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Air jet weaving: Control of weft breakages for cotton & polyester weft yarn

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ABSTRACT

This project mainly focuses on the control of weft yarn breakages to improve the loom efficiency. The main advantages of the modern air jet weaving machine is high weft insertion rate up to 2000 meters per minute. Whereas control of filling CMPX is the burning issue on air-jet loom in case of weft yarns of different quality parameters and material. This study is conducted to reduce the loom stops due weft breakages by changing variables in terms of air pressure setting and heald frame setting on air jet loom. Trials were conducted for weft yarn of cotton yarns of 40 Ne, 80 Ne, 100 Ne and polyester filament yarn of 30 Denier.

INTRODUCTION

The weaving operation contribution by the largest proportion to the cost of conversion of the yarn into fabric. The cost of actual weaving operation in mills with conventional preparatory machine and non-automatic looms is about 85% and in mills with modern preparatory machines and automatic looms about 65% of the total cost of conversion of yarn into fabric. This means a small increase in productivity of loom will result into considerable reduction of manufacturing cost. More importantly an increase in l % productivity on looms will bring in additional realization on the extra fabric available. Mainly in the loom shed department there are several factors which are responsible for the productivity level. These factors are yarn quality, quality of yarn preparation, loom settings, breakages and atmospheric conditions in the department. Again in other words above are the thrust areas in the weaving department through which the expected level of productivity will be achieved, by controlling the process parameters at each stage. In case of air jet picking, weft yarn is propelled with help of compressed air. If the weft yarn is not inserted completely, the machine stops to facilitate the removal of the residual weft yarn. Air pressure, nozzle settings and shed opening timings are likely to affect the failure of weft transfer during picking. Hence, optimization of these parameters is essential to control the filling breakages in case of cotton and polyester weft yarns.

LITERATURE REVIEW

Brief Description of Air Jet looms

For the weft insertion mechanisms of air jet looms, the profile reeds with sub-nozzle systems are the most advantageous in terms of improving high speed weaving and wider cloth width. Not only the airflow from the main nozzle and sub-nozzles but also the airflow in the weft passage is closely related to the flying state of the yarn at the time of weft insertion in this system. In order to manufacture high quality textiles with air jet looms, it is necessary to establish optimum weaving conditions. These conditions include the supply air pressure and air injection timing for the main nozzle and sub-nozzles according to the kind of well yarn.

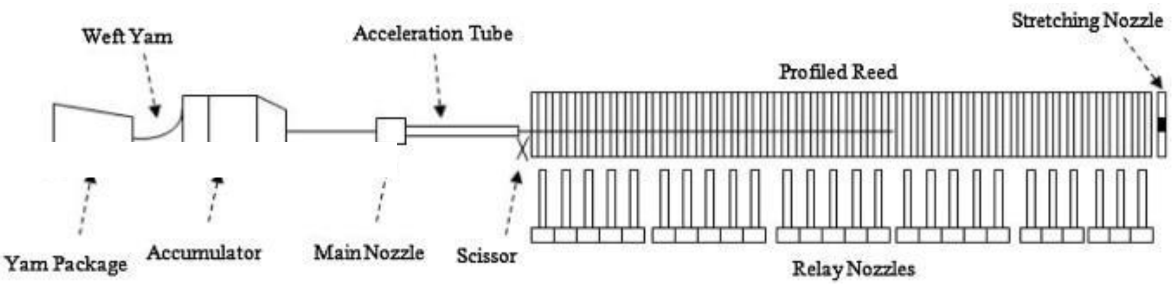

Figure: Filling feeding system

The air jet loom feeds the filling as in Figure 1. The filling length is measured according to the width of the fabric by 1 rotation of the loom. It is accelerated by the main nozzle at a specific timing, and is inserted into the air guide o the reed. Groups of sub-nozzles are located across the whole width. Each group jets compressed air in a specific order to feed the filling tip to the right end of the fabric. The compressed air is supplied from the compressor, its pressure is adjusted by the regulators for the main nozzle and the sub-nozzles, and it is stored in the proper tank.

The control system of the loom opens and closes the electro-magnetic valve, and sends the compressed air to the nozzles.

Physical properties and characteristics of yarn.

Several physical properties and characteristics of yarn are thought to have an effect on yarn velocity in air jet weaving applications. The yarn characteristic thought to have the most effect on yarn velocity (and therefore, Air Index value) is the yarn hairiness, which is a quantitative means of describing the surface roughness of a cotton-based spun yarn. Yarn hairiness is a means of counting the broken fibres that protrude from the surface of a spun yarn, giving the yarn a fuzzy appearance. It is hypothesized that yarns with higher hairiness values will result in higher Air Index values, due to an increase in surface area of the yarn for the air to "push" on; i.e., an increased aerodynamic drag. Other physical characteristics of yarn will be investigated in this report to determine whether or not they have an influence on Air Index value, especially yarn count. The count of a spun yarn is a numerical designation of yarn size that relates the length of the yarn to its weight, as well as describing its diameter. The higher the yarn count, the smaller the diameter and density of the yarn is, so it is thought that higher yarn counts will result in higher Air index values. This is due to the increased surface area-to-mass ratio as yarn count is increased.

Opening & closing timing of nozzle.

Correction made delayed opening loss pressure through valve enhance the efficiency of machine. Early opening will reduce the air consumption. Improper opening & closing timing of valves lead to undue stress on yarn thereby leading to break. After proper adjustment the no. of end breaks can be reduced. The air consumption can be reduced up to 5 to 6%.

Pressure on the nozzle.

Pressure on nozzle has more impact on the m/c performance. Improper pressure adjustment will causes the weft stop during working so quality & productivity can be minimized. To avoid the problem, proper setting of pressure can be required. These can be adjusted according to count, rpm, width of m/c. Proper combination between main & relay nozzle will reduce the air consumption.

Setting of nozzle:

Distance between two nozzles- Improper setting between to relay nozzle will cause to variation in air pressure and will cause m/c performance to be in decreasing the air consumption will be unnecessary increases.

Nozzle height – Proper height setting of relay nozzle will causes reduction in air pressure during weft insertion & air consumption can be reduced. Proper setting of the nozzle height will provide the uniform displacement of yarn during insertion.

Nozzle angle- For uniform weft insertion of yarn during insertion proper nozzle angle will reduce air consumption. Pressure required for insertion can be reduced.

Reducing weft breaks:

The main problem while weaving with filament weft yarns is that of excessive weft breakages and resulting fabrics defect which significantly reduce the sale value of the fabrics. The filament yarns are usually stronger and have higher elongation at break compared to equivalent count spun yarns; each constituent filament, of course, is subsequently weaker compared to the spun yarns; for reducing weft breaks, therefore, it is essential that the constituent filaments are not allowed to be frayed or else that constituent filaments are not allowed to be frayed or else these may rupture one by one, and the whole yarn may breaks. For these reason the twisted filament yarns give less breaks than the zero twist filaments yarn, because the small amount of the aero set yarns are tanged by special techniques using air blast.

Nature of weft break :

Broken Pick: Broken pick is measure problem or the measure fault in the textile industries. It completely affects the production of the company products. It is necessary to avoid this problem or the fault in machine. So By using the standard air pressure it may reduce or minimizes the fault.

Bend Pick: Bend Pick is the fault which arising due the air pressure where the yarn is distract. It may create the problem yarn is its original position and it not goes to its destination due to that air pressure. So it is entanglement of shed. That's why use of the proper pressure of the main nozzle and relay nozzle.

Short Pick: Though the prewinder is used, slippage in the friction of the drag rollers could cause a problem. Cleanliness of the stopper is another reason for a short pick. Any observation in the passage of weft would cause a short pick.

Loose pick: In this case loom will not be stop but woven cloth will be defective as weft yarns will be shown in left hand side.

1. Low air pressure on main or sub nozzle.
2. Delay beating time, short lead angle of main nozzle.
3. Discrepancy in weft yarn, thickness or other defect may be present in yarn.
4. Air jetting time of main nozzle either more or less.

Snarl: If a premeasured weft is blown on to the shed, this snarling shortness the effective length of weft causing the machine to the stop by weft sensors by adjusting the storage to position, increasing the effectiveness of the suction at the end of tube and altering the auxiliary nozzle pressure effected a better and optimum loop formation. Defect can be avoided. Is the major fault on weft yarn? This is the problem are create is the pressure of main nozzle or relay nozzle or degree of relay nozzle.

Sticky end: some of the time we can change the all settings but not to stop of weft break. That time see is the where are stop to the pick and check to the warp yarn see sticky of the end that's why stop of the filling.

Entanglement of weft Yarn: firstly we can check of where are stop the weft yarn. Then find out which are the shed are stop to the pick and then find out to the warp end or warp sheet is the loose. The only one end are loose these end are tied to the end and the fully warp sheet is loose that time change the setting of the backrest roller. The upper level shed end is stop of the pick that time backrest roller height is the downward direction and lower level shed end is stop of the pick that time backrest roller height is the upward direction. These are the setting are opposite direction and they will be check of the setting and control of the weft yarn. Another setting is the check of the heald frame setting that like height or amount.

Knotting tail end: This problem is the man related. This problem is create a filling break. Then the one solution of the problem. The weavers knot is the fine then the altimetry control of the filling break.

Selvage end: selvage side stop of the filling so we can check it's a selvedge end. Check is the selvage end draw-in order, loose of the selvage end that reason is the stop of the filling so we can change is the draw-in order, or tied of the end

.

Excess number of relay nozzle: Excess number of relay nozzle in the form of unnecessary weft stop in spite of the pressure of weft. The last nozzle being very close to the weft detector he deflection of the weft yarn could end up as faulty signal of weft absence. This problem can be avoided if,

1. In case of profile reed the distance between the fell of the class and temple should not be set very close, as in case of shuttle looms otherwise the selvedge ends are likely break frequently.
2. The mechanical cutter that tis used immediately after the main nozzle should cut shapely and effectively at the appropriate time, failure of which result weft stop problems.

Tip Trouble: In this case weft entanglement of the tip of weft yarn takes place reasons are, low feeding power, timing of weft yarn of out pin may not be proper. Timing of shed may not be proper, too high or too low main nozzle pressure or Left side warp yarn is loose.

EXPERIMENTAL WORK

Weft Breakage study for Cotton yarn

Sort No.1, Weave - Plain, Weft count - 40 Ne, Picks/ inch - 90

Machine Aspects	Before Study	After Study
Speed	580 rpm	580 rpm
Efficiency	87.3 %	93 %
Air – Pressure: Main Nozzle 1	3.5 bar	3 bar
Air – Pressure: Main Nozzle 2	3.4 bar	3 bar
Air – Pressure: Sub Nozzle	4.7 bar	4.5bar

Prewinder Sensor c1 & c2	78 – 240	78 – 240
Sub Nozzle Distance (Total No. of relay nozzles - 11)	80mm (Stretch Nozzle 70mm)	80mm (Stretch Nozzle 70mm)
Shed Crossing	280^0	280^0
Filling CMPX	12.5	6
Total Stoppage Time due to Weft Breaks	10.6 min	6 min

Table No. 1

Sort No.2, Weave – 4/1Satin, Weft count – 80 Ne, Picks/ inch – 66*3

Machine Aspects	Before Study	After Study
Speed	450rpm	450rpm
Efficiency	83.9 %	88.7 %
Air – Pressure: Main Nozzle 1	3.8 bar	3.5 bar
Air – Pressure: Main Nozzle 2	3.8 bar	3.5 bar
Air – Pressure: Sub Nozzle	4.8 bar	4.5 bar
Prewinder sensor c1& c2	80 – 240	80 – 240
Sub Nozzle Distance (Total No. of relay nozzles - 11)	80mm (Stretch Nozzle 70mm)	80mm (Stretch Nozzle 70mm)
Shed Crossing	300^0	308^0
Filling CMPX	20.3	9.8
Total Stoppage Time due to Weft Breaks	17.6 min	11.6 min

Table No. 2

Sort No.2, Weave – 4/1Satin, Weft count – 100 Ne, Picks/ inch – 124*4

Machine Aspects	Before Study	After Study
Speed	420rpm	420rpm
Efficiency	76.3 %	80.7 %
Air – Pressure: Main Nozzle 1	3.1 bar	3.0 bar
Air – Pressure: Main Nozzle 2	3.1 bar	3.1 bar
Air – Pressure: Sub Nozzle	3.8 bar	3.7 bar
Prewinder Sensor c1 & c2	88 – 240	88 – 240
Sub Nozzle Distance (Total No. of relay nozzles - 11)	80mm (Stretch Nozzle 75mm)	80mm (Stretch Nozzle 75mm)
Shed Crossing	300^0	308^0
Filling CMPX	39.6	20.2
Total Stoppage Time due to Weft Breaks	35.2 min	25.8 min

Table No. 3

Weft Breakage study for Filament yarn

Loom No.1, Weft -30 Denier, Weave - Satin Stripe, Picks / inch – 68*6

Machine Aspects	Before Study	After Study
Speed	400 rpm	400 rpm
Efficiency	74.8 %	77.3 %
Air – Pressure: Main Nozzle 1	3.5 bar	4.2 bar
Air – Pressure: Main Nozzle 2	3.5 bar	4.2 bar
Air – Pressure: Sub Nozzle	4.8 bar	4.8 bar
Prewinder Sensor c1 & c2	90 – 244	86 – 240
Sub Nozzle Distance	80mm	80mm

(Total No. of relay nozzles - 12)	(Stretch Nozzle 70mm)	(Stretch Nozzle 70mm)
Shed Crossing	308^0	308^0
Filling CMPX	25.4	18.2
Total Stoppage Time due to Weft Breaks	30.6 min	20.2 min

Table No. 1

Loom No.2, Weft - 30 Denier, Weave - Satin Stripe, Picks / inch – 68*6

Machine Aspects	Before Study	After Study
Speed	490 rpm	490 rpm
Efficiency	83.8 %	87.3 %
Air – Pressure: Main Nozzle 1	3.5 bar	4.2 bar
Air – Pressure: Main Nozzle 2	3.5 bar	4.2 bar
Air – Pressure: Sub Nozzle	4.8 bar	4.8 bar
Prewinder Sensor c1 & c2	90 – 244	86 – 240
Sub Nozzle Distance (Total No. of relay nozzles - 11)	80mm (Stretch Nozzle 70mm)	80mm (Stretch Nozzle 70mm)
Shed Crossing	308^0	308^0
Filling CMPX	15.4	10.7
Total Stoppage Time due to Weft Breaks	18 min	10 min

Table No. 2

RESULT AND DISCUSSION

Weft Breakage study for Cotton yarn –

In case of 40Ne cotton yarn, by reducing air pressure of main nozzle gives the 40 % reduction in filling CMPX, this is followed by synchronizing the air pressure of main and relay nozzles. As coarser yarn is having more hairiness, as compare to finer yarns it requires low air pressure value for propulsion during weft insertion.

Also in case of finer yarns (80Ne and 100 Ne) as weft, by changing the timing of shed crossing timing gives the slight reduction in filling CMPX value. This is because closing the shed earlier will leads to arresting of weft yarn in the warp yarn in the upper layer of shed.

For cotton weft yarn, 5% increase in loom efficiency is noted after conducting trails as per the above parameters,

Weft Breakage study for Filament yarn –

In Case of filament yarn Co-efficient of friction is less as compare to cotton yarns, because of having smoother outer surface. Hence it requires higher air pressure value than it is in cotton yarn. Results from above study shows that by increasing the air pressure of main as well as sub-nozzles gives the 30 % reduction in weft CMPX.

For filament weft yarn, 3.5 % increase in loom efficiency is noted after conducting trails as per the above parameters,

CONCLUSION

In case of air jet picking, weft yarn is propelled with help of compressed air. If the weft yarn is not inserted completely, the machine stops to facilitate the removal of the residual weft yarn. Air pressure, nozzle settings and shed opening timings are likely to affect the failure of weft transfer during picking. Hence, optimization of these parameters is essential to control the filling breakages in case of cotton and polyester weft yarns.

From the above study it has been concluded that by optimising the air pressure value of main and sub nozzles as well as shed crossing timings gives the 40 % and 30 % reduction in filling CMPX for cotton and filament weft yarns respectively.This will give an increase in loom efficiency by 5% for cotton yarns and 3 % in case of filament yarns.

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