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Cotton Quality Requirement and Its By-product Utilisation

EXPERT's Column

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Dr. P. Jagajanantha is a scientist at ICAR – CIRCOT (Central Institute for Research on Cotton Technology), Mumbai. His specialisation lies in the fields of Textile Chemistry, Textile Technology and Smart Textiles. He has handled projects in multi-disciplinary areas like developing conductive yarn, developing smart textile garments and eco-friendly method of preparing absorbent/ surgical cotton as Principal Investigator (CRP on Natural Fibre-external project). He has also worked as Co-Principal Investigator on developing PPE for front line workers, during the on- going Covid-19 pandemic, developing heat generating garments for high altitude sportswear and commercial wear, developing eco-processed sanitary pads and air filteration fabrics for window curtains. He has received Best Employee Award under scientist category for the year 2020, ICAR-CIRCOT, Mumbai. He also received 'Best Paper' award at International Conference on "Applied Science, Technology Management and Language Studies" held at Sona College of Technology, Salem in 2020.He has numerous research papers to his credit.

Cotton is one of the premier commercial crops of India supporting the livelihood of about 60 million people engaged in cotton cultivation, trade and processing. The requirement of quality cotton has always been an issue with the processors. The quality of the cotton fibre is dependent on the pedigree or genetic composition of the variety as well as on the conditions under which the plant is grown. Although fibre quality parse cannot be improved during processing, however improper handling or processing can adversely affect the quality. With globalisation and the opening of markets, major changes have taken place in the cotton processing industry. ICAR-CIRCOT, Mumbai had worked on many by-products of cotton like cotton seed oil, degossypolised meal, cotton seed hulls, cotton stalk, cotton linters, nano-cellulose etc. and came out with many technologies for budding entrepreneurs.

The market value of Indian Textile and Apparels was USD 137 billion (2016) and it is expected to grow upto USD 226 billion by 2023. The textile sector has evolved in India since the first cotton mill was started in Mumbaiin 1854. Today, with 50 million spindles and 0.75 millionopen-end rotors, which accounts for about 24 per cent of the world's spindle capacity and 8 per cent of global rotor capacity; India has the highest loom capacity (including hand looms) with 63 per cent of the world's market share.

In order to cater to this kind of industry India needs to produce the raw material of matching magnitude. Textile plays a major role in the Indian economy. India's textile market contributes 14 per cent to industrial production and 4 per cent to GDP with over 45 million people employed; the industry is one of the largest sources of employment generation in the country.

Requirement of the Industry

India became a net exporter from an importer of cotton after 2003-04. The increased production after meeting domestic consumption, opened the opportunities of export of raw cotton by India. The improvement in quality has been a major achievement in recent years and the textile industry has expressed their satisfaction. Today, Indian yarn is widely accepted in international markets, as the exporters here regularly meet the needs of importers with unmatched efficiency and economy in countries like USA, Italy, Spain, Japan, China, South Korea, Taiwan, Bangladesh, Vietnam, etc.

Table 1: Count-wise Production of Cotton Yarn during the Year 2015-16

Sr. No.	Count	Production in million kgs.	Requirement of cotton* (lakh bales of 170 kg.)
1.	1s-10s	634.39	47
2.	11s-20s	754.27	55
3.	21s-30s	981.05	72
4.	31s-40s	1209.83	89
5.	41s-60s	378.63	28
6.	61s-80s	127.88	9
7.	Above 80s	51.95	4

**Assuming the average waste percentage at 25 % (In the case of carded yarn, we can assume an average waste of 18% (from blow room to winding). In the case of combed yarns, we can assume an average waste of 36%. Of the total quantum of yarn production in Indian mills, combed yarns constitute 35% and carded yarns constitute 65% (roughly)*

Table 2: The Classification from the UHML Point of View

Category	Range of UHML (mm)
Short	20 mm and below
Medium	20.5 - 24.5
Medium Long	25.0 - 27.0
Long	27.5 - 32.0
Extra long	32.5 mm and above

The country is divided into three parts so far as cotton production is concerned. The Northern region produces short and medium staple cotton; the Southern region normally produces long staples cotton, while the Central region produces long and medium staples.

Table 3: The Quality of Cotton Required to Produce Different Counts of Yarn

Count Range	Range of UHML (mm)	Minimum value of UI	Minimum Tenacity (g/t) (HVI mode)	Micronaire Range	Type of Cotton
<14s	Below 24 mm	-	-	Above 5.0	Short
14s-18s	24-25	81	27.5	3.9-4.7	Medium
20s-24s	25-26	82	28.0	3.8-4.2	Medium Long
25s-30s	26-27	83	29.1	3.4-4.2	
31s-40s	27-29	84	29.3	3.3-4.1	Long
41s-50s	29-31	84	31.3	3.3-4.0	
51s-60s	31-33	86	33.6	3.2-3.9	
61s-80s	33-34	86	36.6	3.2-3.8	Extra Long
81s-100s	34-36	87	38.3	3.1-3.4	
101s-120s	36>	88	40.0	2.9-3.2	

Table 4: Requirement of Cotton and its Availability

Sr.No.	Count	Requirement of cotton* (lakh bales of 170 kg.)	Type of Cotton required	Requirement (%)	Production (%)
1.	1s-10s	47	Short	15	1
2.	11s-20s	55	Medium	42	32
3.	21s-30s	72	Medium Long		
4.	31s-40s	89	Long	38	65
5.	41s-60s	28			
6.	61s-80s	9	Extra Long	5	2
7.	Above 80s	4			

Despite a bumper crop, the mills were forced to go in for some imports, particularly of extra-long staple cotton (ELS) as there has been a quantitative and qualitative gap in this category. Since the indigenous ELS cottons do not combine all the fibre parameters to yield world class yarn in the superfine count group; mills have been continuing to import such cotton from Egypt, USA, etc.

After the introduction of Bt hybrids for commercial cultivation in the year 2002-03, the composition of cultivation of species drastically changed. Presently, all the cotton in India is under hirsutum group (>95%, 2012) leaving only <5% under arboreumharbaceum and a negligible area under barbadense group. As a result, in recent years, the textile industryhas suffered from a shortage of short staple and ELS cotton.

Cotton By-Products

Cotton seed is the by-product of cotton that obtain from ginning. The four major products that can be obtained from cotton seed, are Linters, Hulls, Meal and Oil. Generally, 5% of the cotton seeds were scientifically processed and the remaining 95% were mechanically expelled.

Scientific processing of cottonseed gives

- Linters (6%),
- Hulls (27%),
- Oil (18%),
- Meal (45%)

Figure 1: By-products Extraction from Cottonseed

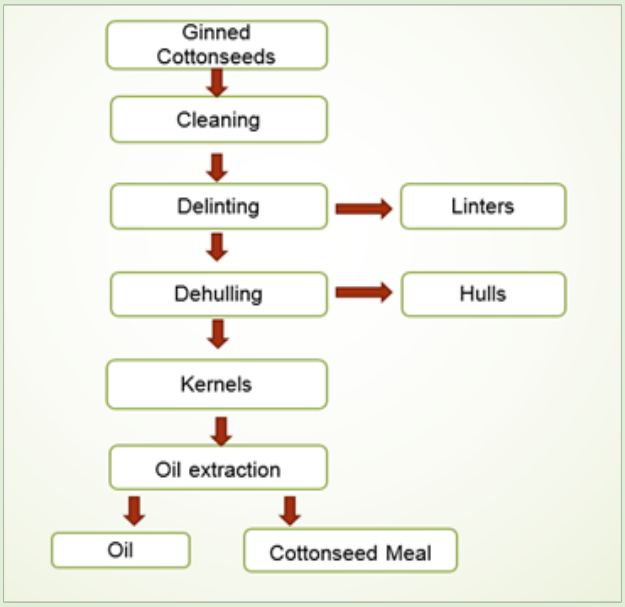


Table 5: Cotton Seed By-Products and their Value

Products (Mn. Kg)	Availability* (Qty)	Value (Rs Mn.)	Potential (Qty)	Value (Rs. Mn.)	Additional Benefit (Rs. Mn.)
Cotton Linter	39.6	871	7920	174240	17336
Cottonseed Oil	1400	926124	2.25	1451498	52537
Cottonseed Hull	178	2492	35640	498960	49646
		929487		**2124698**	**Rs.1195 Billion**

Cottonseed Cake

Presently, in India, whole seeds are crushed and oil is extracted in which case the oil recovery is only 11-12%. The cake thus obtained is fed to cattle. The crude protein in the cake is about 25-27%. When kernels are used for extraction of oil, the recovery of oil is much better and the cake fetches a better price due to its high protein and good colour.

Cottonseed Meal

Availability: 5.75 million tonnes annually

- Oiled Cake: 5.4 m tonnes and De-oiled cake: 0.35 m tonnes
- Uses: Mostly used for ruminates feeding
- Total gossypol content: 0.6 - 1.15% (0.05 – 0.7% free gossypol)

- Gossypol: Limitation to non-ruminants like fish and poultry
- Large scale production of degossypolised meal under trials
- Small scale production of degossypolised meal for poultry and fish feeding, etc. using CIRCOT technology

Cotton Seed Oil

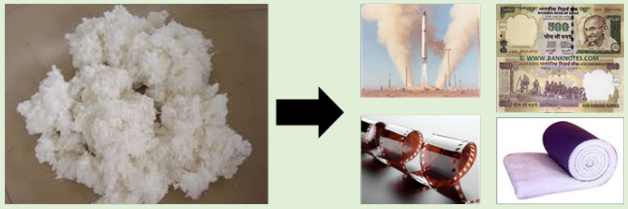
It is well known that as much as 60-70% of seed is available from seed cotton during ginning. The cottonseed despite being rich in edible oil and protein, has not received as much attention as it deserves. The seeds are stored in the open and there could be chances of infection by fungi elaborating aflatoxins. Such seeds become unfit for feeding to cattle and even the meal cannot be exported. Efforts have to be made to utilise cottonseed more scientifically to realise good returns.

Figure 2: Scientific Cottonseed Processing Plant

Preparation of Pulp and Paper from Cotton Linters

Cotton linters are the short fuzzy fibresderived from cottonseed. The linter sample was mechanically cleaned using shirley trash separator. Cleaned linter samples were kiered with various concentrations of alkali (2%, 4% and 6%) in a rotary bomb digester at 160°C for 2 hours. The kiered samples were washed thoroughly and then converted into pulp by beating in a valley beater to desired freeness. Pulp samples were bleached in plastic containers using hypochlorite at 40°C for 2 h. Standard paper sheets were prepared from all the pulps and evaluated for various strength properties. The test results indicated that the quality of paper was quite satisfactory.

Figure 3: Products from Cotton Linters



Uses:

Cellulose Nitrate (explosives), Cellulose acetate (film, membranes etc.), High grade paper (currency, security), Medical grade cotton (absorbent), Micro crystalline cellulose (filler in tablets) Food Casings, Felts etc.

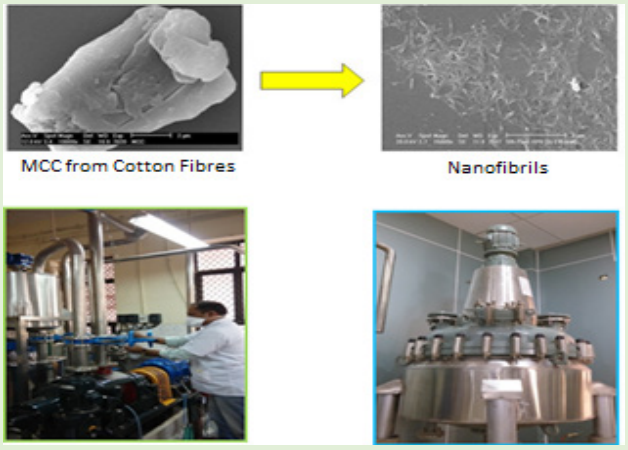
Cottonseed Hulls

Bio-enriched cattle feed: Cottonseed hull is a conventional feed for cattle and is a by-product of seed crushing industry. Cottonseed hulls are available in abundance and are rich in cellulose content but poor in digestibility. The presence of lignocellulosic bonds makes the material difficult to digest by ruminants. It is well known that microorganisms attack lignocellulosic bonds of these materials resulting in improved digestibility of the materials. The digestibility of cottonseed hulls could be improved by subjecting them to an inexpensive anaerobic treatment with mixed microbial consortium for 7 days at room temperature.

Nano-cellulose from Cotton Linters

Nano-cellulose is produced at ICAR-CIRCOT's pilot plant with the capacity of 10 kg per day. The nano-cellulose particle size is usually less than 100 nanometer. Nano-cellulose Crystalline Cellulose (NCC) could be produced from cotton linters.

Figure 4: ICAR-CIRCOT pilot plant with capacity of 10kg/day



Generally the nano-cellulose will have the following properties

- ✓ High mechanical strength (1 to 10GPa)
- ✓ High young modulus (100-130GPa)
- ✓ High surface area (50-200 m2/g)
- ✓ Bio degradable
- ✓ Novel optical properties

Figure 5: Applications of Nano-cellulose

Cotton Stalks

Availability : 26 million tonnes annually

- ❑ Utilisation: About 5-6 % commercially utilised
- ❑ Properties: about 60% holocel lulose, 27% lignin and 6% ash, Gross calorific value: 4000 kcal/kg
- ❑ Commercial Uses: Briquettes, Pellets, Compost, Power generation
- ❑ Under Trials: Particle Board, Pulp and Paper, Hard Boards, etc.

Figure 6: Applications of Cotton Stalk

On-farm Utiliasation of Cotton Stalks

CIRCOT accelerated process for compost preparation. Compost is enriched with nutrients, plant growth microorganisms. This is stable for the period up to one year. In mushroom production, Oyster mushroom (edible) were grown from cotton stalks. This mushroom yields up to 500 g per kg of cotton stalks.

Conclusion

The mills in India produce yarn ranging from 1s count to 80s and above. Therefore, the availability of raw material with appropriate fibre attributes to produce yarn with such a wide range of fineness has to be ensured. It has been discussed the requirement of the cotton fibre by the industry vis-à-vis its present availability has been presented with emphasis on fibre quality. On the subject of cotton by-product, many developments are required to uplift the agro waste utilisation. It is also another path to grow the economy value for the farmers as well as for the country.

(The views expressed in this column are of the author and not that of Cotton Association of India)

Since 1921,
we are dedicated to the cause of Indian cotton.

Just one of the reasons, you should use our Laboratory Testing Services.

The Cotton Association of India (CAI) is respected as the chief trade body in the hierarchy of the Indian cotton economy. Since its origin in 1921, CAI's contribution has been unparalleled in the development of cotton across India.

The CAI is setting benchmarks across a wide spectrum of services targeting the entire cotton value chain. These range from research and development at the grass root level to education, providing an arbitration mechanism, maintaining Indian cotton grade standards, issuing Certificates of Origin to collecting and disseminating statistics and information. Moreover, CAI is an autonomous organization portraying professionalism and reliability in cotton testing.

The CAI's network of independent cotton testing & research laboratories are strategically spread across major cotton centres in India and are equipped with:

- State-of-the-art technology & world-class Premier and MAG cotton testing machines
- HVI test mode with trash% tested gravimetrically

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COTTON ASSOCIATION OF INDIA
Established 1921
ISO 9001:2015

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UPCOUNTRY SPOT RATES

(Rs./Qtl)

Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Gravimetric Trash	Strength /GPT	Spot Rate (Upcountry) 2020-21 Crop April 2021 5th	6th	7th	8th	9th	10th
	Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]												
1	P/H/R	ICS-101	Fine	Below 22mm	5.0 – 7.0	4%	15	10742 (38200)	10798 (38400)	10854 (38600)	10854 (38600)	10854 (38600)	10854 (38600)
2	P/H/R (SG)	ICS-201	Fine	Below 22mm	5.0 – 7.0	4.5%	15	10882 (38700)	10939 (38900)	10995 (39100)	10995 (39100)	10995 (39100)	10995 (39100)
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	8436 (30000)	8492 (30200)	8548 (30400)	8548 (30400)	8520 (30300)	8492 (30200)
4	KAR	ICS-103	Fine	23mm	4.0 – 5.5	4.5%	21	9251 (32900)	9336 (33200)	9336 (33200)	9392 (33400)	9392 (33400)	9392 (33400)
5	M/M (P)	ICS-104	Fine	24mm	4.0 – 5.5	4%	23	10686 (38000)	10742 (38200)	10742 (38200)	10742 (38200)	10742 (38200)	10742 (38200)
6	P/H/R (U) (SG)	ICS-202	Fine	27mm	3.5 – 4.9	4.5%	26	11895 (42300)	11979 (42600)	11979 (42600)	11979 (42600)	11923 (42400)	11923 (42400)
7	M/M(P)/ SA/TL	ICS-105	Fine	26mm	3.0 – 3.4	4%	25	10854 (38600)	10911 (38800)	10911 (38800)	10911 (38800)	10911 (38800)	10911 (38800)
8	P/H/R(U)	ICS-105	Fine	27mm	3.5 – 4.9	4%	26	12035 (42800)	12120 (43100)	12120 (43100)	12120 (43100)	12063 (42900)	12063 (42900)
9	M/M(P)/ SA/TL/G	ICS-105	Fine	27mm	3.0 – 3.4	4%	25	11192 (39800)	11248 (40000)	11248 (40000)	11248 (40000)	11248 (40000)	11248 (40000)
10	M/M(P)/ SA/TL	ICS-105	Fine	27mm	3.5 – 4.9	3.5%	26	11389 (40500)	11473 (40800)	11473 (40800)	11529 (41000)	11614 (41300)	11585 (41200)
11	P/H/R(U)	ICS-105	Fine	28mm	3.5 – 4.9	4%	27	12232 (43500)	12288 (43700)	12288 (43700)	12288 (43700)	12232 (43500)	12232 (43500)
12	M/M(P)	ICS-105	Fine	28mm	3.7 – 4.5	3.5%	27	12204 (43400)	12260 (43600)	12345 (43900)	12345 (43900)	12401 (44100)	12429 (44200)
13	SA/TL/K	ICS-105	Fine	28mm	3.7 – 4.5	3.5%	27	12232 (43500)	12288 (43700)	12373 (44000)	12373 (44000)	12429 (44200)	12457 (44300)
14	GUJ	ICS-105	Fine	28mm	3.7 – 4.5	3%	27	12345 (43900)	12401 (44100)	12485 (44400)	12485 (44400)	12541 (44600)	12541 (44600)
15	R(L)	ICS-105	Fine	29mm	3.7 – 4.5	3.5%	28	12373 (44000)	12401 (44100)	12401 (44100)	12401 (44100)	12373 (44000)	12373 (44000)
16	M/M(P)	ICS-105	Fine	29mm	3.7 – 4.5	3.5%	28	12570 (44700)	12626 (44900)	12682 (45100)	12682 (45100)	12738 (45300)	12738 (45300)
17	SA/TL/K	ICS-105	Fine	29mm	3.7 – 4.5	3%	28	12598 (44800)	12654 (45000)	12710 (45200)	12710 (45200)	12766 (45400)	12766 (45400)
18	GUJ	ICS-105	Fine	29mm	3.7 – 4.5	3%	28	12654 (45000)	12710 (45200)	12766 (45400)	12766 (45400)	12823 (45600)	12823 (45600)
19	M/M(P)	ICS-105	Fine	30mm	3.7 – 4.5	3.5%	29	13048 (46400)	13132 (46700)	13216 (47000)	13273 (47200)	13301 (47300)	13301 (47300)
20	SA/TL/K/O	ICS-105	Fine	30mm	3.7 – 4.5	3%	29	13076 (46500)	13160 (46800)	13244 (47100)	13301 (47300)	13329 (47400)	13329 (47400)
21	M/M(P)	ICS-105	Fine	31mm	3.7 – 4.5	3%	30	13273 (47200)	13357 (47500)	13413 (47700)	13469 (47900)	13498 (48000)	13498 (48000)
22	SA/TL/ K / TN/O	ICS-105	Fine	31mm	3.7 – 4.5	3%	30	13301 (47300)	13385 (47600)	13441 (47800)	13498 (48000)	13526 (48100)	13526 (48100)
23	SA/TL/K/ TN/O	ICS-106	Fine	32mm	3.5 – 4.2	3%	31	13498 (48000)	13554 (48200)	13610 (48400)	13638 (48500)	13694 (48700)	13694 (48700)
24	M/M(P)	ICS-107	Fine	34mm	3.0 - 3.8	4%	33	20162 (71700)	20246 (72000)	20387 (72500)	20387 (72500)	20528 (73000)	20528 (73000)
25	K/TN	ICS-107	Fine	34mm	3.0 - 3.8	3.5%	34	20809 (74000)	20809 (74000)	20949 (74500)	20949 (74500)	21090 (75000)	21090 (75000)

(Note: Figures in bracket indicate prices in Rs./Candy)