EFFECT OF FLYER SPEED ON YARN BREAKAGES IN PRODUCTION OF JUTE YARN

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Abstract: *In Bangladesh, jute mills are producing conventional yarns heavier than 275 tex. These are used as hessian, sacking, carpet backing cloth etc. For diversified uses of jute it is most essential to produce medium count yarn of 241 to 275 tex. In this regard, slip draft spinning machine has been studied. This machine is capable to produce yarn of 241 to 280 tex at flyer speed of 2900 rpm to 4850 rpm. But there is a relation between flyer speed and yarn breakages of the machine. In addition spinning efficiency of the machine also depends on the yarn breakages. Through a series of experiment, a relation has been established between flyer speed and yarn breakages of the experimental machine for production of jute yarn. From the experimental observation, it shows that for production of 241 tex jute yarn 4700 rpm flyer speed is the most suitable speed and 4800 rpm flyer speed is the most suitable speed for production of 275 tex jute yarn. In addition productivity of the machine also maximum at that flyer speed of the machine. In this experimental study, it was found that at 4850 rpm it was very difficult to spin yarn due to its random breakages. That consequently lowered the productivity. Therefore, it is necessary to select proper flyer speed for the production of yarn of particular linear density (tex). It was also observed that the number of breakages increased with the increase of flyer speed. At 2900-rpm flyer speed, the yarn breakage was 0.8/ spindle-hr and at 4850 rpm the yarn breakages is 3.5/spindle-hr. for producing 241 tex jute yarn. Almost all jute mills of Bangladesh have been slip draft spinning machine. Using proper flyer speed, which was found from the experiment, can use the machine in production of medium count jute yarn. The produced yarn can replace the synthetic/manmade fibre in the world textile market.*

Key Words: *Spinning, Tex, Productivity, yarn and Breakages.*

1 Introduction

Jute is a natural cellulosic bast fibre. It is a textile fibre of good spinnable character. Now a days Jute, textile earning 12% of total foreign currency for Bangladesh, is facing tough compatibility from cheap synthetic fibres [5]. Hence for the survival of this environment, friendly fibre, its is necessary to diversify the use of jute by making new products with raw and modified Jute, Usually coarser yarns and manufactured from Jute fibre but the flyer spinning. Ring spinning, Wrap spinning and centrifugal spinning, which we usually used to spin jute yarn, are used for medium count yarns [1].

Bangladesh earns about 70% of its foreign currency by exporting ready-made garments. However, the lion's share of earned foreign currency is spent for importing 95% of required fabrics for garments. Only 5% of required fabrics are produced locally for ready-made garments [7]. To overcome this high competition it is necessary to produce quality jute yarn by slip draft spinning frame. Through this machine, it may be possible to spin quality jute yarn, which can be used for diversification of jute such as shopping bag, furnishing fabric, decorative fabrics, finer fabrics etc. As a result, jute fibre may be used in the production of fabric that may further enhance its uses in various fields of textiles. Productivity is an important factor for any production-oriented industry. In this view for achieving maximum productivity, it has been necessary to determine the optimum parameters. The idea of this study was to determine the flyer speed and yarn breakages for maximum productivity of jute yarn 241 and 275 tex from the slip draft spinning frame.

2 Materials and Methods

BWB (Bangla white B) grade of jute fibre was taken as the raw material for the experiment. Fibre was piled with required emulsion and kept for 48 hours for maturation. Then the fibre was processed through Breaker card, Finisher card & the conventional drawing line (1st, 2nd & 3rd) for spinning yarns of 241 and 275 tex. The 3rd drawing sliver was processed for spinning into yarn with different flyer speeds in the slip draft spinning frame. In the spinning department, the slip draft-spinning machine of forty flyers was used in the experiment. James Mackie & Sons Ltd. of Ireland manufactured the original machine (flyer type). In the flyer type spinning frame, the twist is inserted into yarn by the effect of flyer speed.

2.1 Effect of flyer speeds on productivity on produced yarn

The flyer speed has various effects on productivity. It is directly related to the yarn tension during the winding of yarn on a bobbin [4]. Spinning tension and flyer speed are two closely related parameters. It has been known from the earliest days of spinning, higher flyer speed increase the yarn breaks during spinning.
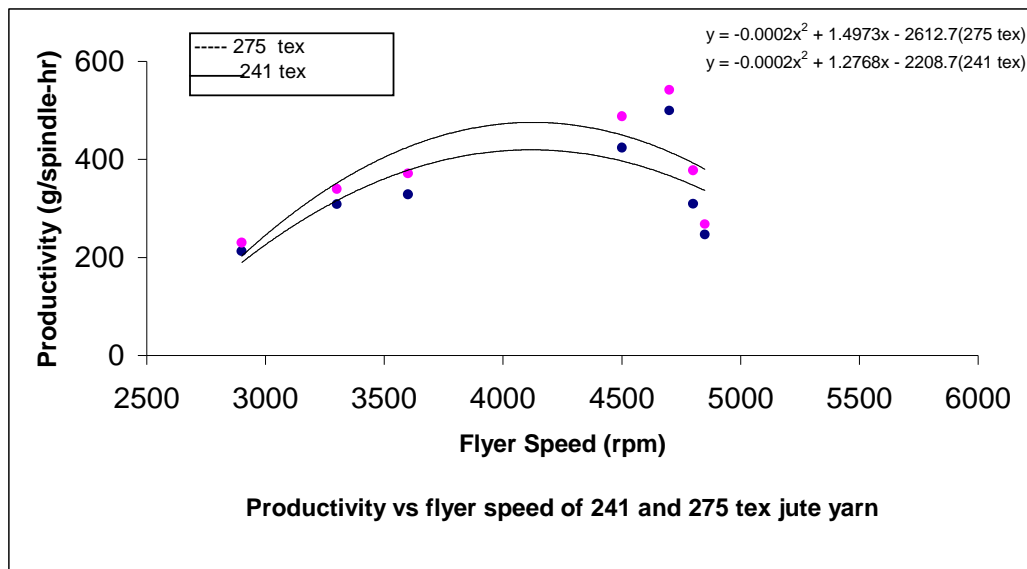

Fig. 1 Productivity vs flyer speed of 241 and 275 tex jute yarn

Flyer speed for the production of 241 tex jute yarn is found to be 4700 rpm whereas for 275 tex jute yarn it is also 4700 rpm for maximum productivity. The results are plotted in figure 1. Production of yarn through higher speed than the optimum flyer speed increased the number of yarn breaks which reduces the production rate. On the other hand lowering the speed automatically lowers the productivity [3].

An equation has been formulated between the flyer speed and productivity of the machine. The relationship is as follows: $y = -0.0002x^2 + 1.2768x - 2208.7$ for 241 tex and $y = -0.0002x^2 + 1.4973x - 2612.7$ for 275 tex jute yarn. Where x is the flyer speed (rpm) and y is the productivity (g/sp.-hr). The developed equations are valid for x = 2900 rpm to 4850 rpm.

2.2 Effect of flyer speeds on no. of yarn breakages on produced yarn

In this experimental study it was found that at 4850 rpm it was very difficult to spin yarn due to its random breakages. That consequently lowered the productivity. So it is necessary to select proper flyer speed for the production of yarn of particular linear density (tex). It was also observed that the number of breakages increased with the increase of flyer speed (fig. 2).

Initially it increased slightly up to optimum flyer speed. After the optimum flyer speed the breakages rate of yarn was higher and it followed the mathematical relationship of

polynomial type. For 241 tex it followed $y = 1E\text{-}07x^2 + 8E\text{-}05x - 0.3154$ for 241 tex and for 275 tex it followed $y = 2E\text{-}07x^2 - 0.0003x + 0.2063$ for 275 tex, Where, y = number of .

yarn breakages and x = flyer speed (rpm). The equations are valid for x = 2900 rpm to 4850 rpm.
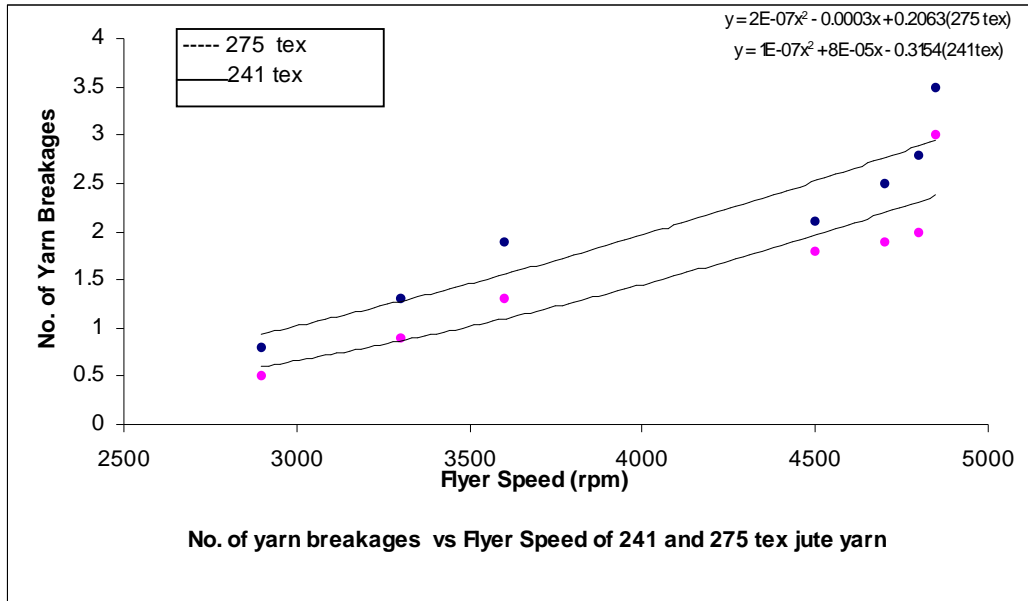

Fig. 2 No. of yarn breakages vs. Flyer Speed of 241 and 275 tex jute yarn

3 Results and Discussions

BWB jute fibre was processed through different flyer speeds at fixed draft of 11 along with different levels of twist to spin 241 tex and 275 tex [2]. After spinning, the physical properties of the yarn were measured.

Table 1 Physical properties of 241-tex jute yarn at different flyer speed in Slip Draft spinning Frame

Flyer Speed (rpm)	Load at Break (Kgf)	Strain at Break (%)	Tenacity at Break (N/Tex)	Textile Modulus (N/Tex)	Quality Ratio (%)
2900	3.060	1.905	0.124	6.661	95.683
3300	3.100	2.023	0.125	6.293	96.648
3600	3.040	1.983	0.123	6.620	96.288
4500	2.890	2.259	0.117	5.221	89.859
4700	3.130	1.984	0.127	6.663	97.596
4800	3.040	1.648	0.123	7.697	92.436
4850	2.530	1.707	0.102	6.189	77.462

Table 2 Physical properties of 275-tex jute yarn at different flyer speed in Slip Draft spinning Frame

Flyer Speed (rpm)	Load at Break (Kgf)	Strain at Break (%)	Tenacity at Break (N/Tex)	Textile Modulus (N/Tex)	Quality Ratio (%)
2900	3.210	2.219	0.103	5.198	88.368
3300	3.200	2.360	0.110	4.661	87.851
3600	3.200	2.299	0.113	4.981	87.306
4500	3.440	2.553	0.122	4.886	93.971
4700	3.380	2.239	0.120	5.406	91.825
4800	3.540	2.514	0.124	5.016	96.463
4850	3.100	2.298	0.110	4.821	84.682

Table 3 Productivity of 241 tex jute yarn at seven different flyer speeds (Draft 11, Twist 189 tpm)

No. of	Yarn productivity (g/ spindle -hr) through different flyer speeds (rpm)						
Exp.	2900	3300	3600	4500	4700	4800	4850
1	109	135	188	208	260	205	170
2	105	130	190	210	253	211	160
3	107	122	175	185	245	210	155
4	103	140	185	195	250	215	140
5	110	130	190	210	255	217	165
6	110	135	190	204	265	202	146
7	103	128	186	195	264	205	155
8	102	130	188	210	252	212	162
9	105	136	192	198	253	215	150
10	105	134	179	205	255	208	157
Mean	105.9	132	186.3	202	255.2	210	156
SD	3.63	5.05	5.39	8.45	6.21	4.96	8.96
CV%	3.43	3.82	2.89	4.18	2.43	2.36	5.74

Table 4 Productivity of 275 tex jute yarn at seven different flyer speeds (Draft 11, Twist 181 tpm)

No. of	Yarn productivity (g/ spindle -hr) through different flyer speeds (rpm)						
Exp.	2900	3300	3600	4500	4700	4800	4850
1	136	165	248	218	245	250	231
2	130	180	240	220	235	252	226
3	140	200	255	215	240	242	235
4	125	170	265	235	250	255	236
5	150	210	250	220	253	265	241
6	117	199	254	230	235	255	229
7	125	195	255	225	238	251	241
8	135	207	247	232	245	253	227
9	137	204	260	217	246	264	240
10	135	170	246	218	231	233	231
Mean	133	190	202	223	240	252	238
SD	9.21	17.04	7.30	7.03	6.20	9.41	5.71
CV%	6.92	8.50	2.89	3.15	2.58	3.73	2.40

Table 5 Flyer speed-Yarn Breakage/spindle-hr of 241 and 275 tex jute yarn

Flyer speed (rpm)	2900	3300	3600	4500	4700	4800	4850
Number of yarn breakages (241 tex)	0.8	1.3	1.9	2.1	2.5	2.8	3.5
Number of yarn breakages (275 tex)	0.5	0.9	1.3	1.8	1.9	2.0	3

To determine the effect of flyer speed on twist of all jute yarn of 241 tex and 275 tex in the slip draft spinning frame, it is found that tpm varies with the variation of speeds. From table-1, it was noted that quality ratio gradually increased with the increasing of spindle speeds. At 4700 rpm, tpm was found 189 along with a quality ratio of 97.596%.

From table-2, it was found that with the variation of speeds, tpm varied and followed an increasing trend. Moreover, it was shown that actual twist inserted in the yarn was reduced with the speeds, although a fixed twist was set. Here at 4800 rpm, quality ratio is also satisfactory i.e. 96.46%. In table-3, it was noted that at different rpm, with increase of flyer speeds productivity increased gradually. The yarn spun at 4700 rpm was found to possess 255.2-g/ spindle -hr with higher quality ratio of 96.64%.

In table-4, it was also noted that at different rpm, with increase of flyer speeds productivity increased gradually. The yarn spun at 4800 rpm was found to possess 252-g/ spindle -hr with higher quality ratio of 96.46%. In this experiment, effect of rpm

variation on quality and productivity of yarn along with its different speeds was studied. From this study, it was noted that with the changes of speeds, quality and productivity were varied. Jute yarn of 241 tex and 275 tex spun at flyer speed of 4700 and 4800 rpm with an actual optimum twist level of 189 tpm and 181 tpm respectively achieved the highest productivity. These are better result of yarn in comparison to others. From table-5, at 2900-rpm flyer speed the yarn breakage was 0.8/ spindle-hr and at 4850 rpm the yarn breakages is 3.5/spindle-hr. for producing 241 tex jute yarn.

4 Conclusions

Almost all jute mills of Bangladesh have been slip draft spinning machine. Using proper flyer speed, which was found from the experiment, can use the machine in production of medium count jute yarn. The produced yarn can replace the synthetic/manmade fibre in the world textile market. The output of the research work has the identification of optimum machine parameters of hessian spinning frame for producing quality jute yarns having better physical properties. The findings have a direct impact on the jute industry and are able to produce better quality jute yarns by adopting the method suggested. Consequently, the use of jute fibre will be increased, which is bio-degrading and therefore environment friendly.

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