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Study on Loom Stoppages in Air Jet Weaving Mill Producing 100% Cotton Fabrics

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Abstract

The work reported in this paper is concerned with the loom stoppages during weaving in an air jet weaving mill manufacturing 100% cotton fabrics. Five different constructions were studied and for each construction three different looms were studied. All types of stoppages were categorized into three classes e.g. warp related stoppages, weft related stoppages and stoppages due other causes like mechanical and electrical. It was observed that 58% stoppages were due to warp breakages, 34% stoppages were due to weft breakages and 8% stoppages were due to other causes like electrical and mechanical. The stoppage time was regarded as the time elapsed in repairing and returning the loom back to weaving. The average time to repair a warp breaks was found to be 2.87 minutes. The average time to repair warp or weft breaks were also found to vary widely depending on the location of the break.

Keywords: Loom stoppage; Warp breakage; Weft breakage; Bunch breakage; Loss of efficiency; Weaving productivity

Introduction

Bangladesh is one of the top exporters of RMG (Ready Made Garments) products in the world. Mainly two types of garments are exported e.g. knit garments and woven garments. Almost 100% knit garments are being produced from locally made knit fabric but substantial amount of woven fabrics are imported to support the woven garments export. It may be mentioned here that hundreds of weaving factories of varying sizes are in operation in Bangladesh but their economic condition is very bad. Off course in recent years the denim factories are doing very well, however for non denim i.e. lightweight fabrics, the situation is very discouraging. Price, quality and meeting the supply schedule are the key factor that dictates export oriented garments factories to import fabrics from abroad. The three factors are directly linked to the smooth operation of a weaving industry. Every stop during weaving will increase the duration of producing that particular length of fabric in that loom. Stoppages occur mainly due to yarn breakages and occasionally due to malfunction of machine. Every breakage or loom stoppage may lead to a fabric defect. Thus loom stoppages during weaving will (i) increase time to produce fabric from the warp of a particular weaver's beam and (ii) decrease the acceptable quality of usable fabric. Both the factors will directly affect the cost of manufacturing. Therefore, stoppages during weaving will have direct impact on the profitability and sustainability of any weaving industry. Nkiwane, LC. and MarasheS [1]. Found that at higher loom speed and higher warp tension warp breakages increases. They also mentioned that the weavers took on average 1.7 to 2.3 minutes to repair a warp break and 1.3 minutes to repair a weft break. However, they probably ignored the matter of different time required to repair breaks occurred in different location of the loom. Apart from this, the authors also did not differentiate clearly between warp break and weft break. Rahman M. & Amin R [2]. published work on loom efficiency and suggested that a small increase in loom efficiency can contribute to considerable reduction in weaving cost. It was also mentioned in the paper that machine maintenance also plays an important role in the efficiency of the loom [3]. They continued that the poor quality of raw material will lead to higher yarn breakage rate and productivity will be lower. Therefore, the quality of raw material must be considered. Aggarwal S.K [3]. mentioned that the warp breaks are due to tensile/abrasive failure of gross thick places and/or obstruction by them to the passage of yarn through healds and reed. He continued that the thick thin places were the major hinders for yarn breakage specially warp yarn and due to improper sizing yarn elongation and strength may hamper. Devare D [4]. showed that breakage rate is directly proportional to the stretching of the warp threads during sizing. If the stretching is high, breakage rate will be high as well. The critical moment is during shedding when the warp yarns are further stretched and a weak and or already stretched yarn breaks at that point. Patil T.C. and et al [5]. Concluded that loom-shed atmosphere is a vital factor in achieving loom efficiency. It was also found that loom shed RH affect warp breakage rate leads to frequent loom stops which in turns affects production and efficiency [6,7]. They found that the loom efficiency was the highest at 85% RH, at lower RH, the size film cracks and warp breakage increased.

The present study has been conducted to investigate the loom stoppages and their causes. Some similar works has been published earlier but over the years machinery and processes have been updated and improved to a considerable extent. Therefore, it was of interest to see whether the pattern and nature of stoppages have changed or not. Apart from this, it was thought that the location of break may also have an effect on the duration of stoppage. If a warp breaks in the back rest or near the reed then the break can be repaired by just applying a knot while a break in the drop wire and heald zone will necessitate additional time to (i) Indentify the concerned drop wire and heald wire; (ii) Thread the warp yarns through the drop wire and heald wire requiring much more time than previous types of breakages. Similarly weft breaks before and after the weft feeder/weft accumulator may

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Table 1: Details of the looms used.

Brand Name:	TSUDAKOMA	PICANOL OMNI PLUS 800
Origin:	Japan	Belgium
Shedding:	Tappet	Tappet
Picking method:	Airjet	Airjet
Selvedge:	Lino	Lino
Average RPM:	450	820
No. of machines used for data collection:	3	12

also have effect on duration of stoppage. Unfortunately the literature survey did not reveal any information about stoppage related to the location of breakage.

Methodology

Details of the looms

The work was done in an export oriented weaving factory having air jet weaving machines of Tsudakoma and Picanol brands. Details of the two types of looms are shown in Table 1. The study was conducted on five different constructions (shown in Table 2.) and for each construction three looms were involved, thus 5X3 = 15 looms were in the study.

Study of warp breakage and loom stoppage

The warp and weft breakages and loom stoppages were studied in the following three ways; (i) stoppage due to warp breakages, (ii) stoppage due to weft breakages and (iii) stoppages due to others causes e.g. Electrical and Mechanical. The stoppage time was recorded by stop watch. In taking warp stop data, it was of interest to locate the exact location of break with reference to the yarn path, in this regards the free length of warp n is divided into 4 zones as shown in Figure 1.

The four zones were (i) Back Rest to Drop Wire zone (B to D), (ii) Drop Wire to Heald frame (D to H), (iii) Heald Frame to Reed Zone (H to R), (iv) Reed Zone (R)-the distance between fell of the cloth and the back most position of reed. Details about zone wise warp breakages & stoppages are shown in Table 3. During the study of warp breakage, it was observed that warp breaks individually as well as in group. The later types of breakage were denoted as "Bunch break" and used in (Table 3,4).

Study of weft breakage and loom stoppage

Like warp breakage, the weft breakage were also studied by using stop watch, the breaks were categorized into three types, i.e., short pick, long pick and Bobbin breakage. Location of the three types of breakage is shown in Figure 2. Information about various weft breakages is shown in Table 5.

Table 2: Constructional details of fabrics used in experimental work.

Sl. No.	Warp Ne	Weft Ne	EPI	PPI	Weave	Yarn Quality	Construction ID	Loom #
1	30	30	150	90	2/1 S Twill	Combed yarn (cotton)	A	53
								54
								56
2	30	30	160	90	2/1 S Twill	Carded cotton	B	4
								15
								19
3	20	20	108	56	3/1 S Twill	Carded (AC)	C	32
								17
								2
4	30	16	148	78	2/2 S Twill	Carded (AC)	D	14
								33
								23
5	16	16	96	48	1/1 Plain	Combed yarn (cotton)	E	25
								29
								31

Table 3: Summary of Warp breakage.

Construction ID	Zone-wise stop time due to yarn Breakages												Total no. of	Total stop Time	Average Time per breakage
	B to D			D to H			H to R			R			Breakages		
	Breakage	Time (min.)	Bunch	Breakage	Time (min.)	Bunch	Breakage	Time (min.)	Bunch	Breakage	Time (min.)	Bunch		min.	min.
A	8	11.47	0	9	18.34	0	11	36.56	5	4	8.81	0	32	71.43	2.23
B	6	12.7	0	10	23.5	0	4	25.42	2	2	4.27	0	22	65.58	2.98
C	6	13.75	1	6	15.59	1	6	19.14	1	2	8.05	0	20	56.53	2.83
D	9	10.67	0	7	33.9	1	3	10.07	0	1	2	0	20	56.77	2.84
E	13	21.78	1	9	45.71	3	8	39.06	4	2	4.6	0	32	111.4	3.48
Total	42	70.37	2	41	137.04	5	32	130.25	12	11	27.73	0	126	361.71	2.87
Time/break		1.68			3.34			4.07			2.52				

Table 4: Details on bunch breakages and stoppage time.

Construction ID	No. of breakages		% of bunch Breakage	Stop time		% of stop time due to bunch Breakage	Average time/normal breakages (m)	Average time/bunch breakages (m)
	Overall	Bunch		Overall (m)	Bunch (m)			
A	32	5	13.9	76.65	18.07	21.92	2.1	3.61
B	22	2	9.1	65.58	21.67	33	2.2	10.8
C	20	3	15	56.53	15.81	27.97	2.26	5.27
D	20	1	5	56.77	14.83	26.12	2.2	14.83
E	31	8	25.8	111.4	52.67	47.28	2.55	6.6
Avg.			13.76			31.26	2.26	8.22

Table 5: Summary of Weft breakage and loom stoppages.

Construction ID	Stop time due to Weft breakages (min.) & no. of breakages.						Total Stop Time (m)
	Short pick	NS*	Long pick	NL*	Package/ initial	NP*	
A	12.15	24	1.83	3	12.57	10	26.55
B	6.03	9	6.73	8	21.37	13	36.6
C	7.75	13	14.32	15	23.62	15	45.68
D	23.65	25	8.42	12	19.73	14	49.8
E	13.61	9	7.85	7	33.61	17	55.07
Total	63.19	80	39.15	45	110.9	69	213.7
Avg. Time to repair each break.	0.79		0.87		1.6	-	-

NS: No of Short Picks; NL: No of Long Picks; NP: No of Package of Initials

Table 6: Loom stoppage due to others problem (Mechanical & Electrical).

Construction ID	Loom No.	No. stoppage due to others problem	Stoppage time due to others problem
	53	1	1.17
A	54	7	7.85
	56	2	1.5
	4	1	1.17
B	15	1	5.83
	19	0	0
	32	1	6.83
C	17	0	0
	2	0	0
	14	0	0
D	33	2	2.62
	23	2	5.42
E	25	3	7.53
	29	1	7.62
	31	3	6.83
Total		24	54.37

The short pick is a pick shorter than actual pick, by default, which cause loom stoppage. The long pick is a pick that is longer than normal pick and extends well beyond the leno selvedge area. Such problem also causes a loom stop. The breakages and stoppages between package and feeder area is known as bobbin breakage.

Others Stoppages (e.g. due to mechanical & electrical)

Apart from the warp and weft breakages, loom stops during weaving for mechanical and Electrical problem. This was recorded and shown in Table 6.

Comparison of various types of breakages/stoppages

The breakages/stoppages were noted for warp, weft and others causes and shown in Tables 3-6. Stoppages related to the three categories were summarized and shown in Table 7.

Results and Discussion

Breakages and stoppages due to warp

Relation of construction with breakage and stoppage time: Table 3 along with Figure 3 shows that the count and threads density did not have prominent effect on the warp breakage and stoppages. The number of breakages of C & D i.e. 20×20/108×56 and 30×16/148×78 were almost same though much higher breakages were expected for later construction because of finer count and greater thread per inch. This may had happened due to quality of yarn and sizing of D, apart from this fabric structure of D is also slightly different from C which may also had some influence on breakage.

The stoppage time was the highest for the construction E. Since the warp count is coarser (means higher strength) and thread density lower than other constructions, construction E was supposed to give the lowest breakage and stoppage than the other constructions. This may be due to poor yarn strength, poor sizing of the warp yarn.

Zone wise breakage and stoppage: It was mentioned in section 2.2 that we have studied warp breakage in zone wise. It can be seen in the tables 3&4 that maximum number of stoppages were took place in the D-H (drop wire to heald) zone and H-R (heald to reed) zone i.e. in the shedding zone; 42 breaks in the D-H zone and 31 breaks in the shedding zone i.e. H-R zone altogether 42+31=73 breaks. It was also observed that the time to repair a break in the D-H and H-R zone (shedding zone) was much higher than that in the B-D (back rest to

Table 7: The comparison between warp, weft and others stoppage and breakages per loom.

Construction ID	Warp		Weft		Others		No. of Total breakages	Total stop Time (m)	Average stop time per breakage (m)
	No. of Stops	Stop time (m)	No. of Stops	Stop time (m)	No. of Stops	Stop time (m)			
A	10.66	25.18	12.33	8.84	3.33	3.51	26.33	37.53	1.58
B	7.33	21.86	10	12.2	0.66	2.33	18	36.39	2.07
C	6.66	18.84	14.33	15.27	0.33	2.27	21.33	36.39	1.66
D	6.66	18.92	17	16.6	1.33	2.68	25	38.2	1.55
E	10.3	37.13	11	18.35	2.33	7.32	23.66	62.81	2.68
Total			194	213.8	24	54.4	343	634	1.85

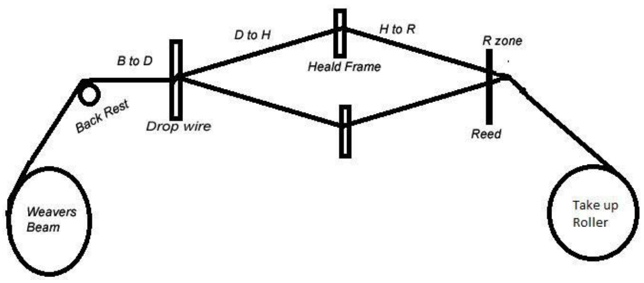

Figure 1: Schematic diagram of loom (four different breakage areas).

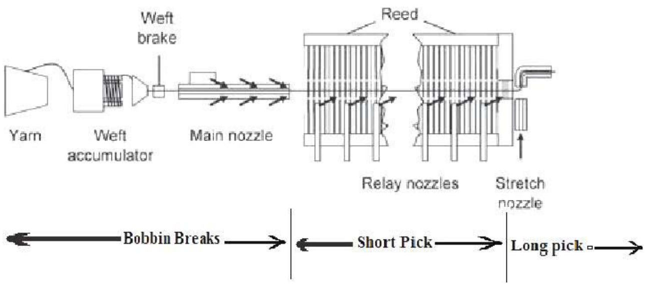

Figure 2: Zone wise weft breakage.

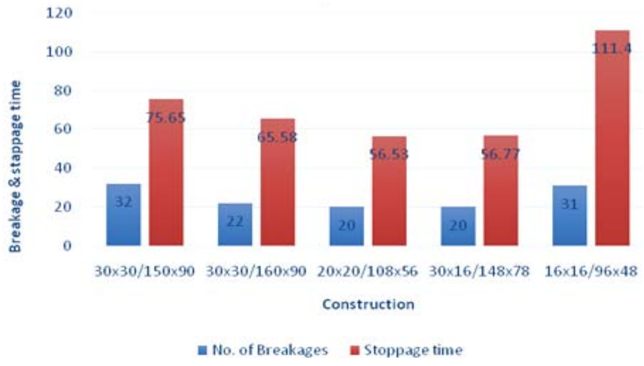

Figure 3: Relation of construction with breakage & Stoppage time.

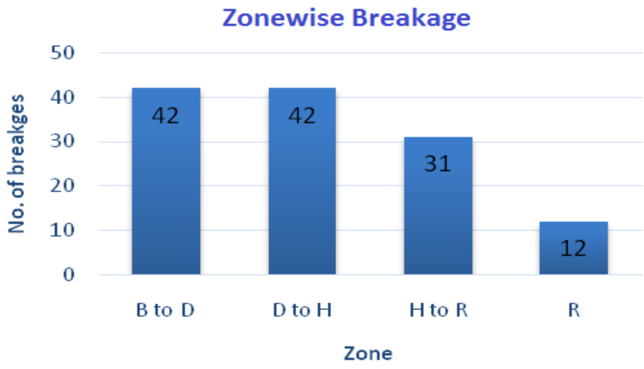

Figure 4: Comparison of number of breakages according to zone.

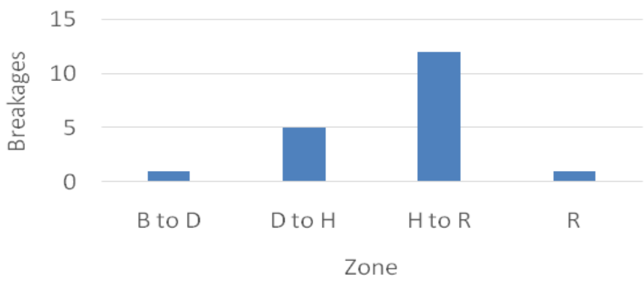

Figure 5: Bunch breakages in different loom area.

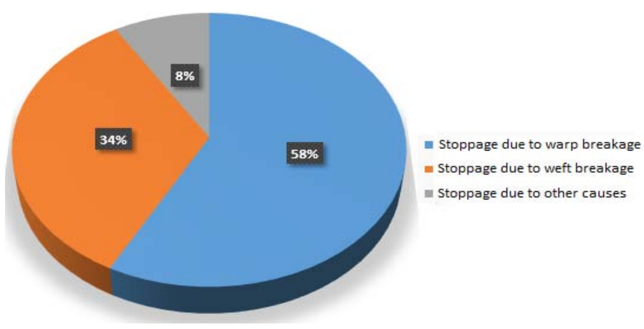

Figure 6: Percentage share of various types of stoppages.

drop wire) and R (reed) zones. It was observed that more time was taken to repair a break in the D-H and H-R zones were due to the location of the break in an inconvenient place. Apart from this extra effort is required to reach, locate the heald wire and to pass the warp through it.

Tables 3,4 and with Figure 4,5 show another feature of observation which was single end breakage and bunch breakage. The bunch breaks were the breakages where several warp threads were broken together. It was gathered that there are several reason for bunch breakages; some of the important reasons for bunch breakages were (i) the presence of lump which generated in the sizing section. Lump is a compact mass of size material that was not diluted completely. The lumps are carried forward with the yarn and during squeezing it is flattened and involves several warp yarns and then dried and carried to the weaver beam. The lumps are first obstructed in the reed of the sizing machine where the yarns are separated but a hard and rough mass is attributed in the warp yarns. As the lumps pass through the drop wire, in majority cases, the yarn breaks. When this types of bunch breakages occurs, several adjacent warps breaks together. (ii) In the cases of use of greater number of heald shafts, the rear most heald shafts need to be lifted relatively higher than other shafts causing stretch and breakage. In such case the broken threads will be distributed across the full width of the loom. (iii) Loss in elongation in winding, warping and sizing is another important reason for which several yarns may break at time; (iv) Lappers locally known as “Keora”; these are broken warp yarns in warping and sizing but not repaired. Under such cases, in sizing, a weavers beam is finished with slightly less number of warp yarns than it has been started with. During course of weaving the broken yarns appeared and if unnoticed then it entangled in the drop wire zone and cause several adjacent warp yarns to break together. (v) Apart from these poor sizing, presence of excessive knots, abrasion and flexing in the drop wire and heald wires etc. also cause bunch breakages.

The number of breaks in the backrest and reed zone was found to be 2 and 12 respectively, which are too low as compared to drop wire and heald zones. It seems that the yarns break in the back rest zone mainly due to presence of weak place and the breaks in the reed zone may be due to abrasion of a heavily abraded, flexed and stretched yarn by the reed.

Breakages and stoppages due to weft

Effect of constructional parameters on breakage and stoppage time due to weft: It seems that the characteristics of only weft yarn is mainly responsible for weft breakage and stoppage, other constructional parameters are not supposed to affect weft breakage. For air jet loom, the nature of air jet i.e air pressure is extremely important; the data suggest that the weft count did not have any visible effect on weft breakage and stoppage. In fact air pressure is always required to be adjusted for each different weft count. Therefore, weft breakage will be a resultant phenomenon of at least weft strength and air pressure. Off course, the short and long picks were not breakages but were unacceptable insertion that necessitated stoppage of the loom.

Total number of breakages and stoppage time: The total number of breakages of due to weft was 194 as compared to 125 for warp. The stoppage time is exactly opposite i.e. for warp 365.8 minutes while for weft it was only 213.70 minutes. The average stoppage time for each weft breakage was 1.10 minutes, while for each warp breakage average stoppage time was 2.93 minutes. The greater number of weft breakages (short and long pick) were probably due to problem of air jet i.e air pressure, which was almost 125 breakages and stoppages. It seems that taking proper care it would have been possible avoid these breakages and stoppages to a considerable extent.

Time for various weft breakages: It can be seen in tables 6 and 7 that the time for each short pick and long pick were 0.79 and 0.87 minutes respectively while time for a bobbin breakage was 1.60 minutes. In all cases it was required to restart the loom to insert a new weft but for repairing a bobbin break particularly before weft accumulator more time was required to thread the weft at first through weft feeder or weft accumulator. In the cases of short and long pick it was not necessary to pass the weft through the weft feeder, therefore time to restart were much shorter and very similar.

Stoppages due to causes other than warp and weft e.g. mechanical and electrical

The stoppages due to mechanical and electrical problem are supposed to depend mainly on machine condition & model and nature of maintenance and perhaps there is no relation with construction and raw material. Tables 6,7 show that there were 24 stoppages due to others problems and the looms were stopped for 54.37 minute which is only 8.57% as compared to 57.7% and 33.73% (Figure 6) for warp and weft related stoppages respectively. In order to ensure a better production and higher weaving efficiency these stoppages must not be ignored.

Conclusion

The study shows that 58% stoppages were due to warp breakages, 34% stoppages were due to weft breakages and 8% stoppages were due to other causes like electrical and mechanical. The stoppage time was regarded as the time elapsed in repairing and returning the loom back to weaving. The average time to repair a warp break and a weft break was found to be 2.87 minutes and 1.85 minutes respectively. The warp breakage and corresponding stoppage was studied in the various zone and found that much more time is required to repair a break if it occurs in the drop wire and healds zone than that occurs in back rest and reed zone. Similarly the average time to repair a weft break was also found to vary depending on the location of the break, if the break is after the weft feeder and in the weaving area, the average repairing time was 0.83 minutes while if the breakage was in the package area i.e. before the weft feeder/weft accumulator the average repairing time was 1.60 minutes.

References

1. Nkiwane, Londiwe C, Marashe Shepherd. Loom Speed and Tension to Reduce Warp and Weft Breaks in Air Jet Weaving. National University of Science and Technolgy Publications. 2012.
2. Rahman ANM, Amin R. Efficiency Analysis in Rapier Loom. International Journal of Basic & Applied Sciences IJBAS-IJENS. Vol: 11, No: 03 44 116203-83k83 IJBAS-IJENS© June 201JENS.
3. Aggarwal SK. An Analytical Approach for Understanding the Phenomenon of Warp-Breakage in Weaving. Indian institute of technology, New Delhi; September 1987.
4. Devare D, Turukmane RN, Gulhane SS, Patil LC. Effect of Yarn Stretch in Sizing on Loom Performance. International Journal on Textile Engineering and Processes. 2016; 2: 2395-3578.
5. Patil TC, Kadam J, Patil Y. Air Jet Weaving: Control of Weft Breakages for Cotton & Polyester Weft Yarn. International Journal on Textile Engineering and Processes. 2016; 2: 2395-3578.
6. Patil VA, Gulhane SS, Turukmane RN, Patil R. Productivity Improvement of Loom Shed by Optimizing Relative Humidity. International Journal on Textile Engineering and Processes. 2017; 3.
7. Asif M, Jarral UJ. To Study How to Improve The Productivity of Yarn And Fabric Production in a Production Mill (Dessertation). 2009-2010.