Sustainable Value Additions for Textile Machinery Processes

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The engineering professionals must always put their best efforts on the manufacturing floor with innovative experiments and making them successful by adding value to the process for long term sustainability of the organization. Here, few experiments and their results are discussed.

1) Common Tube Suction System: In Ring Spinning, the lapping on rollers - either on top or bottom roller - is one of the chronic issues, especially in PV fiber dyed Spinning at higher and higher spindle speeds. The huge amount of physical effort is required in removing lapping and joining broken threads. If it is too high, it affects workload of operators also. There are two options to reduce lapping frequency on the rollers in ring frames. Either use of higher capacity suction motor to increase the suction pressure or reduce number of openings on suction ducts. The Common Tube Suction System will help us to improve suction and reduce the breakages in LR6 ring frames. The suction is improved by 40% with common tubes compare to earlier tubes. This is because of reduction in the opening points on the main suction duct across the length of the machine by $1/8^{th}$ that means instead of 8 suction tubes in one section of 8 spindles each, now we require only one opening on the duct for common suction tubes & rest of 7 opening points are closed. Hence lesser the opening of duct, higher is the suction with same capacity motor and its speed. The strong suction not only helps in improving suction, but also to reduce lapping by 80 to 90% and increase installed efficiency by 1 to 2%. It has hardly or nothing much to do with breakage rate, but helps in reduction of lapping on the rollers once the end breaks. The repairing of broken end, once the lapping is formed - is very tedious, laborious and time consuming job, but due to lesser lapping with common tubes, operator is joining ends faster. Hence it would improve efficiency. At the same time, operators' physical efforts are also reduced in comparison to energy wasted in removing lapping and joining the threads earlier.

2) Installation of C-Factors on Cards: The card web is very nepy in PV fiber dyed even at lowest permissible speeds on old cards like C1/3. With installation of C-Factors, the quality of card web is improved and yarn imperfection have also come down and the C-Factor is nothing but increase of stationary flats by reducing revolving flats which are easily retrofitted without any adverse effect on the design aspect of the machine. The C-Factors are already integrated in new generation cards with reverse movement of flats, but in old C 1/3 Cards, C-factors are being used with normal moving direction of flats. The C-Factors are to be changed in every 1 ½ years and regular check on settings during every scheduled cleaning of cards is required. The use of C-Factors not only improves the quality of sliver and yarn, but also cost effective in the real sense. The quality improves with reduction of spares cost. We got 40 to 45% reduction in

imperfections with C – Factors. Some mills are taking advantage of quality improvement without increase of productivity, but some are taking advantage of productivity by increasing speeds with stationary flats with same level of quality depending on their choice. but in our case, quality is on priority and we are taking quality benefits.

3) Installation of Spring Load Drafting on Speed frames: The one of the burning quality issue in spinning preparatory is high roving U% which was always on higher side on old LF1400 speed frame compared to new LFS1660 Speed frame. The one of the biggest difference found is that cradle size is not matching with fiber length which we are using and another reason is that there were lots of problems found in pneumatic loading system. Then we went for drafting components with correct cradle size and instead of pneumatic, installed spring loaded top arms of reputed make on old Speed Frames. The higher U% is not because of old age of machine, but deterioration in drafting components over a period of two decades and wrong choice of cradle during project set-up which is unnoticed by mill technicians. The results of U% are much better than our expected level. The U% reduced from 4.5 to 5.5% to 3.0 to 3.5% after installation of new drafting components. With good care of old machines, we are able to get good results comparable to latest machines.

4) Use of Larger Diameter of Cots in Ring Frame : The working of PV dyed material is far better on KTTM ring frames compared to LR6 ring frames. One of the differences is larger diameter of cots in KTTM ring frames. The larger diameter cots are installed on LR6 ring frames and there is remarkable change in yarn result. In addition, there reduction in lapping by around 10 to 15%. The bigger diameter cots will have less imperfections in yarns as well as helps in reduction of lapping tendency of material. The average reduction in imperfections is around 30%. As far as design aspect of m/c is concerned, the roller circumference ideally should be around 2.5 times the staple length. The use of 44mm PSF & 38mm VSF in 65/35 blend gives average length of fibers in blend around 42mm or even slightly higher as few shades of VSF are of 44 mm also being used due to non availability of 38mm at supplier end. The circumference of 35mm diameter rollers is closer to the 2.5 times the staple length (42mm).Hence we are getting better working in respect of reduction in lapping and imperfection levels.

5) Use of Low Height Separators on LR6 Ring Frames : On LR6 Ring Frames, because of more height of separators, the doffers can not pick the full cop unless they push back the separators for every group of 6 spindles and again put in same position after the cops are removed. The pushing back and putting again in working position affects the cop picking speeds of doffers and also few seconds are wasting in this operation, but in KTTM ring frames, because of low height of separators, there doffers are simply picking the cops continuously & saving time. This eliminates manual tilting operation of separators even there is no saving in doffing time, it is well and good as fatigue is a big problem for doffers and this helps them a lot to overcome it.

There is no such impact on yarn quality seen and there is happiness among the workmen as these low height separators are operator friendly, But separators of these low height are not readily available in the market. Neither machine supplier nor local vendors are making these short separators. We procured one set of normal separators and cut them at our end and installed on one full machine of 480 spindles. We have LR6 Ring Frames without auto doffer. The use of auto doffers is not feasible in PV dyed plant where frequent change over in count, use of small ring frames, small lots and running wide varieties of shades in the whole year. The mills having such product mix are using manual doffing even today. The availability of short separators is an issue which can only be solved either by cutting the long separators to required height or by searching suitable supplier in the secondary market.

6) Optimization of Doff Weight in LR6 Ring Frame: In spinning mills, huge quantity of material is split into many thousands of small pieces in the ring frames during spinning and collected together machine wise in batches (doffs). The weighing is made manually on weighing balances to know the production of each machine on any particular day, shift etc. These small cops (like water drops) collectively forms doff (like a sea).The process is similar to formation of sea by drops of water. The optimization of doff weight is nothing but use of maximum permissible bobbin surface for winding yarn for particular ring diameter and lift of machine. This will help the spinner in not only reduction of number of doffs, but also reduction in doffing losses which is one of the major contributor to loss of working and installed efficiency. The doffing of full cop is unavoidable process also, but it is recurring in nature. We have LMW & KTTM ring frames. In LR6 Ring Frame, the optimization of doff weight needs special attention on continual basis as changeable parameters are mechanical in nature and open during normal working ,while in KTTM once you initially set in the control panel with password, there is nothing open on the machine and optimization of doff weight is only one time effort. There is increase in cop content of about 7%. This is due to strictly prohibiting the workmen for un-authorized handling of bobbin build setting (Ratchet Wheel Setting).Earlier there was a fear of ring cut in the mind of workmen at larger diameter of bobbins and they were changing the settings of bobbin build even without informing officers to produce smaller diameter bobbins and officers were also not monitoring these settings. Hence doff weight was low. After thorough inspection of machine, we allowed to run machines for full build of bobbins and observed few bobbins with ring cut initially, attended them by re-centering of rings with spindles. At the same time, we insisted supervisors to set, monitor doff weight and take care of bobbin build settings. Hence the results of increased doff weights are sustained. The points to be followed in regular practice to maintain cop content in ring frames are : Optimization of required settings for maximum permissible cop content , Strict administrative controls on settings by supervisors and allowing any change by supervisors only, Time to time inspection of ring cuts by supervisors and immediate correction, if change is seen, Monitoring & control on idle spindles, Monitoring

breakage rate and suction waste and higher values of both these will give low cop content. Hence the corrective actions must be taken based on these data.

7) Improvement in Installed Efficiency of KTTM Ring Frames on next day of the mill holiday: On every public holiday, it was regular practice to release the top arm pressure while stopping KTTM ring frames on holiday to avoid damage to cots when kept stationary under pressure in ring frame for long time and immediately on next day, there were huge breakages of yarns while restarting machines after applying the pressure on rollers. The department was out of control and it was huge time consuming to restore normalcy in working. Also there was huge loss in efficiency , then we started short running of each ring frames on holiday at interval of 8 hours without releasing arm pressure and on next day of every holiday, working was smooth from beginning of the shift itself and there was increase in efficiency from 68% to 80% (11% jump). It is necessary to inform electrical engineering dept to make availability of power for this activity on holiday and spare electrician with production officer. This improvement in installed efficiency is achieved with short running of ring frames instead of releasing and reloading top arms manually. No need to call workmen early in the morning on over time to attend ends down, elimination of manual efforts of lifting and pressing of top arms , drastic reduction in time required to restore the normal working, no damage of cots on holidays and ultimately improvement in efficiency is seen.

8) Improvement in Installed Efficiency of LR6 Ring Frames on next day of the mill holiday : On LR6 ring frames where pneumatic loading is there, there also we were facing high ends down on next day of holiday while starting the machines, but lesser compared to spring loaded rollers of top arms and there was drop in efficiency. The drop in efficiency is because of earlier machines were delayed to start on next day of every holiday due to pneumatic loading of top arm in LR6 ring frames and roving was slightly becoming slack in drafting zone leading to more breaks while re-starting the machines taking more time to set the department and it was ultimately affecting efficiency of ring frame section. Then what we did is that we tightened the roving by reversing the movement of roller by loosening the gear in few minutes on each machine and then there is hardly or negligible number of ends down and efficiency has improved a lot and shown in below table. There is 18% jump in installed efficiency without increasing load on workmen. Benefits are no need to call workmen early in the morning on over time to attend ends down, elimination of manual efforts of piecing broken ends, drastic reduction in time required to restore the normal working, and ultimately improvement in efficiency also.

9. Pre- Carding of VSF for reduction of neps: The spinning of fiber dyed PV yarns is highly complex in nature. Every month, we spin 60-70 shades and each shade has 4 to 5 colors of polyester and viscose in proportions. Some of these shades have a small proportion of dark

colored viscose while all other shades are light in color; while some other shades have light colored viscose with all other shades being dark. This small proportion of viscose forms neps that have to be removed during mending. Certain shades have so many neps that it is not possible physically to remove them during mending; such fabrics have then to be over dyed, putting mills to considerable loss, then the pre-carding of these small proportions of viscose will solve this tricky problem. The imperfections are lower by even less than 50% in pre-carded shades compared to regular non pre-carded shades in 33Ne 65/35 PV blended yarns. The viscose carding require different parameters in carding and Blow Room. Every time while pre-carding, one has to change settings before start of viscose which require extra time. The viscose require larger lap weight to avoid lapping on doffer, Web fall in carding, piecing difficulty in card, slipping of lap etc. With larger laps, reduction in laps, saving in doffing time, no breaking of webs in the card, are the benefits. The advantages of pre-carding are : 1) The reduction in neps in the yarn even less than 50% compared to normal yarn imperfections. The imperfections can be further reduced by increase of flat waste in carding 2) The fabric appearance will improve to a great extent. The re-mending / over dyeing will be reduced to great extent by adopting pre-carding technique. To begin with, start first odd/white/poor quality VSF shades going in full quantity i.e 35% in 65/35 blend ratio. draw backs of pre-carding are **:** 1) Increase in waste by 3 to 4% depending on the supplied quality of Viscose component to be pre-card and increase of cost of yarn by about Rs7 to 8 per kg of yarn 2) Separate pre-Carding line for viscose apart from regular production line is required, if pre-carding quantity is high and it needs huge capital investment in machineries, labors, electricity, humidification plant etc 3) The breakages observed are on higher side in ring frames in pre-carded shades and waste is also high in ring frame 4) The breaking of pre-carded sliver is tedious, laborious and time consuming and huge man hours are required in breaking the sliver, also delay in delivery of pre-carded shades. The spinner will have option for sliver breaking either by machine or manually. The machine breaking is better for big quantity and quality of breaking is better in manual system 5) The high speed cards have to be run at slow speed by 20 to 30% for pre-carding and shorten the preparatory capacity for regular production line, if pre-carding quantity is high 6) The designer also has to develop shades alternatively by reducing % of odd/ white/ poor quality VSF or eliminating odd component shades from product mix.

10.Converson from Rotary to Stationary filter suction box on G5/1 & LR6 Ring Frames : The major draw backs of rotary filter boxes faced by us are : 1) Frequent choking of system resulting into utilization and production loss 2) Complicated system with lot of pneumatics & huge number of small parts 3) Repairing is time consuming due to dismantling and reassembling of whole system even for minor fault 4) Even though material is good in working, but behaving poor due to drop in suction during and after choking 5) More parts are involved and many times, more follow-up with supplier for parts resulting into delay in replacement of defective parts 6) More break downs related to Electrical/Pneumatics/Mechanical due to automatic

operation of system 7) Many times, faced labor unrest also for poor working of material due to less suction. No major investment is involved in converting rotary to stationary filter box on 1 machine and very minor expenses were involved. No help of external agency is taken and entire work is done in house with the help of workshop and our maintenance team. By this modification, we come out of all the above mentioned problems and stationary filter box is working satisfactorily. In PV dyed spinning, switching over to stationary filter box is always better decision. The rotary system is good for grey PV and cotton mills.

11) Conversion from Mechanical Variator to Electronic Inverter Drive on G5/1 Ring Frame: The problems with present Pneumato - Mechanical drive on G5/1 ring frames are 1) The speed fluctuation during running of machine due to vibrations in variator drive. 2) The structure of variator pulley is complicated compared to simple belt drive system. The lot of pneumatics and huge number of parts are also involved in the system. 3) The break down attending time was varying from minimum 8 hours to maximum 12 hours or even more for simple problem and also even for 4 hour were required for changing belts.4) The spares ordering/follow-up with the supplier is time consuming for replacement of defective parts frequently.5) The breakage rate on these machines was also high due to vibrations generated during running of variator pulley. With the help of our maintenance team / workshop, the old variator pulley system is removed, simple driver & driven flat pulleys are installed and in addition to this, inverter is also installed. The new conversion system is successful and running satisfactorily.

12) Reduction of Uster Value on RSB Draw Frame: This machine was under annual maintenance service agreement with machine manufacturer and inspected by expert from machine supplier three time in a year. During the visit of engineer also, we raised this issue, but root cause could not identified. Then the machine is for technical audit with the objective of finding root cause of higher U% values and the Coiler Calendar Roller found defective. Then we took immediately trial by installing roller of one of the neighboring machine on it and kept under observation & testing the U% values. There is drastic improvement in U% Values i.e reduction by 25%. We ordered this part and regularized this improvement in bulk production.

13) Energy Saving in Ring Frame by W-8 High Speed Spindle Tapes : The machinery manufacturers have developed many energy conserving ancillaries to reduce the energy consumption. Ring spinning is a major consumer of energy and it accounts for 50% of total spinning mill consumption. Studies conducted by SITRA in modern ring frames revealed that about 1/3 of total machine power is spent in driving the spindles. The design and construction parameters of spindle tapes is one of the factor affecting the power consumption of spindles. With this background, we conducted study of new spindle tapes made by thermoplastic polyurethane material. These W-8 tapes are made of Thermoplastic Polyurethane material and reduces the bending resistance of new spindle tapes significantly, the efficiency of transmission

improves due to higher co-efficient of friction at the pulley side and it is reflected in the speed of spindles. The another important aspect of W-8 spindle tapes is the flex proof because the joining area is like the English letter W which does not offer any resistance to the movement of spindle. The experiments were carried out on a modern high speed LR6 ring frame. The spindle speed was measured for both spindle tapes during the study to see their transmission efficiency. The increase in spindle speed is by 2 to 3%. The increase in spindle speed is due to higher dynamic frictional co-efficient of new tapes. The transmission efficiency of new spindle tape is higher by about 2.33% in our study (423 rpm) as compared with existing HS-5 tapes. This higher speed is due to low slippage of W-8 Spindle tapes.

In this study, care must be taken for TPI correction because change of tapes increases the spindle speed by 423 rpm without any change in delivery speed of front roller. Hence there is increase in TPI in the yarn which we do not require at all in the yarn and higher TPI than recommended is enemy of productivity. In our study, change in TPI is 2.36% on higher side. This increase in twist per inch is altered by suitable twist combination wheels to get nominal twist per inch in the yarn. Therefore, the mill can achieve higher production rate due to increase in spindle speed by about 2.33% (423 rpm) with alteration of twist combination wheels. This study shows saving of 3.2 min in every doff duration. The doff duration is shortened by 3.2min (2.31%). The cost of W-8 tapes is 5 times the cost of HS-5 tapes, but it is worth to use W-8 tapes as these give recurring saving in power and about ½ year more life. The payback is only 7 to 8 months .The pay back is explained later on at the end of this project. It shows saving of 0.37Kwh power which is about 2%. The final closing of any investment made is to know its pay back period to understand whether investment is adding value to process or not. It gives idea about how and in how much time, the investment made will be recovered. This will be helpful in deciding whether the project is successful or not. The pay back period is only 7 to 8 months and it is short time recoverable project even within a year. The investment is also not so big. Hence this project is successful and one can implement it. The cost of tapes is recovered in 7 ½ months only and after that there will be recurring saving on account of reduction in power.

14) PV Fiber Dyed Siro – Lycra Yarn Manufacturing Project: This project is prepared for PV Spg.

Parameters	**Option 1**	**Option 2**
Yarn Counts (Nm)	2/70Nm	2/80Nm
Fabric Length (M/Month)	1,50,000mts/month	1,50,000mts/month
Fabric Weight (g/m)	300	285
Share of Weft (%)	50	50
Weft Quantity (g/m)	150	142.5
Weft Quantity required (kg)	22500	21375
Allowance for False Selvedge (%)	6	6
Total Quantity Required (Kg)	23850	22657.5

Allowance for Winding Waste (%)	1.5	1.5
Total Weft Required (Kg)	24207.75	22997.36
Weft Quantity Required/Day (Kg)	**806.92**	**766.57**
Spindle Speed (rpm)	11000	11000
Twist/Inch	22	25
Installed Efficiency (%)	80	80
Resultant Count (Nm)	35	40
Spindles / Ring Frame	480	480
Production/Day/Machine (Kg)	200.64	154.49
Number of Ring Frames Required	**4.02 (4 M/Cs)**	**4.96 (5 M/Cs)**
Auto Winding Speed (Mts/min)	1000	1000
Installed Efficiency (%)	50	50
Resultant Count (Nm)	35	40
Production/Drum/Day (Kg)	21	18
Number of Drums Required	**38.42 (40 Drums)**	**42.59 (45 Drums)**

15) Success of High Speed Spinning: For one full year, we are able to run four LR6 ring frames at maximum speed of 22000rpm in PV fiber dyed spinning without deterioration in quality and the department is audited by outside expert. The full case study is published in the book titled "High Speed Spinning of PV fiber dyed yarns" written by Shri.S.Y.Nanal which is joint publication of Textile Association (India) and Wood Head Publishing House, New Delhi. OurS is the highest probable speed in the world in PV fiber dyed spinning as commented by textile consultants.

16) Imported Rings and Travelers: The life of major spinning accessories is very less in PV spinning compared to cotton mills. This because of highly abrasive material (Titanium Dioxide) used in polyester manufacturing process. Any local rings give further less life in PV dyed Yarn Spinning. Hence imported rings and traveler life at least twice the life of locals. The benefit is not only higher life, but also sustainable improvement in quality.

Views presented here are that of the author of the article.

About the author

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