

Cause of textile waste and its control in the spinning mills

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Each drafting operation introduces fresh irregularity, the irregularity of the final yarn is summation of irregularities produced during each operation. Roll drafting or the attenuation of slivers and rovings to produce yarn of specific count is the most important principle involved in the processing of raw material into yarn. The irregularity introduced in drafting process mainly depends upon the parameters of the drafting system, mechanical faults and quality of the input material.

When mechanical faults are eliminated, drafting irregularities depend upon to control on the floating fibers in the drafting zone. Setting between the roller nips, distance between the apron at the nip, distance between the apron at the nip, and pressure on the top rollers are some of the factors.

The characteristics of the sliver fed to the drafting system also exercise considerable influence on the irregularities introduced and drafting system, operated under the optimum conditions. Short fiber content, neps, trash and other impurities, in addition to the degree of fiber parallelization and number and extend of residual hooks in the fibers together with their direction of presentation are some of the important factors that characterize sliver quality and determine its behavior during drafting.

Nutter and Slater examined the effect of hooked fibers on yarn strength and found that better strength is obtained when a fiber tip is presented to the drafting system than a hooked end. **Grade, Wakanker and Bhaduri** found better yarn regularity and strength, when majority hooks are fed as trailing, as leading to the ring frame.

They further found that the yarn quality diminishes with increase in the number of majority hooks, when these are fed as leading. **Simpson, Deluca and Flori** also confirmed that feeding majority hooks as leading to the ring frame contributed to poorer yarn quality and more breakages, the effect being pronounced in case of fine yarns. Apart from hooks, the fiber parallelization may also effect on drafting irregularities.

The treatment given to raw material during spinning process through various machines greatly influences not only the quality of spun yarn but also its quantum. Factors like setting between rollers, draft distribution, Pressure on top rollers, shore hardness of rubber cots, spacers, type/size of ring travelers, rings, relative humidity in the plant and mixing of raw material etc, contribute towards the quality and quantity of yarn.

Moisture content in the raw material especially in cotton is very important because of its direct effect on yarn strength as well as elongation and neps in the yarn. Whereas, the strength and elongation directly affect the performance of yarn in warping, the neps influence surface of finished cloth and dye take up.

Discussion

If a given mixing is not handled properly, some of the fibers may be damaged during its passage through various machines. As a result the waste percentage would increase and the quality of yarn would deteriorate. Moreover, the yarn manufactured under such conditions would result in reduced profit margin due to increased costs.

Conversion of lap into yarn is a question of reducing weight per unit length of the input material, and, at the same time, maintaining product uniformity. The uniformity is achieved by appropriate rate of draft; higher drafts above certain optimum limits produce irregularity with the advent of high drafting, much more

attention has to be paid to accurate setting for maintaining quality. In practice, the reduction in weight per unit length is carried out in stages; each drafting operation introduces fresh irregularity; the irregularity of final yarn being the summation of irregularities produced at each operation.

Fiber breakage is a very important factor, because any increase in breakage can lead to additional fly waste and greater number of ends down. Fiber breakage is a function of two main factors; the ratch setting (the distance between consecutive roll pairs in a roller drawing system) and the roving twist. To avoid breakages, it is necessary to set the ratch longer than the longest fiber, because a shorter ratch will break all fibers greater in length.

For a given ratch the extent of machine control over the fiber depend on the length distribution; a wider distribution and a longer ratch lead to lesser fiber control. The strain and distortion imposed on fiber ends during drafting due to the initial pull, continually repeated at each operation also lead to an increase in breakages. It is to be expected, therefore, that fiber will be beheaded or betailed as a result of this stress and fatigue, the effect being more pronounced in case of longer fibers.

Blending of different varieties of cotton is usually the responsibility of the spinner. With natural fibers, like cotton maintenance of a completely uniform blend can be very difficult.

A spinner's first concern is to control staple length and fiber fineness so as to maintain consistent conditions and standard yarn properties. His second concern is with yarn's appearance. Generally speaking a spinner has to sure, that if yarns out of different dispatches (lots) from the factory are compared, the weaver/ user should not be able to see any difference between different lots).

For achieving uniform blend, good quality, higher production, sandwich/ Stack mixing, block creeling and cross creeling/ color coding at each operation is must.

Yarn breakages and their gradual increases with higher spindle speed poses another bit problem. Frequent yarn breakages result in higher waste percentage and the quality of yarn is also impaired due to thick places emerging from piecing of yarn; moreover, extra labor is required as an operative can only piece a limited number of threads per unit time. The amount of waste produced is proportional to the product of end breakage rate and the average time an end is down.

If the RPM of a machine is increased without considering the spinning conditions, the result will be retardation of the spinning process; not only the expected production would be unachievable but also the quality would deteriorate.

For example, if 5% increase in spindle RPM of the ring spinning frame results in 4% increase of ends down and, in order to control yarn breakages, 1% increase in twist is introduced, the production will remain the same, but the yarn will give more defects and unnecessary additional energy and materials would be used/wasted. Therefore, without giving due weightage to over all spinning conditions, an increase in machine speed means deliberately inviting reduction in efficiency.

Current spinning technology is developed, with an aim to maintain higher productivity, with effective quality control, by selecting suitable equipment and spinning conditions to match with the raw materials. Modern developments of machinery, labor demands and increased market competition compel the

spinner to produce as satisfactory yarn as economically possible.

The problem of waste is well recognized, but nothing is done except to collect it, either to sell or reprocess it. In recent times waste has become a serious problem for the following reasons:

1. Raw material and labor costs are rising resulting in an increase of manufacturing cost.
2. Machinery investment today is much greater than ever before.
3. External and internal competition at market level is expanding, thus necessitating reduction of price and/or improvement in efficiency in order to remain competitive.

It is a popular misconception that the cost of producing waste is mainly a factor of raw material cost. The cost of waste production may thus be severely under estimated, since these factors must be considered in any assessment of the losses involved.

1. Raw Material Cost.
2. Processing Cost
3. Handling Costs.
4. The reduction in machine efficiency and production quality
5. Loss in selling profits.
6. Reprocessing cost (if any).
7. Sale value of the waste. (if the waste is sold)
8. Energy Cost.

Above factors show that the losses progressively increase throughout the processing cycle. The cost per Kilogram of producing waste in Ring being significantly higher than the cost per Kilogram for the earlier processes. Thus, from cost point of view more gains may be in the later processes. To save energy (which is one of the main cost factors) it will be better to reduce whorl dia of spindle to increase the RMP of the spindle with the same power.

Causes of cotton waste

The production of the high quality yarn free from faults and its production in bulk quantities are the major considerations in spinning. Yarn breakages and their gradual increase with spindle speed causes a problem.

As a result of frequent yarn breakages the waste percentage will increase and the quality of the yarn breakages the waste percentage will increase and the quality of the yarn is also impaired by the thick places emerging from him piecing of the end, thus the operative can only piece a limited number of threads per unit time.

In other words the number of ends down is directly related to waste. Thus the amount of waste produced is proportional to the product of end breakage rate and the average time an end is down. A large number of other variables which affect waste production are raw material, room and fiber conditioning, processing variables, operators and mechanical conditions

Raw material

The blending of different varieties of cotton is normally the responsibility of the spinner. With natural fibers, such as cotton, the maintenance of a completely uniform blend can be very difficult indeed. The first concern of the spinner is to control staple length and fiber fineness, so as to maintain consistent spinning conditions and standard yarn properties.

His second concern is generally with yarn appearance in particular color. He will do his best to ensure that when yarns from different deliveries are compared, the weaver will not be able to see any difference between them. For this proper mixing schedule cross creeling and grading of raw material is a must, according to the count spun from that material.

Room and fiber conditioning

The natural fibers are highly sensitive to the conditions of the ambient air; they are hydroscopic, so that the moisture present, whether expressed as moisture content or re-gain depends to temperature. The mechanical properties of fibers and yarn depend upon the humidity and temperature.

Atmospheric conditions thus influence the rate at which machine can be worked. In a very dry climate or atmosphere, the electrical charges generated by friction, if not conducted away makes it difficult to retain the control of the yarn. Correct R.H. % ensures the working of yarn with minimum risk of breakage, reduction of static electricity by reason of the greater electrical conductivity of the yarn, the amount of fly liberated is also reduced. Moisture content of the textile material affects the physical behavior of the product.

So the conditioning of fiber plays a major part in spinning, variation from optimum conditions can bring about a large increase in the amount of waste produced. Under dry conditions the generation of static electricity promotes the formation of feather edge sliver, roving and yarn which often gets attached to the revolving parts of the machine, too moist conditions also give trouble.

The user of oil can be beneficial since it tends to reduce static charges, can reduce the need for more accurate humidity control and can affect the ends down. The addition of oil can also reduce the amount of fly waste. The addition of anti-static agents is very effective in reducing waste. Antistatic agents allow lower relative humidities, since charges are neutralized as soon as they are formed. However, when an antistatic agent is present more oil can be tolerated.

Processing variables

The treatment given during spinning and adjustment of the various machines, exercise considerable influence upon the quality of yarn spun. If the given mixing is not processed properly, some of the fibers may be damaged during their passage through, various machines; this would not only increase the waste percentage, but would also results in inferior quality of products. The goods manufactured under such conditions would increase the cost price and reduce the margin of profits. Therefore, processing variables such as doubling, drafts, ratch settings, twists, etc in turn effect the amount of waste processing variables, such as doubling drafts, ratch settings; twists, etc.

The conversion of lap to yarn results in the reduction of weight per unit length of the input material, whilst maintaining product uniformity. The uniformity is affected by the weight of draft. High drafts above certain optimum limit produce more irregularity. With the advent of high draft much more attention has to be paid to accurate settings to maintain quality.

In practice, the reduction in weight per unit length is carried out in stages, each drafting operation introduces fresh irregularity, the irregularity of the final yarn being the "summation" of irregularity produced by each operation. Doubling is used as a method of improving the product uniformity, a compromise having to be made between the benefits of extra doubling and the detrimental effects of the extra drafting, which doubling entails.

There is a limit to the number of doublings passage which improves yarn levelness. During carding fiber become hooked and the direction in which the hooked fiber are presented to each process is important. Although later drafting processes tend to reduce the hooks, they are never completely eliminated, the higher the draft, the greater is the need to present the fibers to the drafting system with their hooks trailing.

The direction of fibers is reversed at each packaging operation and since most of the fibers leaving the card have trailing hooks, there would be an even number of packaging processes between the card and the ring frame, in other words there should be an odd number of machines or processes.

When this is the case fibers enter the drafting system of the ring frames, where the draft is normally the highest with their hooks trailing. Failure to present the fibers in the appropriate direction at the ring frame can result in a loss of strength of upto 10%. In other words, ends down in Ring will increase, therefore, it is advisable not to put sliver of one can to another.

Fiber breakage is a function of two main factors, the ratch setting and the roving twist. It is necessary to set the ratch longer than the longest fiber to avoid breakages, since a short ratch will break all fibers greater in length. For a given ratch the extent of machine control over the fibers depends on the length distribution, a wider distribution and longer rather leading to less fiber control.

Twist is used to provide cohesion between the fibers, so as to maintain control over the short fibers, however, this tends to restrict fiber movement and increase in breakages. As the attenuation is increased the amount of twist must be increased, to maintain the strength required to withstand, winding on tension and the tension of withdrawal from the creel at the next operation. This increase in twist combined with the decrease in the number of fibers per cross section must inevitably lead to fiber breakage.

The strain and distortion imposed on fiber ends during drafting due to the initial pull, continually repeated at each operation on alternate ends of the fiber, must lead to an increase in breakage. It is to be expected, therefore, that fibers will be beheaded or beheaded as a result of this stress and fatigue, the effect being more important for longer fibers.

Yarns with high/ normal twist break at thicker spot, because of poor twist propagation. Breakage is caused primarily by the production of thin places but breakage tends to be caused by fiber slipping rather than fiber breakages. High tenacity of fiber causes more static charges in drafting.

Operator

The operator plays an important role in the production, handling of material between processes, cleaning, collecting of waste, etc. The consequences of poor operators and/or incorrect operating procedures.

Excess waste produced by a particular operator, however, may not be only his responsibility, but also that of the supervisor and management. It is the responsibility of management to arrange the staffing of the installation, the classification of the work to be carried out by particular type of operators, the setting out of detailed operating procedures and techniques and the training schedules for supervisors and operators.

It is the responsibility of the supervisor to arrange the operator training and to keep constant check that the operating procedures are carried out correctly. Excess waste produced by an operator may thus be a function of inefficient operating procedures, inadequate training, poor supervision and lack of skills in carrying out particular procedures and/or operator carelessness.

An important operative effect on the amount of waste is the spinner patrol cycles, the average time an end is down is greater and thus more waste will be produced. If the end is down too long a further loss may occur due to the building up of a malformed package.

Mechanical condition

Machinery can be kept upto date only by using proper maintenance schedule. The proper maintenance and updating of machinery is also one of the most important factors to get better quality and optimum production from machine.

In the blowroom, the machinery is mainly expected to open the bales, blend the Cotton from various bales, clean the Cotton from impurities and present it in the form of sheets made of small tuft to the next process. The function of various machines in spinning and their impact on yarn quality suggests, that the processing parameters that are likely to have an impact on yarn irregularity are production rate and settings in carding, and hence these effect fiber separation and level of waste.

The drawframe is essentially meant to parallelize the fibers and to reduce medium and long term irregularities present in the sliver fed to fly and ring frame drafts. Therefore, any research for cause of high yarn irregularity should, therefore, include an assessment of the correctness of these parameters.

Furthermore, the importance of fiber control, brings out the need for checking the aspects of fly and ring frame, break draft, spacer and setting between rollers. It is not possible to set universally applicable norms for all the parameters enumerated above. However, inter mill comparison and studies provide broad guide lines.

Roll drafting, or the attenuation of slivers and roving to produce yarn of specified counts, is perhaps the most important principle involved in the processing of raw cotton into yarn. The more nearly perfect the drafting at each yarn preparation machine, the stronger and more uniform will be the spun yarn.

It is important, therefore, that the drafting at each process and especially in the spinning of the yarn should be as perfect as possible, but in practical an ideal condition of drafting can never be attained at any process or in any machine. This is true because of the varied factors that effect drafting, some of the more important of which are:

1. The accuracy and suitability of roll settings.
2. The employment of reasonable roll speeds.
3. Correct weighting of rolls.
4. The amount of draft.
5. The condition of the drawing rolls.
6. The physical characteristics of the cotton fiber.

With the advent of high drafting much more attention has to be paid to accurate setting to maintain quality. High draft requires perfectly fluted rolls with a minimum of run out; quality yarn depends on quality rolls. Spinning spindle speeds have in recent times reached or surpassed the 15,000 rpm. This calls for a more precise centering of the spindle, than was the practice when 9,000 rpm was considered a high speed. Imperfect centering will have a considerable effect on yarn quality, including yarn fuzziness, increased end breakage, premature and irregular ring wear and rapid traveler deterioration. This causes the length of yarn between the traveler and the winding point to vary. If we consider that the traveler lies on a normal plane at the yarn delivery and the difference in yarn length must come from the winding point.

Only that the travelers is being dragged and not driven, plus yarn elasticity keeps the yarn from breaking. As the travelers is being dragged, it is free to follow the movements imposed by the yarn and will varies its speed.

The difference in winding points is recovered by yarn, which is already wound and the traveler is forced to suddenly, accelerate and decelerate at its opposite points. Two negative effects are

traveler behavior and the effects on yarn quality, the traveler in normal working conditions varies its speed and position according to the slow variation of the winding diameter. However, when spindle is eccentric, the condition created by the eccentric spindle forces sudden speed variations.

The deceleration creates an inertia movement and a consequent in yarn tension. This forces the traveler to change its normal inclination and to assume almost vertical position. A sudden acceleration causes the traveler to lean excessively and to come into contact with both the upper and lower part of the ring.

This condition results in aggravated ring wear, as the traveler is creating heavy friction by working in wedged position. Thread tension is consequently increased. If the mechanical damage resulting from the above situation is considerable, than the yarn quality will obviously suffer. A bobbin of yarn spun of this spindle will be quite fuzzy, with the degree of fuzziness relating directly to the spindle eccentricity, so proper maintenance is one of the most important factors to get quality and production from the machine.

Waste control

It is important to examine the problem of waste control in terms of all processes rather than just the problems involved in Ring. Since saving in one department may lead to increased waste in other departments.

It is clear for example that significant improvement may be expected by placing more emphasis on a more uniform initial product. It is also important to think in terms of subsequent processing after spinning i.e. weaving, finishing etc. since any economy in spinning which results in low yarn quality may have adverse effects in later processes.

The control of waste may be carried out by taking steps to obtain optimum processing conditions and by implementing a waste control scheme.

Given a particular raw material and particular mill there must be an optimum set of conditions, i.e. relative humidity, doubling, draft, machine settings etc. which will give the best quality in conjunction with minimum waste. No two mills are alike, i.e. the optimum conditions in one mill may not be the optimum in another. In order to obtain the best results, it is necessary to carry out a continuing experimental programme constantly varying roller settings, spindle speeds, traveler weight, etc. until the best combination is achieved for each count and quality. Careful recording of

the results is necessary and the sampling methods used must stand up to statistical demands.

After obtaining the best technical standards, the next step is to put these standards into practice. It is also necessary to record the performance of each lot as a guide to future experimentation, so that standards may be constantly revised to maintain optimum conditions.

An important feature in the maintenance of technical standards is the institution of continuous and systematic quality control and preventive maintenance, when these later processes are adequately maintained, the likelihood of significant waste due to machine faults is greatly reduced.

It should be realized in all spinning room testing that only very small percentage of spindles are tested, so that constant visual checks and periodic re settings are necessary to ensure that these are representative of the whole.

The implementation of regular end break checks can be invaluable, as an aid in the maintenance of end break rates to predetermined levels end, in the location of faulty spindles. It is good practice to number every spindle on every frame and to note the spindle on which end break occur during the checks, so that spindle with high end break rates may be detected.

Control scheme

It is important to note that a "Waste drive" will be virtually useless, unless it is followed up by systematic methods and supervision. It is often not good enough to call in supervisors to announce that departments are producing too much waste and that they had better do some thing about it.

As a first step the problem should be explained intelligently in terms of cost, quality and job security to all key supervisors and their cooperation to run the scheme would be advisable so that various aspects may be adequately coordinated.

The next step is to determine the location of waste problem. This will usually involve the combined thinking of supervisors and management and this can be arranged by organizing a series of periodic meetings on waste to be attended by all concerned individuals. Each supervisor should be encouraged to talk about his particular waste problem and suggest methods of reducing the waste.

Last, but not the least, it is essential in any waste control programme, that a scheme of classification and sorting of waste is designed and implemented. ♦

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