute: acrylic=80:20) by weight over the Breaker card lattice. The total fibre was processed through Breaker card, Finisher card & the drawing line (1^{st}, 2^{nd} & 3^{rd}) for spinning yarns of 241 tex blended jute yarn.

The entire piled jute was processed through finisher card machine by changing the gears of the cylinder in five positions i.e. 54, 58, 60, 66 and 68 for 1453, 1560, 1614, 1775 and 1830 inch/min delivery speeds respectively for producing 241 tex (7 lbs. /spy) yarns. These delivery speeds have been calculated in the following way:

The R.P.M. of Motor is 725, Motor pulley diameter is 7 inches and that of machine pulley is 34 inches. The R.P.M. of machine pulley, cylinder, cylinder pinion and stripper driving pulley all become the same, i.e. 725 x 7”/34”x π/ π =149.2 rpm. The delivery speed (inch/min)= cylinder rpm x (number of teeth cylinder change pinion/no. of teeth in delivery wheel) x л x diameter at delivery roller. Here, number of teeth in delivery wheel is 74 and diameter of delivery roller is 4.25 inches (Ahmed 1966).

Slivers of 5 yards length taken randomly from the breaker card and processed with each of the different delivery speed were weighed. The five different slivers obtained from breaker card were further processed through all the stages of conventional jute processing and 241 tex (7lbs. /spy) yarns were spun. Finally, the spun yarns were tested as per standard methods.

RESULTS AND DISCUSSION

BWB jute fibre and acrylic fibre were (80:20) processed with different drafts at fixed doubling at three drawing frames to spin 241 tex blended jute yarn. Results obtained from the experimental machine i.e. finisher card machine were discussed below. The all jute yarns and blended yarns thus obtained from slip draft spinning frame were then studied to assess their physical properties e.g. count, cv% and quality ratio etc. The above properties were determined by using standard testing equipment as per standard methods of testing (Spiegel 2003-2004). The results were as follows:

Table 1. Physical properties of 241 tex all jute yarn at different delivery speed of cylinder in finisher card machine

Delivery speed of cylinder (inch/min.)	Load at Break (Kgf)	Strain at Break (%)	Tenacity at Break (N/Tex)	Textile Modulus (N/Tex)	Quality Ratio (%)
1453	2.31	1.901	0.094	5.118	72.752
1560	2.610	1.918	0.106	5.757	82.200
1614	2.82	1.915	0.115	6.207	88.814
1775	2.95	1.889	0.120	6.453	92.908
1830	3.05	1.789	0.124	7.208	96.058

In this experiment, eleven slivers received from the breaker card were placed side-by-side at the feed end of the finisher card and fed into this machine. These slivers were processed through finisher card machine by changing the gears of the cylinder in five positions i.e. 54, 58, 60, 66 and 68 for 1453, 1560, 1614, 1775 and 1830 inch/min delivery speeds respectively for producing 241 tex all jute yarns and blended jute yarns. These delivery speeds have been calculated in the following way:

Table 2. Physical properties of 241 tex blended jute(jute:acrylic=80:20) yarn at different delivery speed of cylinder in finisher card machine

Delivery speed of cylinder (inch/min.)	Load at Break (Kgf)	Strain at Break (%)	Tenacity at Break (N/Tex)	Textile Modulus (N/Tex)	Quality Ratio (%)
1453	2.970	2.278	0.105	4.767	82.881
1560	3.220	2.278	0.114	5.252	87.743
1614	3.410	2.219	0.121	5.796	92.124
1775	3.600	2.497	0.127	5.210	96.195
1830	3.800	2.592	0.132	5.146	103.547

The R.P.M. of Motor is 725, Motor pulley diameter is 7 inches and that of machine pulley is 34 inches. The R.P.M. of machine pulley, cylinder, cylinder pinion and stripper driving pulley all become the same, i.e. 725 x 7”/34”x π/ π =149.2 rpm. The, delivery speed (inch/min)= cylinder rpm x (number of teeth cylinder change pinion/no. of teeth in delivery wheel) x л x diameter at delivery roller. Here, number of teeth in delivery wheel is 74 and diameter of delivery roller is 4.25 inches. Slivers of 5 yards length taken randomly from the finisher card and processed with each of the different delivery speed were weighed and the % CV of the weight of the finisher card slivers was calculated. Three different slivers obtained from finisher card were further processed through all the stages of conventional jute processing to spin 241 tex yarns. Finally, the spun yarns were tested (Stout 1988).

It was observed that with the increase of gear teeth of the cylinder, that is, with the delivery speed of the cylinder, CV % of the weight of the finisher card slivers decreased, indicating better uniformity in the sliver weight. Five different delivery speeds i.e.1453, 1560, 1614, 1775 and 1830 inch/min respectively on the finisher card machine were attained by changing gears in the finisher card cylinder. The effect of the speed variations on the quality of the yarns of 241 tex in terms of actual count, load at break, strain at break, tenacity at break, textile modulus and quality ratio were studied.

The finisher card machine was operated for different speeds. The results obtained in the experiment are plotted in figure 2.

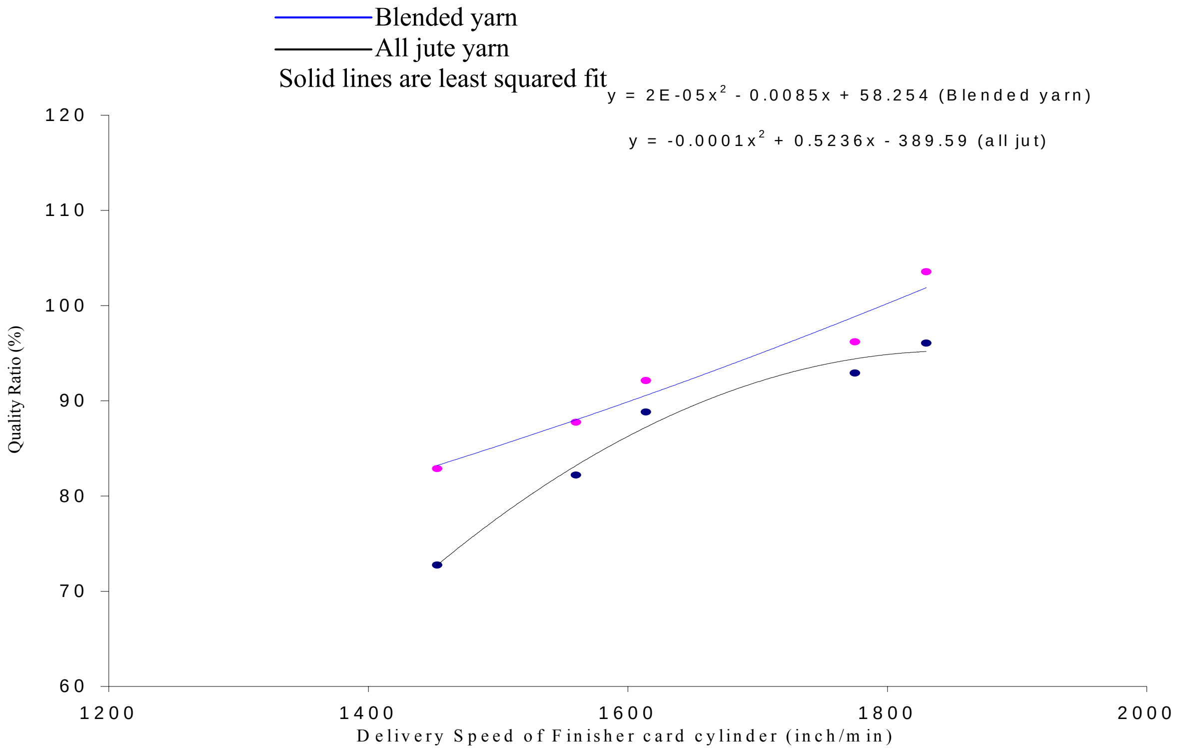

Fig. 2. Quality ratio vs Delevery speed of Finisher card cylinder of 241 tex all jute yarn and blended yarn

It was observed that with the increase of delivery speed, CV % of the weight of the finisher card slivers begun to decrease gradually. It can be seen from fig 2 that optimum speed of 1830 inch/min the cylinder displayed better effect in terms of quality ratio (96% and 103%) of the all jute yarns and blended yarns respectively.

CONCLUSION

By using optimum delivery speed of cylinder good quality yarn in jute spinning industry can be produced. Incidentally the optimum delivery speed of cylinder 1830 inch/minute is also the maximum speed of the machine. By using the experimental data the following empirical equations have been developed relating the delivery speed of the finisher card cylinder and quality ratio of produced 241 tex yarn, $y = -0.0001x^2 + 0.5236x - 389.59$ for all jute yarns and $y = 2E\text{-}05x^2 - 0.0085x + 58.254$ for 241 tex blended jute yarn, where x is the delivery speed of the finisher card cylinder and y is the quality ratio (%) of produced yarn and E means the multiplication of the number by the power of 10.

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