

'NEW TRENDS IN COTTON GINNING & COTTON SEED PROCESSING'

By M. K. Sharma – President, Bajaj Steel Industries Ltd., Nagpur India

(Presented at 6th Meeting of the Asian Cotton Research and Development Network, at Dhaka, Bangladesh - 18-20 June 2014)

Abstract

The optimum utilization of all ingredients of cotton i.e. fibre, cotton seed, cotton stalk has become the necessity for survival in the competitive field of cotton growing and processing. The reduction of electrical power cost and to mechanize the operations in a way that manpower component is reduced to the minimum for complete cotton value processing chain has become necessity due to scarcity of manpower and increase in the price of electricity rates in different countries.

The continuous efforts are being made to address these issues by the manufacturers and scientific community and various new equipments / systems have been introduced in the recent year in the journey of modernization / improvement of various operations in the cotton ginning and cotton seed processing.

The goal is to achieve the optimization in the following areas:

1. The cotton fibre will be ginned in a way that it retains best natural fibre parameters i.e. maximum length, natural luster, and other natural parameters as they are available on the cotton boll when it is grown on plant in the field.
2. To fully utilize the various components of seed cotton i.e. cotton lint, cotton seed, hull, kernel, and oil.
3. To fully utilize the cotton stalk etc. to make various items such as wood pallets, particle boards, biogas, energy generation & compost making.

Recent Advances in Cotton Processing Technologies:

The areas in which advances have taken place in the Cotton Processing Technologies may be summarized as below:

- (1) Transportation, loading-unloading and feeding of cotton
- (2) Moisture control in seed cotton
- (3) Efficient cleaning of different varieties of cotton and variable trash contents due to picking / harvesting practices of seed cotton such as varieties of semi-opened cotton bolls, hand stripped cotton, machine stripped cotton, machine picked cotton etc.
- (4) Uniform & Proper Feeding of Seed cotton to processing machines to optimize the production quantities.
- (5) Power efficient individual gin machine seed cotton feeding system.
- (6) Moisture control in cotton lint.
- (7) Uniform cotton bale with optimized user friendly and cost effective making of cotton bales on modernized cotton baling presses.
- (8) Contamination Free Lint.
- (9) Best Spinning Parameters retained after processing.

However area of contamination and trash is continuing to be bad to worse which is primarily due to commercial reasons though the technologies and systems are available to control the same to the maximum extent and the only solution appears to be that with the buyers of the lint cotton and cotton seed or the authorities if they can introduced fool proof methods for quality gradations and realistic standards for allowable trash and contamination limits and the prices of these commodities are totally related to these standards. The details would be seen at length in the full paper.

Introduction:

The cotton plant has long been known as nature's food and fibre plant. The cotton fibre forms about $\frac{1}{3}^{\text{rd}}$ of the cotton boll while the remaining $\frac{2}{3}^{\text{rd}}$ is cotton seed. Apart from the various uses of cotton fibre and cotton seed now various uses have been found for cotton plant / cotton stalk also. As the different parts of cotton plant provide food, feed and valuable industrial products, it is rightly termed as "Golden Goose".

The traditional methods of separating the cotton fibre from seed by some ginning machines and using the cotton seed with linter on it for cattle feed or for oil crushing are going under significant changes and various new uses for each component of the cotton plant have found its way for value addition. Moreover, the methods of transportation, ginning, seed processing have changed in a way that lower manpower and electrical power is required as compared to traditional methods. Apart from positive changes there have also been some trends which have adversely affected the cotton and seed quality. Some of the recent prominent changes in the processing trends of seed cotton and cottonseed are discussed below:

New Trends in Cotton Ginning:

When we talk of ginning, it has to include all the operations which are normally being undertaken in the premises of a ginning factory, (whether the ginning factory is working on job work basis or ginner owns the cotton or it is a government or co-operative ginning factory) from the point, the seed cotton arrives inside the gate of ginning factory till the cotton fibre bales leave the gate of ginning factory. The major operations being undertaken in a ginning factory may be summarized as below:

01. Grading of Seed Cotton
02. Weighment
03. Unloading of Seed Cotton
04. Storage of Seed Cotton
05. Drying & Cleaning, of Seed Cotton
06. Conveying and Feeding of Seed Cotton to Gins
07. Ginning of Seed Cotton
08. Cleaning of Cotton Lint
09. Conveying of Cotton Fibre to Press
10. Conveying of Cotton Seed to packing area
11. Humidification of Cotton Lint
12. Baling of Cotton Lint
13. Sampling of Cotton Lint
14. Testing of Cotton Lint
15. Storage of Cotton Bales
16. Storage of Cotton Seed
17. Loading of Cotton Bales
18. Ginning Factory Premises

1. Grading of Seed Cotton

In cases where the seed cotton is brought in modules and the farmer himself owns the cotton no grading used to take place at the ginning factory premises but in view of increased electrical power costs the ginning factories have started grading the same for moisture and trash contents to decide the level of drying and cleaning required and the job work charges are varied depending upon moisture and trash contents as the cost of single or double stage drying and cleaning varies.

In cases, where the ginner has to buy the cotton from the seller and the cotton is brought either loose in the vehicles or in the bags, ginner used to do the hand ginning to decide the fibre length and the seed cotton was spread on ground to detect mixing of varieties. Majority of ginner have started using laboratory model gins and testing equipments for determining the length and other parameters. This has resulted in better understanding.

2. Weighment

In case of the purchases of cotton by ginner various malpractices were adopted in the ginning factories. Now most of the weighment is taking place on independent or government approved marketing yards weighbridges. This has resulted in correct weighment.

3. Unloading of Seed Cotton

Traditionally seed cotton when brought loose or in bags was being unloaded in the ginning factory premises manually. With the increase in the cost of manpower and unavailability of adequate manpower, modern methods of its unloading; such as telescope or tractor attachments are being used, which has reduced manpower cost significantly.

4. Storage of Seed Cotton

In cases of loose arrival of seed cotton earlier heaps were made manually or by belt conveyors which were time taking and costly. Now tractor attachments are widely used to make heaps or carrying the same to storage place which has made the process very fast and cost effective.

5. Drying & Cleaning, of Seed Cotton

Though the best machines for cleaning the seed cotton for handpicked as well as machine picked have been developed where the trash contents can certainly be brought below 1 or 2% however due to acceptance of higher trash contents by the spinning mills very few ginner are making full use of these cleaning devices. In cases, where the moisture is above the recommended limit of 7-8% in seed cotton, the dryer must be used for proper cleaning but for the same reason of spinning mills accepting the higher trash contents and normally not paying any premium for lower moisture and trash contents in absence of direct purchase from the ginner (most of the time bales are purchased through brokers who cannot market the quality of specific ginner and offers same price for all ginner in an area and situation of spinning mills at distant places than the supplying ginner). In several cases, ginner add excessive water as high as up to 25% or more on seed cotton which results in higher trash and deteriorated fibre parameters for earning higher through this malpractice is really creating multiple problems and national loss due to wastage of energy in adding the water than drying the fibre and seed as well as damaging the goodwill of the cotton of the country which finally results in lower exports and reduction in value in long term. It is the need of the hour that this problem excessive water addition in seed cotton is tackled by institutions like International Cotton Advisory Committee and respective governments of the countries by proper gradation and regulatory systems.

6. Conveying and Feeding of Seed Cotton to Gins

The uniform feeding of seed cotton to the ginning machines is of vital importance to obtain optimum production and reduce electrical power and other costs of ginning. In the recent past several devices such as seed cotton dispensing systems, level sensor based feeding systems; reservoir boxes have been added to seed cotton feeding systems in the various countries where earlier these systems were not in use as the capacity specific systems were not available. Now with the introduction of these systems by various machinery manufacturers, the ginner have started taking advantage and optimizing their ginning costs per unit.

7. Ginning of Seed Cotton

The following technologies are being used for cotton ginning in the world:

1. Saw Ginning
2. Roller Ginning
 - (a) Double Roller Ginning
 - (b) Single Roller Ginning
 - (c) Rotobar Rotary Knife Roller Ginning

In the last decade the share of Saw Ginning in the world was about 85% (Harvesting and Ginning of cotton in the world by Dr. M. Rafiq Chaudhry) while the share of Roller Ginning was only 15%. Most of the ginners were unaware of selection criteria of ginning technologies and used to purchase the ginning machinery led by the information available in their area and other factors such as financing and government to government country relations were the guiding factor rather than suitability of ginning technology for their cotton. Now the ginners have started understanding the role of cotton fibre parameters such as length, micronaire, strength, trash content etc in the selection of suitable ginning technologies and now prefer to buy the ginning machines based on suitability of technology to fibre in their area. This trend is increasing day by day such as the Benin which up till now uses only Saw Gins are willing to go for Double Roller Gins as early as possible due to its suitability for the cotton to be ginned in the country.

The Selection parameters of ginning technologies can well be understood from the paper *"Cotton Ginning Technologies - Selection Criteria for Optimum Results"* by Mr. M. K. Sharma – President, Bajaj Steel Industries Ltd., Nagpur India At, “The First International Conference on Science, Industry and Trade of Cotton” Held, on October 2-4, 2012 at Gorgan, Iran.

The spinning mills prefer roller ginned cotton as the fibre parameters in terms of length, neps, short fibre and strength are best retained for certain cotton varieties and pay higher value by about 2 cents per pound for roller ginned cotton. Among the roller gins Double Roller Ginning is the most preferred as this technology can gin most of the varieties at lowest costs while Rotobar Rotary Knife Roller Ginning is suitable mainly for black seeded cotton where the attachment is lowest however now the efforts are being made to make it suitable for fuzzy seeded cotton also. Single Roller ginning is getting outdated due to its higher costs of ginning. The share of Double Roller Ginning has increased significantly in the past decade and at present around 35% of the world cotton is being ginned on Roller Gins out of which Double Roller Gin is having 30% share alone. Many other countries where the cotton is handpicked are intending to expand in Double Roller Gin; therefore the share of Double Roller Ginning is likely to up sharply. Similarly, in USA high speed high capacity Rotobar Rotary Knife Gin are being tested on upland cotton successfully and it is likely that share of this technology will increase in countries like USA and Turkey etc.

8. Cleaning of Cotton Lint

Fibre friendly lint cleaning technologies are need of the hour and various devices such as Saw Lint cleaners with / without Louver Max, Sentinel Lint Cleaner have been introduced in USA for saw ginned fiber, while simpler lint cleaning devices such as spike cylinder cleaners, leather flap cleaners, and leaves cleaner grid etc. have been introduced in India, which are suitable for roller ginned cotton.

9. Conveying of Cotton Fibre to Press

Traditionally the lint was being carried to bale press by suction system in automated factories where some fibre damage used to occur; now the trend is changing towards conveying of lint to press by belt conveyors which is retaining the natural luster.

10. Conveying of Cotton Seed to packing area

Against traditional conveying cotton seed by screw conveyor, the trend is changing to convey by Roots Blower positive displacement and online weighing of cotton seed and direct packing in standard bags where the seed is not required for further delinting or oil milling.

11. Humidification of Cotton Lint

As against traditional cold moisturization of lint the ginners have resorted to scientific humid air application in lint slides for proper humidification, this has helped in improvement of fibre parameters and moisture contents. More and more ginners are understanding the advantages of humid air moisturization and use of this system to balance the fibre moisturization at desired level is increasing.

12. Baling of Cotton Lint

There are different sizes and weight of cotton bales in different countries. It is necessary that uniform cotton bales size and weight should be adopted for the standardization of machinery at ginning and spinning level. In the recent past the trend is more and more acceptance of international cotton bales standard ISO 8115 and the bale sizes as mentioned in the standard are being adopted, which is optimizing the container loading and reduces transportation costs to some extent, however a long way is yet to go in this direction and it is recommended that ICAC and governments / regulatory authorities should pay attention to this requirement. Moreover, the complete coverage of bale is necessary to stop entering of trash in cotton bales which also needs to be further improved.

13. Sampling of Cotton Lint

Sampling of cotton in most of the countries is done by selecting specific bales from a lot and big samples of over 2 Kg are cut in presence of buyer's representative due to mutual distrust among buyer and seller. Whole of the world is willing that the sampling method from each bale by taking small samples are few samples per lot taken by some regulatory / independent authority may eliminate the traditional method of sampling and cotton quality may be improved to great extent. The presses being supplied by the machinery manufacturers are having provision for small sample cutter which should be used and the data generated by the regulatory / independent authority should only form the basis of trading.

14. Testing of Cotton Lint

The traditional testing of lint by hand has now been majorly replaced by machine testing HVI or AFIS. The trend is increasing day by day and in the near future only testing machine results will only be acceptable.

15. Storage of Cotton Bales

The open storage of cotton bales is replaced by covered and humidified storage of cotton bales which is helping in improved fibre parameters.

16. Storage of Cotton Seed

The traditional storage of cotton seed in the bags is now changing to storage in silos which is retaining the seed parameters and contributing to better realization of value in terms of higher oil after long storage. This trend is likely to further increase in near future.

17. Loading of Cotton Bales

The Traditional manual loading of cotton bales in to the trucks and containers is now totally mechanized by tractor attachments or forklifts. This has reduced the requirement of manpower significantly and made the loading very fast.

18. Ginning Factory Premises

Apart from above practices, the ginning premises have been upgraded to be fully concreted and covered storage which is helping to improve the working inside the factory premises and control on trash contents

It will be seen that various measures are being taken in the ginning sector to improve upon the working and reduction of electrical as well as manpower requirement per unit of ginning which will certainly help to improve the profitability and working of this sector however certain practices of adding excess water and non standard cotton bales still need to be effectively controlled in the interest of ginning industry as a whole.

New Trends in Cotton Seed Processing:

The cotton seed is the 2/3rd portion of seed cotton boll. The cotton seed has so far been considered as secondary product or byproduct of cotton lint and not given its due importance. Cotton seed has traditionally been considered as cattle feed however in recent time multiple uses to maximize the value generation from cotton seed have been developed. The traditional uses of seed cotton are as below:

01. Feeding whole cotton seed to cattle
02. Use of cotton seed after processing for sowing
03. Processing to obtain oil and oil cake
04. Use of oil cake for oil extraction and de-oiled cake

The new trends in the cotton seed processing may be summarized as below:

1. Removal of Linters from seed i.e. Delinting

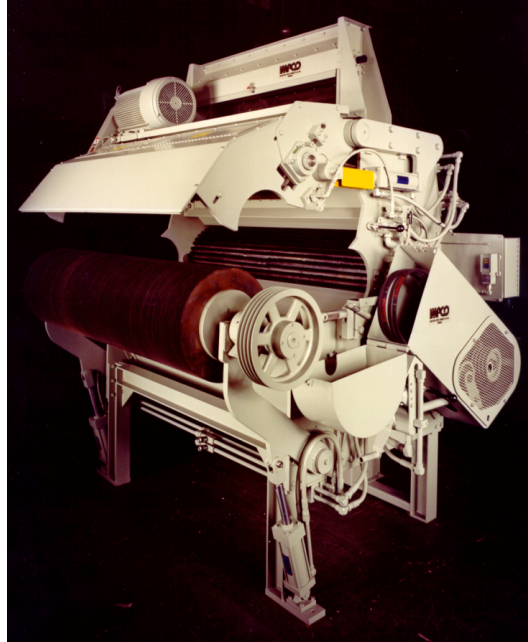
Delinting processes are the new trend. The delinting is done by following four methods

a) *High Capacity Saw Type Mechanical Delinting*

This is the most used process for removal of excess fibre remaining on cotton seed after commercial ginning. In this process higher volumes of seed are delinted by high capacity Saw Type Delinting Machines which only leaves around 3-4% fibre on seed and the balance fibre removed out of around 9-13% fibre on cotton seed. The linter obtained by this process is having several uses which add value for the seed. The major uses may be summarized as below:

- i. Fibre pulp for high quality papers
- ii. Absorbent cottons
- iii. Cellulose Acetate for making Plastics, Films & Yarns
- iv. Cellulose Esters and Ethers for Pharmaceuticals, Cosmetics, Paints, Tooth Paste, Ice-cream, Lacquers, and Salad Dressing etc.

- v. Cellulose Nitrate for Dynamite, Smokeless Gun Powder, Solid Rocket Propellants
- vi. Felts for Automotive Upholstery, Pads, Cushions, Furniture Upholstery, Mattresses and Comforters etc.
- vii. Yarns for Twine, Rugs, Mops, Lamps and Candle Wicks etc.



Saw Type Mechanical Delinter

b) *Mechanical Delinting by Brush Delinter:*

Where the capacity requirements are lower, Brush Type Delinters are most preferred. Standard Brush Type Delinters are having about 500 Kg. cotton seed per hour processing capacities hence average 10 Tons cotton seed can be processed per day in 3 shifts. The linter obtained can be used for similar uses as referred in Clause 'a' above. This removal makes the seed either available for further processing for sowing seed by using lower quantity of acids or other chemicals, commercial oil crushing to obtain higher oil percentage, feeding to cattle as black seed or decorticating process.



Brush Delinter in Use

c) *Diluted Sulphuric Acid Delinting:*

For high capacity sowing seed plants this is most ideal method to produce naked seed without producing any pollutants for sowing seed preparation. Each machine in this case processes about 1 Ton cotton seed per hour. The linter in this case is not recovered hence this process should preferably be carried out after mechanical delinting to better utilize the value chain of cotton seed.



Diluted Sulphuric Acid Pollution Free Delinting Plant

d) *100% Concentrate Sulphuric Acid Delinting:*

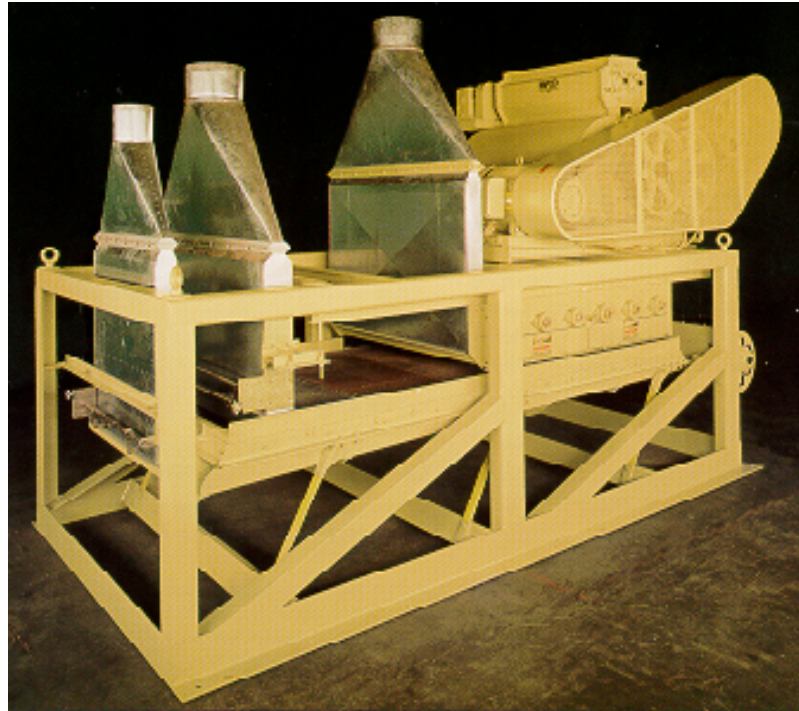
This Delinting process is used for small capacity say 1-5 Kg. per batch cotton seed delinting for preparation of sowing seeds or laboratory requirements; however the pollution created by this process is a major problem.

Particularly Mechanical Delinting provides linter which adds value to the grower / user and improves his earning and product utilization.

By removal of excess fibre remaining of cotton seeds after commercial ginning through the delinting processes for its several uses such as paper making, paints, plastic, crackers, automotive upholstery, cotton swabs, cellulose nitrate, viscose, food casings and several other uses

2. Removal of Hull from Delinted or Un-delinted Cotton Seeds - Decortication

When the cotton seed oil is extracted by Solvent Extraction, it is most suitable that the decorticating should be used by which the hull should be removed from the cotton seed and only kernel / meat should be used for solvent extraction for higher efficiencies. The hull obtained can be used for cattle feed, oil well drilling mud, poultry litter, mushroom growing etc. while the Kernel can be used for crude oil extraction or meal and cake for various feedings to cattle, fish, sheep, goats, horses and poultry etc.



Decorticator with Hull Separator

3. Use of De-oiled Cake for Cattle Feed for High Protein Diet

The dairy cattle feeding is one of major use for de-oiled cake. The cotton seed de-oiled cake as 41% protein product. As per AAFCO definition the de-oiled cake must not contain less than 36% crude protein. When most of the oil is extracted and only 0.5 to 1.5% oil remains in the cotton seed meal then the same is termed as de-oiled cake. The high protein diet increases the milk production in the milking cattle significantly. Various experiments have shown that cotton seed de-oiled cake is best feed for milking animals for higher milk quantity and their health. The users are now understanding the advantages of the cotton seed de-oiled cake for cattle feed and its uses for the purpose are increasing rapidly. Apart from this cotton seed de-oiled cake is also used for fish and poultry feeding.



Cotton Seed De-oiled Cake

Apart from cotton fibre and cotton seed significant changes in the use of cotton stalk have also witness improved trends and cotton stalk pallets, billets and particle boards production is increasing day by day. All these measures are contributing towards the growth of cotton sector and increase in the value of the products from cotton plant.
