Priority Cotton By-products Activities for Development

(Cottonseed: Linters, Hulls and Meal)

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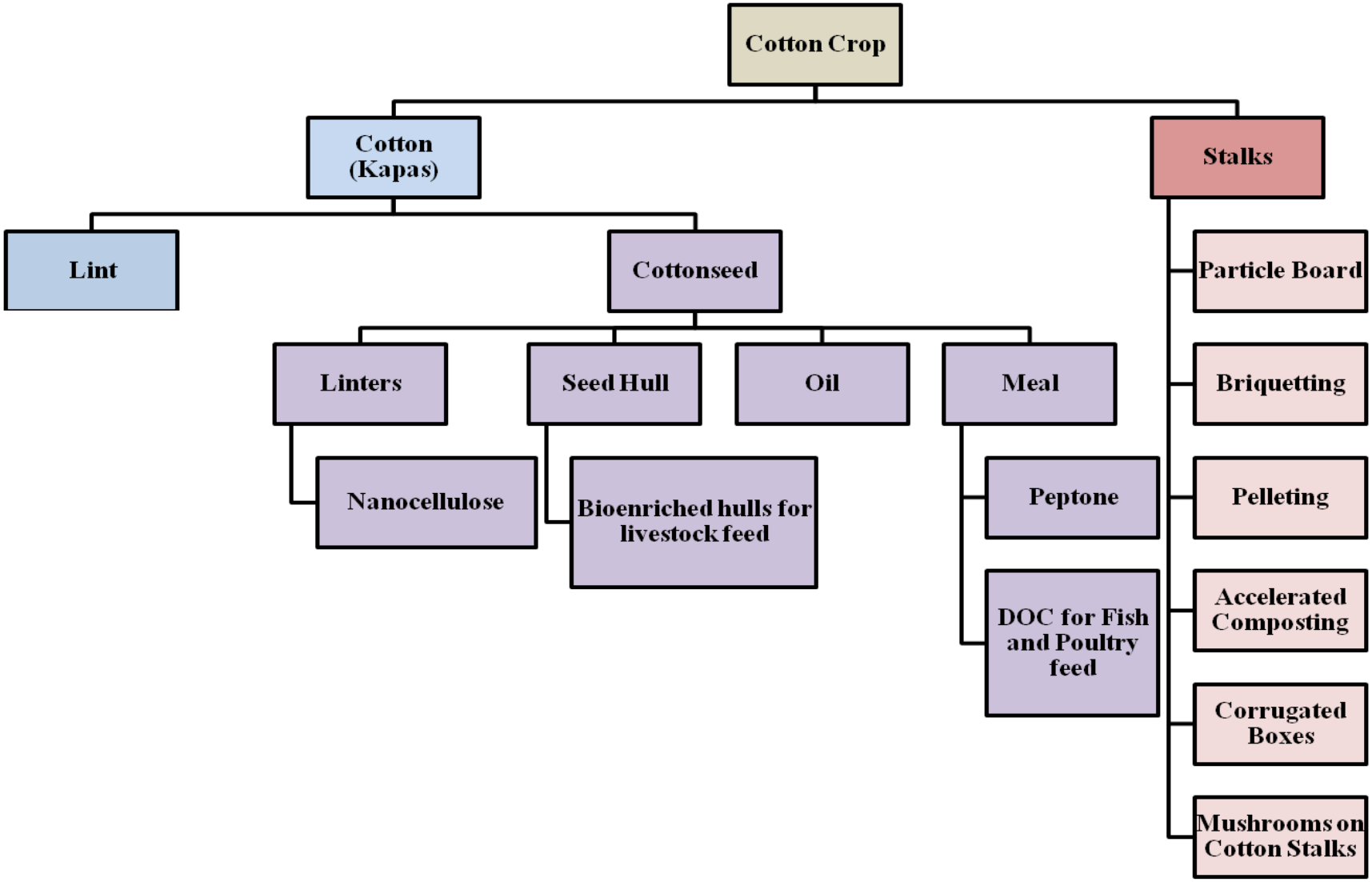
Cotton Sector in India (2016-17)

- Area Under Cotton Cultivation : 10.5 million hectares
- Cotton Production : 5.88 million tonnes
- Cottonseed production : 11.5 million tonnes
- Cotton Stalk Production : 26 million tonnes
- Cotton Farmers : 5 million

Value Addition to Cottonseed and Stalks



Industrial Applications of Cottonseed Meal

Cottonseed cake: India's Experiences

- Availability : 5.75 million tonnes annually
- Oiled Cake: 5.4 m tonnes and De-oiled cake: 0.35 m tonnes
- Uses: Mostly used for ruminant feeds
- 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

Possibility of By-products Preparations from Cottonseed Meal in Tanzania (2016-17)

- Area Under Cotton Cultivation : 350,000 hectares
- Cottonseed production : 121,000 tonnes
- Linters : 12,000 tonnes
- Cottonseed cake(45-55%) : 60,000 tonnes
- Cottonseed hulls (25-27%) : 30,000 tonnes

Source: Estimated based on USDA

- **Prospects exist for Preparation of degossypolised cottonseed meal using CIRCOT Technology**
- **One TPD capacity**

CIRCOT : Degossypolization Technology

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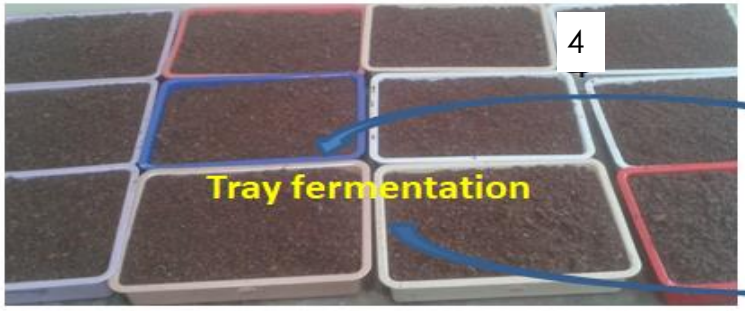

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Degossypolized Cottonseed Cake

- CIRCOT microbial process
  - Reduction of free gossypol content (80%),
  - Reduce bound gossypol (60 %),
  - Reduce crude fibre (30%)
  - Improvement of protein content (40%)
  - Improvement in lysine content (25%)
- Gossypol level meets standard: UN's Protein Advisory Group (UPA)
- Enable Cottonseed meal for Poultry and Fish feed
- Human Protein Supplement

Pilot Scale Production: Degossypolised cake

A	**Capital Investment (1 TPD Capacity)**	**INR (Mn.)**	**USD**
	Land and Building (Land Area: 2000 sq. m; Building for Machinery: 50 Sq. M ; Material storage area:500 Sq. M ; Office Building: 40 Sq. M)	0.50	7,962
	Plant and Equipment	0.90	13,846
	Auxiliary and Service Equipment (Electricals and handling tools)	0.10	1,538
	Total investment	**1.50**	**23,077**
B	**Operational Expenses**		
	Raw Material Cost for 1 year (1 TPD for 300 days @ Rs. 20,000 per tonne)	4.80	73,846
	Operational cost including repair and Maintenance and other charges (Rs. 3000/tonee) for 1 year	0.72	11,077
C	**Gross Annual Income (Rs. 25000/tonne)**	**6.0**	**93,308**
	Net annual income (Rs. 2000/tonne)	**0.48**	**7,385**
D	Payback period: **38 months** Return on investment : **26.3%**		

Cottonseed Hulls

- Hulls contain about 35%-47% of alpha cellulose, 19%-27% pentosans, 15%-20% lignin, 5% ash, protein, fats, etc.

Uses:

- For extraction of Furfural, an industrially important chemical
- Good roughage and commonly used in feed lot and dairy rations

Enhanced utilization of Hulls through Bio-enrichment

- Digestibility and crude protein content of Hulls can be enhanced by fermentation
- With increased digestibility and enhanced level of crude protein it can be used as cattle feed

Industrial Applications of Linters

Linters from Cottonseed: India's Experiences

Short fuzzy fibres from cottonseed

Uses

- Cellulose Nitrate (explosives)

- Cellulose acetate (film, membranes etc.)
- High grade paper (currency, security)

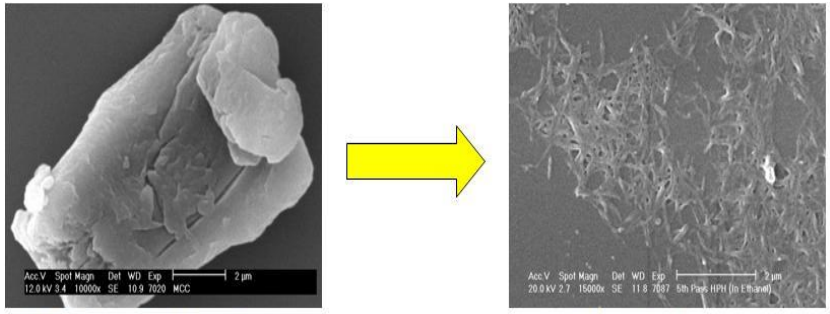
- Medical grade cotton (Absorbent)

- Micro Crystalline cellulose (Filler in Tablets)
- Food Casings, Felts

Nanocellulose from Cotton Linters

Nanocellulose (size < 100nm)

- ✓ High mechanical strength (1 to 10GPa)
- ✓ High young modulus (100-130GPa)
- ✓ High surface area (50-200 m^2/g)
- ✓ Bio degradable
- ✓ Novel optical properties

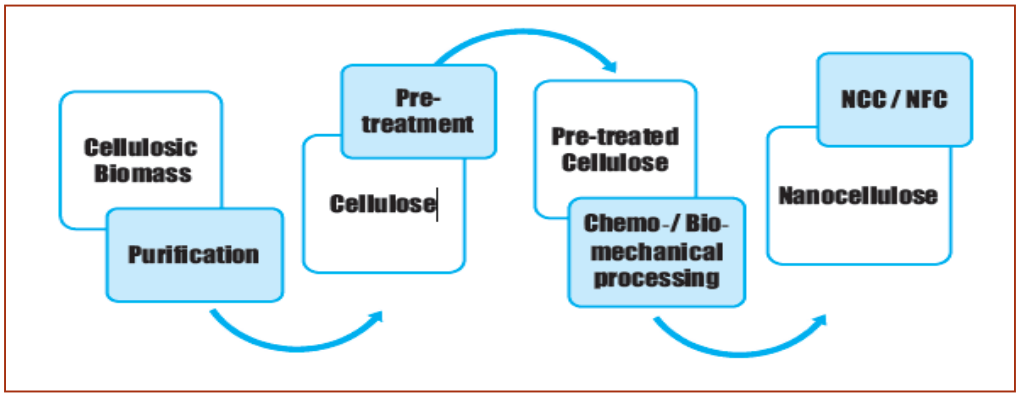


MCC from Cotton Fibers

Nanofibrils

5th Pilot Plant in the World (1st Plant in Sweden – 2011)

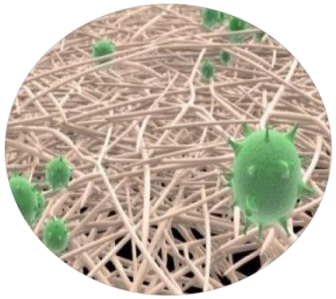
ICAR-CIRCOT pilot plant with capacity of 10kg/day



ICAR-CIRCOT Process

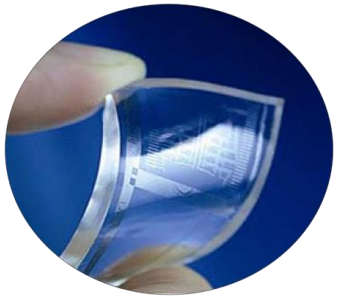
Applications of Nanocellulose

Virus filtration



Emulsion/ dispersion stabilizer

Liquid Crystal Display



Non-caloric Food thickeners

Targeted drug delivery

Fillers in Cement

Fillers in Film

Paper Coating & Furnish Additives

Industrial Applications of short staple/comber noil cotton

Short staple/comber noil cotton: India's Experiences

- **Availability : 0.25 million tonne annually**
- **Properties: staple length < 20 mm, MIC: 3-5; strength: 25g/tex Trash: 0.1-0.25%**
- **Commercial Uses: Surgical Cotton, medicated cotton, Cotton Ball, Ear buds, wadings, security paper, currency notes, blend for coarse yarn and OE spinning for denim production**
- **Under Trials: Technical Textiles, etc.**

Standard of Absorbent cotton

Raw Material	Virgin Cotton/Comber noil
Sinking Time/absorbency	< 10 Sec
Water Holding Capacity	Not less than 24 times of It's weight in water
Ether Soluble Substances	Max 0.50 %
Water Soluble Substances/Per 5g	Not more than 0.50%
Alcohol Extract	Colorless
Sulphate Ash	Max 0.40%
Surface Active Substances	Max 2mm
Mercury	None when examined under ultraviolet light
Odor	Odorless
Foreign Matter	Absent
Extractable Coloring Matters	Negative
Moisture (%)	8

Absorbent Cotton Preparation Process

i. Bale opening- manual or machine

ii. Pre-cleaning & opening- cleaner

iii. Kier/HTHP bleaching (100 ^{0}C Temp and 4 bar pressure using wetting agent, NaOH and H_2O_2

iv. Neutralization and Hydro extraction

v. Wet opening

vi. Drying

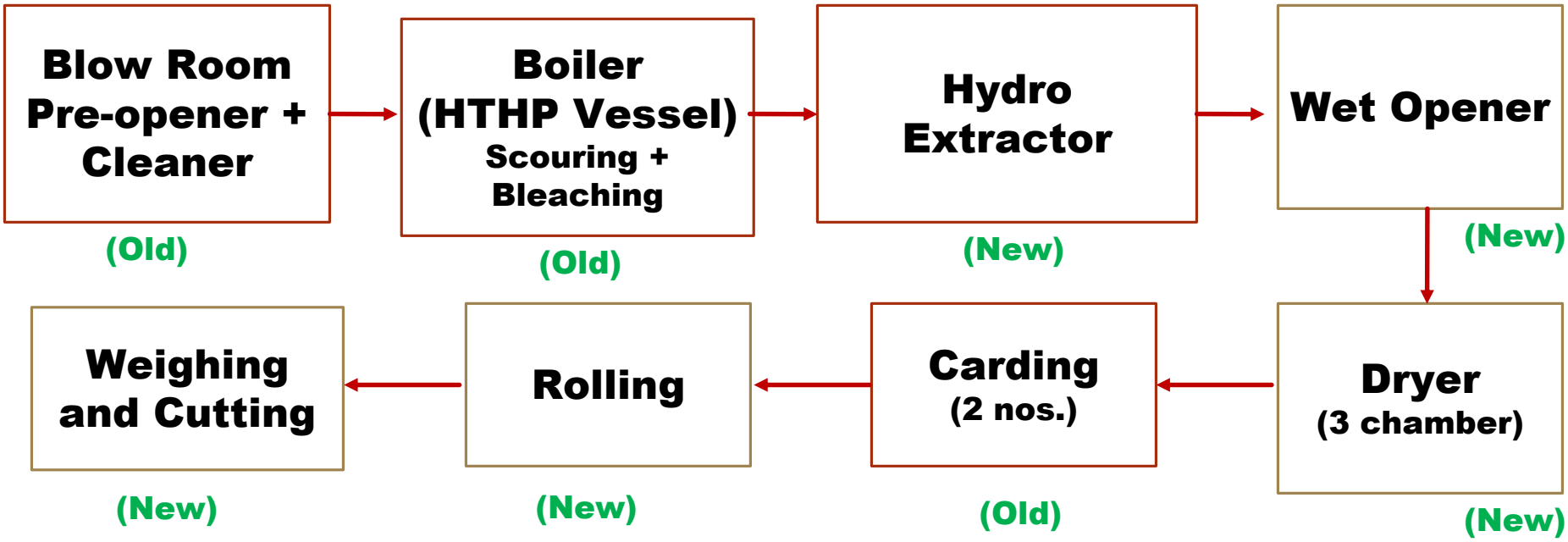
vii. Carding

viii. Cutting, weighing

ix. Packaging

Flow Chart for Absorbent Cotton Plant

- **Capacity: 1.5 TPD for 3 shifts (Semi automatic can be converted to fully automatic)**



Commercial utilization: Absorbent Cotton

A	Capital Investment (1.5 TPD Capacity)	INR (Mn.)	USD
	Land and Building (Land Area: 1000 sq. m; Building for Machinery: 600 Sq. M ; Material storage area:200 Sq. M ; Office Building: 300 Sq. M)	**0.50**	**7,692**
	Plant and Equipment	**4.00**	**61,538**
	Auxiliary and Service Equipment (Electricals and handling tools)	**0.50**	**7,692**
	Total investment	**5.0**	**76,923**
B	**Operational Expenses**		
	Raw Material Cost for 1 year (1.5 TPD for 300 days @ Rs. 90,000 per tonne)	**40.05**	**616,153**
	Operational cost including repair and Maintenance and other charges (Rs. 40,000/tonee) for 1 year	**18.0**	**276,923**
C	**Gross Annual Income (Rs. 1,900,00/tonne)**	**85.5**	**1,315,384**
	Net annual income (Rs. 50,000/tonne)	**2.25**	**34,615**
D	Payback period: **27 months**	Return on investment : **37%**	

Bottom line

- Cottonseed meal is well established product for animal feeding, however, it can be explored as poultry and fish feed.
- Utilization of Cottonseed oil is well established and is recognized as safe edible oil across the World
- Bioenrichment of Hull will enable it as good feed supplement
- Explore the option of Absorbent cotton Production

Announcement

International Training Programme

- ICAR-CIRCOT offers International Training cum Exposure programme on "Post-Harvest Processing of Cotton and value addition to crop residues" to African Nationals

- Fourth coming training programme in this series is scheduled during 19.02.2018 to 03.03.2018, Nagpur

Thank You

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