Cotton Contamination

Its Sources & Remedial Measures

By:
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ABSTRACT

According to recent survey by ITMF, Indian cottons are amongst the most contaminated cottons in the world due to the lack of availability of systematic instruments to judge the level of contamination. Contaminations present in the fabric not only deteriorate the quality and appearance of fabric, but also affect on the profits of the organization. Here, we have tried to highlight the sources and remedial measures for contamination, practiced in the cotton cultivation to yarn manufacturing industry.

INTRODUCTION

As prevention is better than cure, it is always more desirable not to generate contamination at all than to have to clean it at different stages of processing. To achieve this, all concerned industries have to work together. According to recent survey by ITMF, Indian cottons are amongst the most contaminated cottons in the world so; producing yarns of world class quality from Indian cottons is a greater challenge. This challenge can be met with selection of suitable cottons, appropriate work practices and proper use of modern machines and technologies. Contamination represents a significant threat and element of cost to spinning mills and this led them to implement a range of costly methods to remove the contamination. On analysis it was found that amongst all the areas of textile sectors, "Fiber cultivation to Yarn spinning stage" remains major source of contamination. Therefore, we have highlighted certain facts and few recent developmental steps, which are being taken to reduce or minimize the contamination level in this area.

NATURE OF CONTAMINATION

Before finding any measures for elimination of contamination first of all let us understand the possible sources of contamination and necessity for contamination removal. Once these sources are sorted out, elimination process becomes effective and easier. Contamination is "the presence of extraneous and undesirable substance in yarn which leads to impure the quality of final textile product". Contaminations at yarn stage are mainly categorized in three types:

1. Removal contaminations like dust, rust, mud and washable finish stains.
2. Partially removable contaminations like loose fly spun, oil stain and grease stain.
3. Irremovable contaminations like bleached fiber, fibers having optical brightening agent and dyed fiber contaminations which get spun with the yarn.

According to International Textile Manufacturers Federation (ITMF), the major contaminant found in cotton bales were pieces of cloth from either woven or knitted clothing in various colors made from either cotton or polyester or blends.

For India the need for the removal of contamination is felt much more since currently India is a topmost exporter of the cotton yarn. Contamination is one of the most serious

problems affecting the cotton fibers. The whole product is rejected due to contamination, even though the basic material has been from the best of cottons and the product was made using the latest machines, which causes the serious problem in cotton spinning industry worldwide. Contamination is one of the critical issues for spinners to maintain first grade yarn quality because it causes the breakages in the warping, sizing, and weaving results in tile defective packages as well as faults in the fabric thus lowering the efficiency means increased cost of production.

Table 1: Types of contaminant

White contaminants	Alien fibers	Colored objects	Oily substances	Dense objects
White plastic fabric	Hair	Colored cotton fabric	Sticks/twigs	Metal pieces
White plastic strings	Feather	Colored cotton yarn	Leaves	Paper
White/transparent Plastic film	Colored cotton fibers	Jute fabric	Oily/Rusty/Black cotton clumps	Stand, stones
	Coir fibers	Jute yarn	Stamp colored/ Yellow cotton clumps	Leather bits
	Colored plastic fibers	Coir yarn	Tar/Grease-affected cotton clumps	Wooden pieces
		Colored plastic fabric		
		Colored plastic string, film		

SOURCES OF CONTAMINATION

Contaminations are not being grown with cotton balls in the tree. These are mostly "added" in fresh cotton during picking. Contaminations to raw cotton take place at every step i.e. from the farm picking to the ginning stage. Since cotton is picked manually by ruler woman so human hair, contamination caused by cloth pieces and fabric sheets are the biggest source of contamination.

International Textile Manufactures Federation (ITMF), Zurich, which conducts a survey on cotton contamination every two years, has identified five major sources of contamination:

1. Strings made of jute.
2. Strings made of hessian.
3. Fabric made of jute.
4. Fabric made of hessian.
5. Organic matter such as leaves, feather, paper, leather etc.

Contamination within raw material
There are the two possibilities of contamination. As the natural fiber cultivation, ginning, and packing process are mostly manual, chances of oil/grease/rust stain on fiber after the stoppages, or the maintenance activities of spinning machines exist.

Handling of packing material during raw material opening
Due to poor wrapper quality, wrapper stripe is passing with fiber mixing and converting in small fiber/strip during carding and finally, gets spun with fiber and creates contamination in yarn.

Cleaning of mixing and conditioning bin
To create difference between product and lot, different chemicals like antistatic, lubricant, optical brightening agent and tint apply on the fiber gets stick on wall and floor and apply on next chemical free mixing will results in contamination if the cleaning is not followed properly.

Frequent product change and loose fly spun
Running gray and dyed material in the same department causes fibers floating from dyed material, getting contaminated with gray material and vice versa. The starting of dyed material after run out of gray material on the same machine produce contaminated yarn. When two or more different products are running in same department, then contamination is mainly caused due to lose fly.

Oil and grease stain after machine maintenance
In case of some machine parts getting oil or grease stains during its maintenance and are not properly cleaned then it results in contamination.

Table 2: Various sources of contamination, their effect and remedial stages

| Source of contamination	Effect	Remedies
Strings/fabrics of jute/hessian	Increased end breakage rate at ring/rotor. Poor yarn appearance differential dye pick-up.	Avoid use of hessian for transport at farms and ginning. Use of cotton cloth for bales.
Strings/fabrics of cotton	Poor quality yarn/cloth	Manual picking, automatic transportation, training
Strings/fabrics of woven plastics/plastic film	Differential dye pick-up. Very Poor quality yarn/cloth. Damaged to machinery	Avoid use of plastic material, better housekeeping and practices
Organic matter - Leaves, feather, paper, leather etc	Increased waste at spinning Damaged to machinery	Use of pre-cleaner at ginning, use of gravity trap, better housekeeping.
Inorganic matter 1. sand dust 2. metal/wire	Increased waste at spinning Damaged to machinery	Use of pre-cleaner at ginning, use metal detector, better housekeeping.
Oily matter 1. Stamp color 2. Grease/oil	Mars yarn/fabric appearance	Avoid use of stamp color, better house keeping
Hair- human	Increased end breaks at ring rotor Poor yarn/fabric appearance	Use of caps, automatic transportation, education/training
Stones	Damaged to machinery	Better housekeeping and practices
Seed coats	Increased waste at spinning Poor yarn/fabric appearance	Use pre-cleaner and post cleaner at ginning
Pouches - Gutkha	Damaged to machinery part	Better practices, education/ training

CONTAMINATION DETECTION SYSTEM

Manual process
Contaminants like jute, chindies, HDPE, gutkha packs, etc. can be removed by the workers. It is difficult to detect the contamination -due to their unpredictable size, shape, material and position as some of the contaminants get inside the cotton fiber

layer and become invisible. This system is costly, time consuming and chances of human error are more. The accuracy of this system is also very poor.

Gravimetric method
In this system the contaminated material is removed because of gravity only. In this method of detection of cotton contaminants, a mechanical model is used. For the vision system and the sorting system, synchronized with the movement of cotton on the conveyor, an encoder is installed at the shift of the conveyor and driven by the belt. In this system only heavy contamination can be removed. Efficiency of this system is less due to lot of mechanical parts.

Contamination due to Plastic | Contamination due to Rubber | Contamination due to Grease and Oil
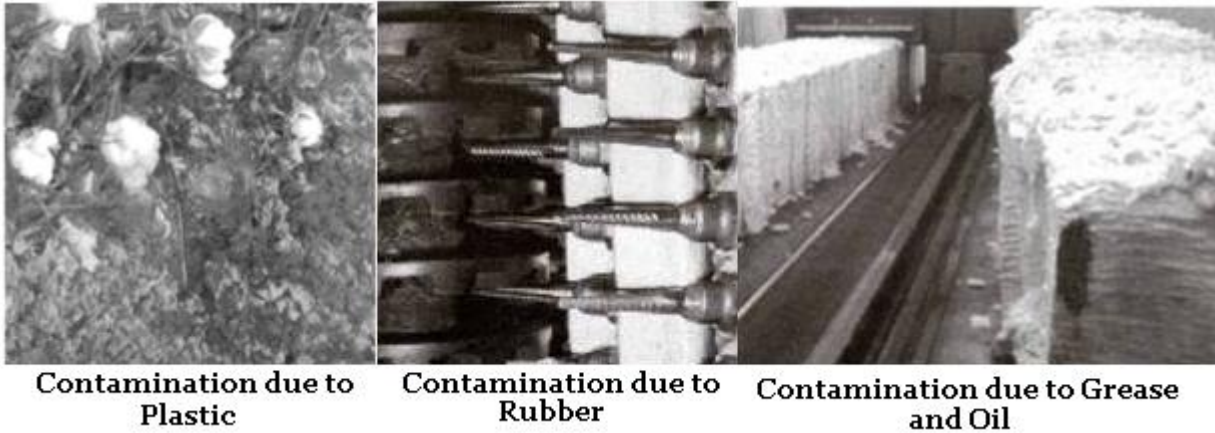
Electro-optical method
Electro-optical method used for cotton contaminant is based on the High Volume Instrument (HVI). This system is suitable for the extensive quality control of all the bale proceeds in a spinning mill. In this system Digital Image Process Technique is used, and this is the one of most efficient method of removal of contaminations.

WORKING PRINCIPLE

Contamination detection by optical means
All systems detect contamination by optical means. Yarn clearers and the" sorter of Loptex use photo sensors and detect the contamination as being darker than the cotton. Optical sensor can only see what visible means is, it cannot detect the contamination which is hidden within the cotton tufts. This permit detection of colorless contamination namely, packing material in polypropylene.

Contamination ejection by ultrasonic means
The degree of reflectance of acoustic waves depends on the surface structure of the object in their path. The sensor consists of a number of emitters of ultrasonic therefore not hearable waves. The receiver will receive waves which are reflected by the contamination contained in the lose cotton. If no contamination is present, the ultrasonic wave will be absorbed in the absorber box located on the other side of the system.

Contamination ejection by pneumatic valves
In case of the detection of a contamination by the optical or the acoustic system, the electronic control will activate pneumatic valves which are variable. It depends on the

size of contamination. It takes into account the transportation speed of the raw material and releases the air blow after the necessary delay. The air blow will be targeted since only the valves are activated, which are located in front of the passing contamination.

CONTAMINATION REMOVAL AT VARIOUS STAGES OF SPINNING

Contamination can be detected at any stage of the processing, from bale to yarn. From the point of view of contamination removal, however each stage has its own advantage and disadvantage in terms efficiency, reliability and impact.

Contamination removal at ginning stage
It is more beneficial to remove the contamination in earlier processing stage because of two reasons, first, the early removal enables to prevent the contamination from spreading to a large extent and second, it also helps to avoid more numerous interventions in later stage.

Figure shows, the manual picking of cotton contaminant before feeding to the blow room. In many ginning factories, electronic contamination control system like Vision shield of Reiter, have been installed in the transportation line between ginning and storing, before putting the cotton fiber into Bale press. Average efficiency of this contamination control system is around 40-45% at this stage. The sorting efficiency is 55-70% with a sorting load of 165 kgs/person/8 hr.

Contamination removal on Blow room
Blow room equipped with different kinds of contamination detection equipment available from different manufacturers like Premier Fibre Eye, Uster Optiscan, and Barco Vision cotton Sorter, Loptex Sorter, and Vision Shield detects and removes the contaminants that can be distinguished by color immediately following the initial stages of opening in the blow room. Any contaminants that are completely masked by the bulk fiber are not detected. The working principle is optical based from all manufacturers. Optimum illumination with combined incident and transmitted light enables both light and dark contaminants to be detected.

Contamination removal on carding and comber
Foreign fibers and cotton contaminants are detected by using intensity and hue properties, they give the Cotton Contamination Analyzer for Micro Cards which convert the raw cotton into thin uniform web without removing any impurities scanned by the CCD camera. Imaging system is used to classify particles in terms of size and number and detect the contamination from the cotton. In case of carding, contaminants are removed with flat and licker-in waste and most of the hair contamination is removed through noil in comber.

Contamination removal on draw frame and lappers
BMS Vision Sliver watch system is installed in the creel of the draw frame for the purpose that it stops the draw frame if the contaminated sliver is detected. Any foreign fibers as well as the fibers of colors other than the cotton are detected. Short and intensive contaminants can also be detected by filter settings.

On lappers up to 24 sensors can be installed in the creel to monitor the sliver and the lapper is stopped if the contaminants are detected.

Contamination removal on ring frame
In the ring frame no direct contamination removal procedure is available but many times yarn breaks where contamination is present. These contaminants go into pnumafit waste, although it does not occur most of the time for very fine fiber shaped plastic contaminations that are longer than cotton fiber and is spun into the yarn.

Contamination removal on winding
Winding is the last process in the spinning mill where the maximum contaminations are removed from the yarn. The procedures are as described below:

By using Electronic contamination channel (foreign matter detection) channel:
Such kind of electronic contamination clearing channels are available from different manufactures like Uster, Loepfe, Keissoki, and Premiere. The working principle is almost same and optical based for all manufactures. During yarn winding this channel measures the color intensity of the yarn and compares the portion every 2mm continuously against the base white yarn. In case of variation in color intensity, it detects and actuates the cutter assembly to cut the contamination portion.

By using PP (polypropylene) contamination detection channel:
The device like Loepfe, Zen it, Uster, Keissoki detect white colored polypropylene contaminants by using UV light. Polypropylene and other synthetic contaminants cannot be detected with conventional optical foreign fiber clearers as contaminants are transparent or look like cotton. The detection is based on the Tribo-electric effect is an electrical phenomenon in which fibers exchange electrons with the sensor, the so called Tribo-electric effect, where certain materials become electrically charged after coming into contact with another different material.

Detection principle
Triboelectric effect
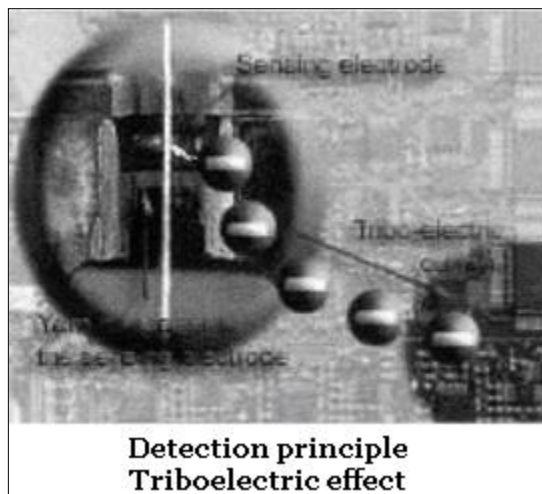
Contamination detection during inspection and packing
Ultra violet lights are installed in the packing and inspection department to detect chemical/oily substances and foreign fibers and other synthetic manmade fibers.

CONCLUSION

Contamination is one of the critical issues for spinners to maintain first grade yarn quality. Contamination comes from raw material, handling of material, ancillary products and work practices. Different methods to reduce contamination are now practiced in cotton ginning to yarn manufacturing processes, which have been reviewed. More and more involvement will definitely improve the contamination removal

efficiency of the industry and as a result such a burning issue of contamination may be solved with ease.

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