Reprint **ISSN 1997-2571 (Web Version)**

Journal of Innovation & Development Strategy (JIDS)

(J. Innov. Dev. Strategy)

Volume: 12 **Issue: 1** **December 2018**

J. Innov. Dev. Strategy 12(1): 17-22 (December 2018)

EFFECT OF CONDITIONING ON PROCESSING AND PROPERTIES OF JUTE FIBRE AND YARN

M. MANIRUZZAMAN, A.K.M. MAHABUBUZZAMAN, M.O.G. MIAZI AND AKM M. ALAM

An International Scientific Research Publisher

Green Global Foundation©

Web address: http://ggfjournals.com/e-journals archive

E-mails: editor@ggfjournals.com and editor.int.correspondence@ggfjournals.com

ISSN-1997-2571 (Online)
J. Innov. Dev. Strategy 12(1):17-22(December 2018)

EFFECT OF CONDITIONING ON PROCESSING AND PROPERTIES OF JUTE FIBRE AND YARN

M. MANIRUZZAMAN[1], A.K.M. MAHABUBUZZAMAN[2], M.O.G. MIAZI[3] AND [4]AKM M. ALAM

[1]Senior Scientific Officer, [2]Principal Scientific Officer, [3]Chief Scientific Officer, Mechanical Processing Division, Bangladesh Jute Research Institute (BJRI), Manik Mia Avenue, Dhaka-1207 and [4]Iowa State University, USA.

*Corresponding author & address: Dr. Engr. A.K.M. Mahabubuzzaman, E-mail: dr.mahabub@hotmail.com
Accepted for publication on 30 November 2018

ABSTRACT

Maniruzzaman M, Mahabubuzzaman AKM, Miazi MOG, Alam AKMM (2018) Effect of conditioning on processing and properties of jute fibre and yarn. *J. Innov. Dev. Strategy.* 12(1), 17-22.

A few number of trial batch were conducted and yarn were produced from different piling time for different grade jute fibre. For each single trial about 50 to 55 lbs of BTC, BTD, BWC and BWD grade jute fibre was taken out from pucca bales. Accurate morahs were prepared and these morahs were passed through the softener machine with simultaneous application of emulsion of requisite percent and were kept in piles for different conditioning time (0 hour, 24 hours and 48 hours). Through this process, the fibres were mechanically as well as chemically/ bio-chemically softened for making the fibres of more pliable and suitable for easy processing in the machine and transforming into yarn. Test result of bundle strength showed better in no piling condition and this strength slowly decreased with the increase of piling time. For breaker and finisher carding machine, wastage% slowly increased with the increase of piling time. The most important parameter quality ratio increased for no piling and slowly decreased with the increase of conditioning time. Over all processing, quality parameter of jute fibre for no piling is better but this process is slightly harmful for all the processing machinery. For this reason, conditioning time 24 hours is more suitable for these grades of jute fibre.

Key words: *morah, jbo, emulsifier, quality ratio*

INTRODUCTION

Jute is the golden fibre of Bangladesh. It was the main exporting item for Bangladesh till 1971. At present, jute is the second foreign currency earner next to the garments sector. Jute is one of the world's most important fibrous crops, being exceeded in quantity only by cotton. It has long been known to people and known as golden fiber (Shahid & Siddique, 2007). Jute fiber is a bast fiber obtained from the bark of jute plant containing three main categories of chemical compounds namely cellulose (58~63%), hemicellulose (20-24%) and lignin (12~15%), and some other small quantities of constituents like fats, pectin, aqueous extract, etc. Jute fiber is composed of small units of cellulose surrounded and cemented together by lignin and hemi-cellulose. The low cellulose content, coarseness, stiffness, low extensibility, low grip performance and some other disadvantages seriously restrict the raw jute fiber from spinning. So a series of wet chemical processing sequences are needed to improve the spin ability of jute. Jute is one of the cheapest, eco-friendly fibers which are renewable, light in weight and sound absorbent. Jute fiber possess some advantageous physical and chemical properties, like high tensile strength, specific stiffness, low thermal conductivity, antistatic properties and good dying ability, but has drawbacks like relative coarseness, brittleness, hardness in feel, rugged appearance, inextensibility, poor washing ability, prickliness and fiber shedding (Hongqin *et al.* 2003 & Ghosh 2004) Recently, due to the improvement of people's living standards and need for environmental protection, the demand of natural biodegradable and eco-friendly fibers is rising worldwide day by day **(**Wang *et al.* 2008).

MATERIALS AND METHODS

Four types of different grade jute fibre (BWC, BWD, BTC and BTD) were selected. JBO (Jute Batching Oil), water and emulsifier were also used for softening jute fibre. Application of emulsion was about 20% (Oil 19.5%, Water 80% and emulsifier 0.5%) (Miazi 2002). Piling time for different jute fibre was 0, 24 and 48 hours.

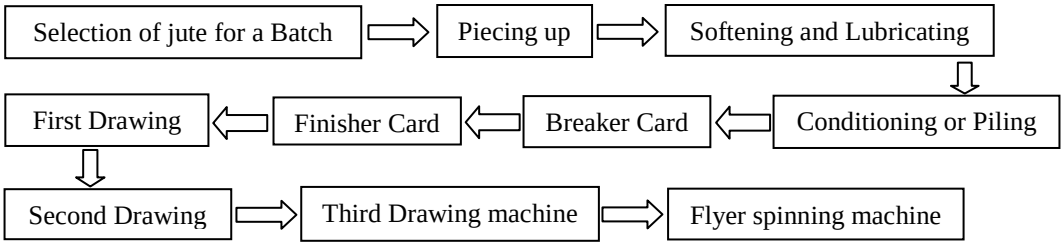
For each single trial about 50 to 55 lbs of BWC, BWD, BTC and BTD jute was first taken out from pucca bales. Accurate morahs of about 1.3 lbs weight each were prepared from the jute reeds. These morahs were passed through the softener machine with simultaneous application of emulsion of 20% and were kept in piles for different time. Through this process the fibres were mechanically as well as chemically/bio-chemically softened for making the fibres of more pliable and suitable for easy processing in the machine.

After opening the piles, the morahs of jute fibres were then fed by spreading on the lattice of the breaker card. The slivers then delivered from the breaker card, were then fed into the finisher card. The finisher card slivers were then passed through three stages of drawing and doubling; commonly known as first, second and third or finisher drawing. In other words, the jute fibre processed through the conventional back processing machinery and stages. The final jute sliver ready for spinning was obtained from third drawing frame. The linear density of third drawing sliver was controlled for requirement of flyer spinning machine to produce about 8.0 lbs/spy yarns. Ten samples of about 8lbs/spyndle were made according to the different piling time. Finally the spun yarns were tested as per standard method.

Working procedure

For this research work, about 150 to 155 lbs of BWC, BWD, BTC and BTD jute fibres were taken out from pucca bales. Accurate morahs of about 1.3 lbs weight each were prepared from the jute reeds. These morahs were passed through the softener machine (64 pair spiral roller type) with 20% application of emulsion. The recipe of emulsion was 19.5% jute batching oil (JBO), 79% water and 0.5% emulsifier. These fibres were divided into three groups for each grade. First group of jute fibre were passed through breaker card, finisher card, 1st, 2nd and 3rd drawing and spinning machine to produce about 8.0 lbs/spy yarn. Rest of the jute fibres i.e second and third group were kept for piling. After 24 hours, second group of jute fibre and after 48 hours third group of jute fibre were passed through breaker card, finisher card, 1st, 2nd and 3rd drawing and spinning machine to produce about 8.0 lbs/spy yarn. Absorption of emulsion through this process, the fibres were mechanically as well as bio-chemically softened for making the fibres of more pliable and suitable for easy processing in the machine and transforming into yarn.

Process flow chart: (Jute Basics, 2010)



RESULTS AND DISCUSSION

Absorption of emulsion (%)

Application of emulsion was 20%. Then the absorption of emulsion of jute fibre was tested through variation of weight. All the test result of these experiments was given in table 1.

Table 1. Absorb of emulsion for different grade jute fibre

Jute fibre (Grade)	Absorb of emulsion%		
	No piling	Piling time = 24 hours	Piling time = 48 hours
BTC	20.33	16.10	11.44
BTD	20.18	17.88	12.38
BWC	19.59	16.32	10.20
BWD	18.99	15.50	9.30

Effect of piling time on fibre strength

Logically a strong fibre produces a stronger yarn. Fibre strength is of no less importance. This is commonly determined by the Presley tester. This is a fibre bundle tester and the data obtained is termed as Presley Index, which is a ratio, (Bundle strength in pounds/bundle wt, in milligrams). i.e. lbs./mg. This is also expressed in units of 1000 pounds per sq. inch.

i) The Pressley Index(P.I.) = $\frac{\text{Breaking load in pounds}}{\text{Bundle weight in milligrams}}$

ii) Tensile strength in pounds per square inch= $[(10.8116 \times P.I.)-0.12](x10^3)$

iii) Tensile strength in grams per tex= 5.36xP.I.

iv) Breaking length in kilometers= 5.36xP.I. (Booth 1968**).**

Normally jute is a strong natural fibre. Bundle strength is commonly determined by the Presley tester. Fibres in a small quantity of jute, are combed and parallelized and placed in a pair of breaking clamps or jaws, in the form of a ribbon about ¼ inch wide. The fibres are cut off on each side of the jaws to provide a sample of known fixed length and the jaws are placed in the machine. After the fibre has been broken, it is removed from the jaws and weighted. The Pressley index or breaking strength in pounds per milligram is obtained. This index is converted to 1,000 pounds per square inch or gram per tex. MEAN, SD and CV% are calculated from 10 number of test (Shirley Developments Limited 1951).

Table 2. Fibre strength

	Fibre strength (gm/tex)							
	Grade C				**Grade D**			
	Raw fibre	No piling	Piling time 24 hr	Piling time 48 hr	Raw fibre	No piling	Piling time 24 hr	Piling time 48 hr
Tossa	43.01	50.54	43.48	38.56	41.69	48.01	43.16	38.16
White	41.95	50.44	45.17	36.80	38.53	49.18	38.30	35.66

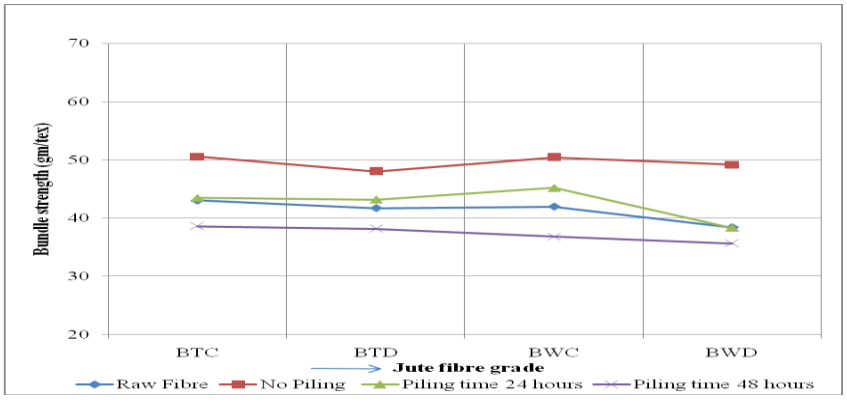


Fig. 1. Fibre bundle strength (gm/tex) test

After softener, the emulsified jute fibre bundles are kept under a cover for certain period of time. By this time, a certain amount of heat is generated within the covered jute mass which along with moisture causes microbes to grow. Due to this microbial action on jute fibres, the fibres become softened. Microbes are supposed to grow up and play an important role in jute piles. Since pectin is the main binding material between jute fibre and stem wood, the incomplete removal of pectin due to improper retting makes the jute fibre harsh, and hence difficult for processing in jute machinery. It is thought that the piling microorganisms might play a significant role by removing the gummy material of fibre, mainly the residual pectin remaining in jute fibre. As the piling time duration is increase, more microorganisms are engaged for removing the gummy material and loss its strength. The above table 2 and figure 1 shows that bundle strength of raw fibre is high. When raw fibres were contact with moisture, its strength were increasing and it was slowly decrease when conditioning time is increases.

Effect of piling time on wastage

During processing some fibres are transformed as wastage for different causes. For this research work, three groups (no piling, piling time-24 hours & piling time 48 hours) fibre from BTC, BTD, BWC and BWD grade jute passed through breaker card and finisher card machine and collect wastage. All the test result of these experiments was given in table 3.

Table 3. Wastage% of breaker and finisher card

Jute fibre grade		**B/C Wastage**	**F/C Wastage**	**Total wastage%**
BTC	No piling	1.41	0.68	2.09
	Piling time 24 hr	1.79	1.11	2.90
	Piling time 48 hr	1.98	1.14	3.12
BTD	No piling	1.48	0.68	2.16
	Piling time 24 hr	1.90	1.11	3.01
	Piling time 48 hr	2.02	1.29	3.31
BWC	No piling	1.42	0.94	2.36
	Piling time 24 hr	1.79	1.34	3.13
	Piling time 48 hr	1.80	1.27	3.07
BWD	No piling	1.45	0.96	2.41
	Piling time 24 hr	1.81	1.29	3.10
	Piling time 48 hr	1.97	1.38	3.35

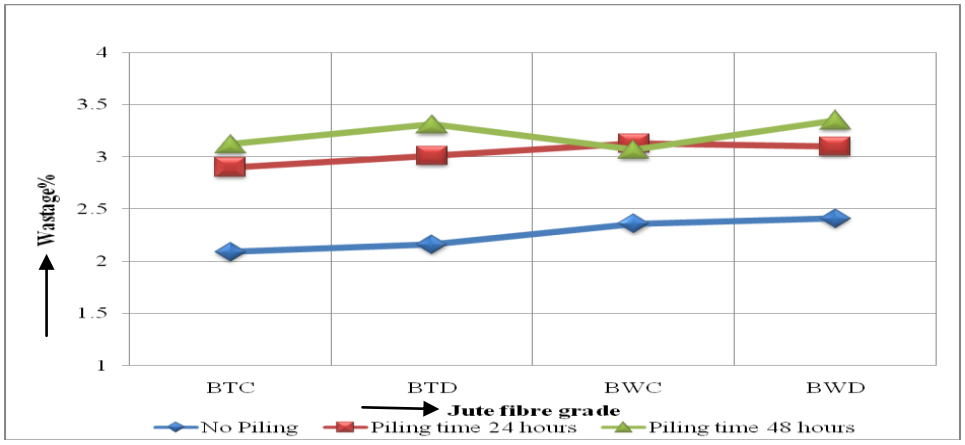


Fig. 2. Wastage% of breaker & finisher card for different piling time

Three groups of jute fibre from BTC, BTD, BWC and BWD grade were kept for piling for different time (no piling, piling time-24 hours & piling time 48 hours). For this different conditioning period, applied emulsion were entered into the fibre, soften the fibre and increases its extensibility, both of which factors prevent excessive fibre breakage at the cards, make it easier for the fibre to bend round pins and rollers, and reduce waste losses. From the table 1, it was observed that absorption of emulsion% remain more in early stage of softening and it was slowly decrease when piling time increase. In softening process, hydrolyses in presence of moisture enhances catalytic degradation of specific carbohydrates such as cellulose, hemicellulose and pectin present in hard barky root ends. On the other hand, moisture was getting away for more piling and jute fibre were drier. For this why, above table 3 and figure 2 shows that total wastage% of breaker and finisher carding machine was slowly increased when piling period was increased.

Effect of piling on yarn fineness

Yarn produced from different piling condition of different grade jute fibre in flyer spinning machine. Count of yarn was about 8 lbs/spy. Flyer speed was 4200 rpm and TPI was 4.18. Test result of these experiments was given in table 4.

Table 4. Yarn fineness (lbs/spy)

	Yarn fineness (lbs/spy)					
	Grade C			**Grade D**		
	No piling	Piling time 24 hr	Piling time 48 hr	No piling	Piling time 24 hr	Piling time 48 hr
Tossa	8.955	8.860	8.092	8.755	8.558	8.104
White	8.869	8.787	8.161	8.765	8.549	8.171

The above table 4 shows the fineness of jute yarn for different piling time. As is observed, both Tossa and White grade jute fibre, yarn count shown a little bit coarser for no piling and it was slightly lighter when conditioning time was increased.

Effect of piling on single yarn strength

The single-thread-breaking load is the most commonly used method of assessments of the strength of jute yarns. For my research work, Shirley strength tester was used. In this tester a specimen is gripped in a fixed-top jaw and in a bottom jaw which is movable. A force initially zero but increasing at a constant rate is applied to the specimen. The effect of applying this force is to extend the specimen until it eventually breaks. The loading has thus caused the elongation. Here we have C.R.L. conditions. Sample specimen length was 50 cm and take 10 number of test was conducted for each group of jute fibre. All the test results were given in table 5.

Table 5. Single yarn breaking strength

	Breaking strength (gm/tex)					
	Grade C			**Grade D**		
	No piling	Piling time 24 hr	Piling time 48 hr	No piling	Piling time 24 hr	Piling time 48 hr
Tossa	11.799	11.139	10.869	11.240	10.888	10.602
White	11.423	10.935	10.777	10.863	10.594	10.338

From the Shirley strength tester, we get the breaking load in kg. Then it is converted into gm/tex. From the table 5, we see that breaking strength of jute yarn for no piling was better and it was slightly decreases with conditioning period were increase.

Analysis of quality ratio test results for different jute fibre

Quality ratio is a property of jute yarn which indicates the load at break. Quality ratio was directly related with yarn strength and its count. Usually high tenacity at break gives maximum quality ratio for yarn. Table 6 shows the quality ratio% of different piling time of tossa and white jute fibre.

Table 6. Quality ratio of jute yarn

	Jute Fibre grade			
	Bangla Tossa C (BTC)	**Bangla Tossa D (BTD)**	**Bangla White C (BWC)**	**Bangla White D (BWD)**
No piling	89.60	85.35	86.74	82.49
Piling time 24 hr	84.59	82.68	83.04	80.45
Piling time 48 hr	82.54	80.51	81.84	78.50

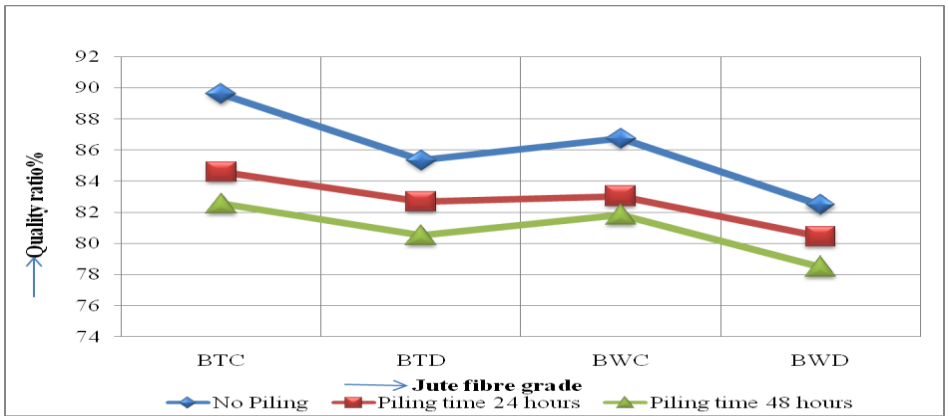


Fig. 3. Quality ratio% of yarn for different piling time

From table 5, single yarn breaking strength shows better result for no piling condition for both grade of fibre. Quality ratio was directly related to its breaking strength. As a result, quality ratio% shows better for no piling and it was slightly decreases with conditioning period were increase.

CONCLUSION

The objective of the present research is to assess the physical and mechanical properties of jute fibre and yarn for different conditioning period. In this work, few number of trial batch are conducted and produced yarn for different piling time of different grade jute fibre. In this chapter, the summary of the results discussed earlier in the thesis is presented and possible extensions of the present research are recommended.

The following are the conclusions of the work done under the present investigation:

- Bundle strength of jute fibre was high in conditioning period and when conditioning time was increase, slowly decrease fibre strength.
- Wastage% of breaker and finisher card machine was increasing with conditioning time. That is, more the conditioning time, more the wastage% of jute fibre.
- Weight per unit length of yarn i.e. yarn count has no significant effect for different conditioning period.
- The most important quality parameter Quality ratio shows better for no piling and slowly decrease with conditioning period is increases. That is higher the conditioning time, lower the quality ratio.
- Over all processing, we can see that quality parameter of fibre and yarn for no piling was better but this (no piling) processing stage is slightly harmful for all the processing machinery. In this processing, pins of cylinder, doffer, worker and stripper are damage by different action and sometimes break few pins. On the other hand, tendency of delivery roller lapping both breaker and finisher card in doffing time. For this reasons, no piling is not suitable for industrial bulk production.

REFERENCES

Booth JE (1968) Principles of Textile Testing, pp-369, 370, 389.

Ghosh P (2004) Effect of Selective Chemical Treatments of Jute Fiber on Textile related Properties and Processible. *Indian Journal of Fibers & Textile Research*, pp 29, 85-89.

Hongqin Y, Min D, Chongwen Y (2003) A preliminary Study on Chemical Degumming of Jute and Kenaf Fibers. Plant Fiber and Products, pp 25, 190-192.

Jute Basics (2010) International Jute Study Group (IJSG).. 145, Monipuripara, Tejgaon, Dhaka 1212, Bangladesh : Dot Net Limited, page-57-69.

Miazi MOG (2002) "An experimental investigation for optimisation of machine parameters in a spinning machine for production of fine jute yarn," Ph.D. Thesis, BUET, pp 31-43.

Shahid MA, Siddique MA (2007) Production of Jute-Cotton Blended Yarn with Different Blended Ratio by Rotor Spinning System. *International J. Eng. Tech*, 4(2), 114-118.

Shirley Developments Limited (1951) Catalogue No.7, pp-23-24.

Wang WM, Cai ZS, Yu JY (2008) Study on the Chemical Modification Process of Jute Fiber. *Journal of Engineered Fibers and Fabrics*, 3(2), 1-11.