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FUTURE TRENDS IN COTTON GINNING AND PRESSING TECHNOLOGIES

A Presentation by

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Introduction:

The projected demand of cotton by the Ministry of Textile, Government of India for the year 2012 is 375 lacs (37.5 million) bales.

At present the area under cultivation of cotton in India is about 90 lacs (9 million) hectares.

The current average yield of cotton in the India is expected to be about 591 Kgs. lint per hectare as against world average of 785 Kgs. Lint per hectare while yield in the countries like Australia, China and U.S. is 1840 Kgs. Lint, 1265 Kgs. Lint and 985 Kgs. Lint respectively.

The growth rate for utilization of cotton is about 10-15%, at present and among all the natural fibres cotton constitutes about 80% of the total consumption of natural fibres in the world. There are various possibilities to increase the use of cotton for diversified product manufacture.

The value addition in the cotton may be done to a great extent by cost efficiency in the processing of cotton and byproducts and optimization of use of byproducts.

The King Cotton or White Gold will continue to dominate fibre scenario of the world and quantum of Indian cotton will continue to grow due to favourable conditions for the production and use of cotton in the country. .

The average cotton yield for India during the last year was about 560 Kgs. lint per hectare and out of 90 Lack (9 million) hectares India could produce above 3 Crore (30 million) bales.

The average yield in India was around 300 Kgs. fibre per hectare in the year 2002-2003 which has rapidly grown to current levels of above 560 Kgs. per hectare during the 2007-2008 and are set to grow further to cross the world average and without any change in the area under cultivation of cotton the quantum may go to 375 Lacs bales if the yield goes to 708 Kgs. lint per hectare by 2012.

With the various irrigation projects being completed in the cotton growing states, integrated pest management schemes and research on cotton varieties there is every possibility that the yield will be above 800 Kgs.lint per hectare in the near future.

With the increase in cotton availability, the demand for better quality cotton fibres nearer to that of hand ginned is becoming the challenge before the cotton ginning & pressing machinery manufacture. The optimization of process cost is another challenge to face the intense competition

Thus the ginning has become a very important area to get the edge in the cotton business. In the words of *Mr. Roy V. Baker (ARS-USDA Lubbock Texas)* and *Mr. A. Clyde Griffin Jr. (ARS-USDA Stoneville, Mississippi)* "Ginning, in its strictest sense, refers to the process of separating cotton fibres from the seeds. The cotton gin has as its principal function the conversion of a field crop into a salable commodity. Thus, it is the bridge between cotton production and cotton manufacturing. At one time the sole purpose of cotton gin was to separate fibres from seed. But today's modern cotton gin is required to do much more. To convert mechanically harvested cotton in to a salable product, Gins of today have to dry and clean the seed cotton, separate the fiber from the seed, further clean the fibres and place the fibres in to an acceptable package for commerce. The Cotton Gin actually produces two products with cash value i.e. the fibre and the cotton seed. Cotton seeds are usually sold to cotton oil mills for conversion into a number of important and valuable products, but in some cases they may be saved for planting purpose. The fibres are the more valuable products, and the design and operation of

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cotton gins are usually oriented towards fibre production. In essence, the modern cotton gin enhances the value of the cotton by separating the fibre from seed and by removing objectionable foreign matter, while preserving as nearly as possible the inherent qualities of the fibre.”

In view of above ginning technologies have become of great importance to produce good quality fibre and to get better returns in the cotton trade.

Historical Background:

The Cotton production in India was mere 136 lacs (13.6 million) bales in the year 2002-03 which has increase over 315 lacs (31.5 million) bales by year 2007-08 and Indian cotton which was termed as most contaminated cotton in the world has achieved a trash level of below 1.5% in many modernised ginning & pressing factories now.

The cotton ginning factories which used to operate predominantly in the manual setup and were highly labour intensive uptill 2001, a large number of them have upgraded their infrastructure and machinery under Technology Mission on Cotton (TMC) and Technology Upgradation Fund (TUF).

The Indian Cotton Mills which used to accept cotton with higher trash contents are now demanding best quality cotton thus putting pressure on every ginning factory to modernise else their cotton is not getting preference in the purchase by the mills.

The smaller ginning factories are finding it difficult to achieve economy against composite ginning and pressing factories hence either going for expansion and upgrading themselves to composite ginning & pressing factories or closing down.

New fully automatic composite ginning & pressing factories have been setup by many renowned groups and individual plants having a capacity of up to 2000 bales per day have been setup in the same premises. (A photo of one of such plant is shown here)



The cotton ginning season earlier used to be longer than six months, has now become shorter to about 3-4 months and much higher speed is required for ginning to handle same volume.

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The individual machine production has increased to some extent as in case of Double Roller Ginning Machines the capacity per gin has gone up from about 50 Kgs. Lint per hour to about 90 Kgs. lint per hour for normal varieties.

The manpower requirement in the Ginning & Pressing Plants has come down drastically in case of automatic Ginning & Pressing Plants.

The fibre qualities being obtained from these modernized and automated Ginning & Pressing Plants is much better than the manual setup.

The four Ginning Technologies i.e. 1) Saw Ginning (about 55%) 2) Double Roller Ginning (about 35%) 3) Rotobar or Rotary Knife Roller Gin (about 5%) and 4) Single Roller (about 5%) being used in the world are having their own considerations and the competitiveness of the cotton is affected by use of particular technology, hence needs to be examined and the most suitable technology needs to be adopted to achieve cost effectiveness.

The most of the developments have taken place during recent period in India whereas elsewhere in the world such as USA, China etc. no significant developments except development of high capacity saw gins has taken place.

The Down Packing Single Stage Double Box Doorless High capacity Cotton Baling Presses have provided much needed solution to reduce manpower and contamination for cotton pressing as well as problems related to underground pit of 40' required for up packing manual presses. Now the complete press is above the ground in the many automated plants where all the maintenance parameters are always under operators watch thereby ensuring troublefree continuous operation.

The cotton bales packing has been adopted with full cover from outside the baling ties thereby reducing any chance of entering of dusts etc after packing.

Despite all significant developments in the Ginning & Pressing Technologies for Pneumatic / Mechanical Conveying of Cotton, Cleaning equipments, increase in production per machine a lot is needed to be done to achieve the expected speed of ginning with optimized fibre parameters and to fully use the each and every byproduct of cotton in optimized manner to get best value.

Future Expectation from Cotton Ginning & Pressing Technologies

The future expectations of technological development in the Cotton Ginning & Pressing Technology may be summarised, as below:

- i. To standardize and provide clear understanding about selection of ginning technology suitable to obtain best results.
- ii. To provide solutions to the areas which are yet to be mechanised.
- iii. To achieve highest cost efficiency with existing equipments.

Future Development Efforts underway for Cotton Ginning & Pressing Technologies

1) To standardize and provide clear understanding about selection of ginning technology suitable to obtain best results.

"Because of the major contribution of ginning to lint quality one should be extremely careful in the selection of ginning machinery. The details about the lint quality obtained on the ginning machine is of prime importance apart from the productivity. The advantages and disadvantages of low production ginning machine as well as high production ginning machine should be carefully compared" - Rohit Bajaj & M.K. Sharma – Current scenario of Cotton Ginning Industry – Page 165 Book of Papers, 21st International Seminar on Cotton & its Utilization in the 21st Century (Dec.1999) CIRCOT.

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“In advanced countries most of the ginning is performed on saw gins. Of late, however, there has been renewed interest in roller ginning especially because of its positive advantages over saw ginning in respect of higher ginning percentage and better retention of fibre length. It may be mentioned here that saw ginning always results in loss of fibre sometimes to the extend of 3%. Further most short fibres with lengths less than 12mm are left unginning requiring further processing. It is also known that saw ginning leads to more neps in the yarn.” *Dr.N.C. Vizia and Dr. K R K Iyer – Ginning Research in India-Future Prospects – Page 169 Book of Papers, 21st International Seminar on Cotton & its Utilization in the 21st Century (Dec.1999) CIRCOT.*

Table 1 – Performance of Different Gins

GOT %	Process Loss %	2.5% Span Length (mm)	U%	Card Web neps/500 Sq. cm.	Yarn Strength (CSP)	Short Fibre%
32.2	0.7	27	46	17	2244 (40 ^s)	25
35.6	0.2	27.5	49	5	1940 (40 ^s)	17
33.7	3.9	29.5	42	33	2016 (60 ^s)	30
37.3	2.7	31	42	10	1866 (60 ^s)	30
33.7	3.9	35.2	51	33	2208 (80 ^s)	32
38.1	1.1	36.8	43	9	2256 (80 ^s)	28.4

Dr.N.C. Vizia and Dr. K R K Iyer – Ginning Research in India-Future Prospects – (170) Book of Papers, 21st International Seminar on Cotton & its Utilization in the 21st Century (Dec.1999) CIRCOT.

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“Rotobar or Rotary Knife Roller Gin includes ginning roller and a stationary knife to which seed cotton is conveyed by the friction surface of the ginning roller for separating lint fibers from the cotton seed, and a rotary stripping blade divide adjacent the stationary knife having blades forming channel-like pockets there between for receiving the seed cotton deposited on the surface of the ginning roller and advanced to the zone of the stationary knife. The blades of the stripping blade device extend radially from a center shaft to span the width of the gin and are arranged in a one turn spiral path about the center shaft, and the stripping blade device has a diameter which is a small fraction of the ginning roller diameter and rotates at a speed causing the surface speed of the blade edges to be approximately the same as the surface speed of the ginning roller such as to restrain seeds in the channel-like pockets while the seeds are advanced over the edge of the stationary knife from the “pinch point” to a “release point” while the ginning roller strips lint from the restrained seeds and then releasing the seeds from blade restraint at the release point before they are pushed beyond the length of the fibers attached at the “pinch-point” (after they travel about $\frac{1}{2}$ the staple length beyond the knife edge) to return to the knife edge before the next blade applies advancing force to the seed and thereby withdraw substantially all the fibers from the seed. An auxiliary feed control roller for providing more even feed to the blade device and comb structure to return unginning seeds to the ginning zone are also disclosed. This technology is having major disadvantages of seed cut and unginning cotton going with seeds”. - *M.K. Sharma – New Developments in Cotton Ginning - 67th Plenary Meeting of the ICAC in Ouagadougou, Burkina Faso (4th Breakout Session).*

“In the case of cage Gins the fibres are pushed between two small rollers (diameters~1/2”) and are ginned by means of either leather clad or hard rubber clad rollers that are pressed against the former. Thus ginning is limited to long fibres due mainly to the factors like the size of the seed, dimensions of the cage rollers and the gin rollers. Thus these are not efficient”. - *Dr.N.C. Vizia and Dr. K R K Iyer – Ginning Research in India-Future Prospects – Page 172 Book of Papers, 21st International Seminar on Cotton & its Utilization in the 21st Century (Dec.1999) CIRCOT.*

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“Templeton Rotor gin is of a different design based on roller gin principle. It employs a huge drum of 1.5M diameter rotating at 350 rpm and containing leather segments. Cotton is ginned with the aid of fixed knives all radiating from the centre of the drum. There are no reciprocating knives however. As per the admission of the designers it can gin only long fibres” - *Dr.N.C. Vizia and Dr. K R K Iyer – Ginning Research in India-Future Prospects – Page 172 Book of Papers, 21st International Seminar on Cotton & its Utilization in the 21st Century (Dec. 1999) CIRCOT.*

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From the various studies it is well established that Double Roller Ginning Technology is the most gentle and fibre friendly technology which can be used in cost effective manner for all type of cottons hence all the future Ginning & Pressing Plants should be based on this technology only. Similarly Automatic Down Packing Baling presses are found to be most advantageous as against up packing pit based cotton baling presses.

The pneumatic conveying is found to be most advantageous as it is helpful to reduce trash and contamination, hence the same should be used for conveying seed cotton as well as cotton fibre / lint.

Electromechanical Raw Cotton Feeding Screw Conveyor based systems to feed each gin are found to be most suitable as the same are feeding each gin at same time in controlled way to facilitate highest production per ginning machine.

The seed cotton, cotton bales and seed must be stored in fully covered godowns to avoid contaminations and fire hazards.

Looking to various parameters, all future ginning plants in India should be fully automatic, composite, high volume, double roller ginning machines with pre and post cleaning and down packing baling press plants with fully covered storages for seed cotton, cotton bales and seeds to achieve best results.

II) To Provide solutions to the areas which are yet to be mechanised:

The areas like seed cotton unloading, seed cotton stacking, contamination removal are yet to be fully addressed. The proper machines and technologies are yet to be developed. In this area, some Indian companies as well as international companies have worked to find solutions for manual picking countries, however the standardisation and mass acceptance of the same are yet to be achieved. The countries like USA have achieved solutions in this regard by module making however same have not found wide acceptance in many other countries, therefore suitable technologies and equipments to suit different requirements of different countries or equipments which can be accepted by different countries simultaneously have to be developed. The research in this regard is underway.

III) To achieve highest cost efficiency with existing equipments:

Though number of suppliers have come up in India as well as other countries to provide customized solutions in respect of seed cotton and lint conveying, however the same do not provide proper solutions for different varieties and compositions of cotton i.e. sometime fibre parameters are getting affected or conveying is obstructed due to higher moisture and other reasons. The tailor made solutions to all such requirements are to be found.

The cotton season which earlier used to be for over six months now the same have come down to about four months, thus the speed of ginning is required to be increased to meet the volume.

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Significant changes have been made in cotton cleaning, conveying baling, and humidification technologies, which are going to benefit cotton ginning & pressing factories in near future.

i) High Efficiency Double Roller Ginning Machine:

Uptill 1998, Double Roller Gins were of lower capacity i.e. about 50-60 Kgs. Lint/Hr. thereby operating cost was higher and the ginning was uneconomical. After year 1998, high capacity, Jumbo Model of Double Roller Gins is having a capacity of about 90 Kgs. Lint/hr. The modifications have improved the working of ginning factories significantly. The research to further increase productivity of the Double Roller Gin to reduce the grooving cycle, roller washer technology for longevity and strengthening of machine to increase the ginning speed is going on and in the future a higher capacity Double Roller Gin will be available to Ginning Factories.

ii) High Efficiency Pre -cleaners:

Absence of proper pre-cleaning machines were an impediment in obtaining cotton with lower trash and contamination. These equipments were designed to suit the Indian cotton in different sizes and capacities which are used now by the cotton ginning & pressing industry to obtain clean cotton. Further improvements are underway to improve the grid, spike and speed to optimize fibre parameters and efficiency. Further, trash collection conveyor is added to improve the trash removal system.

iii) Pneumatic / Mechanical Cotton Conveying Systems:

The manual conveying of seed cotton into the ginning hall was replaced by well designed, suitable capacity, electrical power efficient, pneumatic suction system to pull the cotton from length up to 750 feet with multiple points. This has resulted in reduction of substantial number of manpower and dependent inefficiencies due to erratic working / non-availability of manpower. Moreover, regular supply of seed cotton has resulted in uniform and sufficient feeding to Double Roller Gins thereby increasing productivity. This has also helped in reducing the contamination and trash. Further efforts to improve airseparators, vacuum wheels, optimized calculations of suction requirement to improve power efficiency as well as maintain fibre parameters are underway.

iv) Automatic Individual Gin Feeding System:

Sensor based individual Gin feeding auto regulators and Overhead Distribution Conveyors over a series of Double Roller Gins in one row and parallel rows has eliminated complete requirement of manpower for feeding each gin and ensured continuous and controlled feeding as per requirement of gin which has helped higher production and reduction of manpower requirement greatly.

v) Improved Auto Feeder / Lattice Feeder on Double Roller Gin:

Earlier each gin was required to be continuously fed and cotton was to be stirred to avoid chocking of beater area. Now improved Auto Feeder / Lattice Feeder provides a reservoir for about 10 minutes feeding to each gin and level sensors signals re-feeding as soon as cotton level in the feeder goes below minimum level hence continuous feeding of cotton is ensured while the rotating lattice spikes removes excess material as well as stirs the cotton in the beater area, thus manual involvement is fully eliminated. As per paper "Performance evaluation of Lattice Feeder for Double Roller Gin" published in journal of The Indian Society for Cotton Improvement – Volume 28, December 2003 (03) "The Lattice Feeder assists in continuous feeding and even distribution of seed cotton to Gin" "Use of Lattice Feeder led to an average increase in Ginning output of 7%".

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- vi) **Automatic Lint Suction System from each DR Gin:**
A well designed Lint collection chutes, Lint Collection Boxes and incremental lint suction ducting has automated lint collection up to lint cleaner. This has eliminated total requirement of manpower for lint collection from each Gin and its carrying up to Lint Cleaner. Further improvements in respect of central suction pipe connections, improvement in lint collection hopper has improved the efficiency greatly.
- vii) **Fibre Friendly Lint Cleaners:** Use of fibre friendly Lint Cleaner with improved Grid and Spike systems has helped to remove trash from lint without damaging the fibre. Further trash removal systems introduced recently have greatly improved the trash removal efficiency.
- viii) **Use of Scanners for Contamination Removal:** Camera and sensor based contamination removal systems have been introduced after the lint cleaner to remove the colour contaminants, which take out all coloured contaminants thereby providing the contamination free cotton to spinning industry.
- ix) **Multipoint Suction System to connect to the Bale Press:** Multipoint suction systems or single point suction system from the end of lint collection conveyors fitted below series of lint cleaners for each module of ginning machines, has facilitated the high volume single ginning factories based on double roller ginning technology and plants upto a capacity of 2700 bales per day using multiple bale presses of 35 BPH each, on three shifts basis being setup in India making them world's highest capacity ginning & pressing factories.
- x) **Use of Humidification Systems :** Modified Humidification systems to suit Double Roller Ginned lint coming out in blanket form have been incorporated in the lint feeding slide or lint feeding belts which can add moisture in controlled manner thereby providing all the benefits of humidification before baling. This has been well accepted by the ginning factories based on Double Roller Ginning Technology. M/s. Bajaj Steel Industries Ltd., Nagpur have provided world-class online Humidification System in collaboration with M/s. Samuel Jackson USA.
- xi) **Use of Down Packing Automatic Baling Presses with online Bagging Arrangements:** Earlier Double Roller based ginning & pressing factories used to have up packing old fashioned manual cotton baling presses requiring a pit of about 40' below the ground level and using large number of manpower being double stage. Now fully automatic, down packing baling presses with online bagging arrangements are being installed in most of the new factories after year 2001. This has resulted in full covering of the bales which finally saves it from contaminants and manpower requirement has come down to 4 persons only. To provide baling solutions to smaller ginneries so that they can operate as composite units a small capacity single box fully automatic press has been introduced by M/s. Bajaj Steel Industries Limited for 8 bales per hour capacity.
- xii) **Value Addition New Trends by Delinting & Decorticating & Use of Cotton Stalk :** In view of new uses found and higher value for linters, D.O.C. and better oil percentage a new trend of delinting and decorticating plants has started. Now worldclass machinery is being introduced in India by prominent machinery manufacturers in technical collaboration with U.S.A. machinery manufacturers. Similarly, parical boards are being made from cotton stalks for better value addition.



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The challenges ahead are to find out ways and means to reduce the energy consumption of per kg. lint produced, to bring down the processing costs, to further improve fibre quality, to further increase productivity and efficiency of machines and to standardize the machinery used for each level of operation in the Ginning & Pressing Factories.

Conclusions:

The technological developments in Ginning & Pressing Machinery has acted as an driving force in structural shift from old outdated to more productive advanced machinery. By and large the good pace of technology development and dissemination has been witnessed in India in the last 10 years. This has helped to produce good quality cotton and also met the need to gin and press additional quantities of cotton produced by the country in a better way. This has also helped the acceptance of Indian Cotton in the world market and about one million bales of cotton were exported in the year 2007-2008 from India. The Indian Textile Industry is now getting better cotton, thus can produce world-class fabrics and resultant benefits are accruing. It will strengthen further and in all probable the ginning industry would emerge out of its inglorious past and march ahead with pride, by providing world standard cotton lint. The continuous thrust of Government, research institutes, organizations like Cotton Association of India and machinery manufacturers towards technological developments will prove a driving force for the further improvement of cotton ginning & pressing machinery in future and the Indian Cotton Ginning & Pressing factories will achieve best fibre properties due to gentle ginning technologies at the same time with the matching speed of developed countries.

