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Evaluating Gin Roller Covering Materials for Cotton Double Roller Gins for the Sustainable Communication, Media, Society and Culture

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Abstract
"Sustainable communication, media, society and cultural development is the development that meets the needs of the present without compromising the ability and efficiency of future generations to meet their own communication, media, societal and cultural needs".Case study and check on gin roller covering materials for cotton double roller ginsin Industry 3.0 were considered. The roller gin can be defined as a cotton gin in which the lint cotton is pulled from the seed-cotton (*or kapas*) by a roller covered with vegetable-tanned leather from walrus (roller leather) and assisted by a fixed knife and moving knife. Walrus (a large sea mammal) has a thick layer of blubber (Whale fat). Blubber is an important part of a walrus marine mammal's anatomy. It stores energy, insulates heat, and increases buoyancy. Energy is stored in the thick oily layer of blubber. Blubber covers the entire body of walruses except for their fins, flippers, and flukes. Walrus leather is extremely exotic. It has a deep and strong grainer skin and texture interfibrillar that is situated between fibrils for lint cotton cellulose fiber adherence. The innovative chrome-free leather product does not contain hazardous chrome heavy metal and acidic substance. In a standard chrome tanned leather, there is chromium content of between 3% to 5% of chromium fixed to the fibril, and the standard value for extractable Cr(III) is 50-1000 ppm (mg/kg) as per the tanning process condition and tightly bound to the collagen fibril proteins. Chromium as Cr(VI) is known to be toxic to animals and humans so it needs to be used and handed under extremely high safety precautions. The permissible environmentally friendly limit of total chromium in leather is 0.1 ppm (mg/kg). About 85% of the World's leather is chrome tanned leather. The covering leather washer packing is chrome tanned leather from buffalo skins for packing the rollers of cotton ginning machinery. The coveringleather hide washer or "Packing" used for cotton roller gin roller is very important to the operation and maintenance of the gin and is supposed to be a major expense item for a commercial double roller (DR) ginning machine. It is important to conduct research experiments on various roller covering materials to find a suitable material that enables faster ginning, longer wearing results, maintenance of good fibre quality, cheaper and eco-friendliness. A major research project entitled "Interdisciplinary and Integrated Science and Technology(IIST)" was performed at the Belgaum Indian roller ginning industries to compare the performance of different roller covering materials. Sustainable communication, media, society and culturalIISTsystem has been devised.

Keywords: Communication, Covering,Chromium, Culture, Eco-Friendly, Roller, Ginning, Performance, Material, Media, Property, Society

INTRODUCTION

Sustainable communication, media, society and culturalIISTsystem is introduced. The efficient IIST communication, media, society and cultureis important for the sustainable development. Case study and check on gin roller covering materials for cotton double roller gins in Industry 3.0 were considered. The cotton ginning mills in the country have been contaminating and polluting the environment with chromium. The chrome composite leather-clad (CCLC) rollers are used in cotton ginning mills to separate cotton fibres from the seed-cotton. The chrome tanned leather roller would have a 180 mm thickness when it was used for the first time and after three months of use, the thickness of these rollers would be reduced to 115 mm. The constant dust-producing grinding action results in the leak of 80 microns of chromium an hour, leading to air pollution and also contaminating the cotton fibres, spun yarns, fabrics, and textile effluents. The invisible contamination present in the Indian kinds of cotton in the form of chromium is much beyond the tolerance limits.

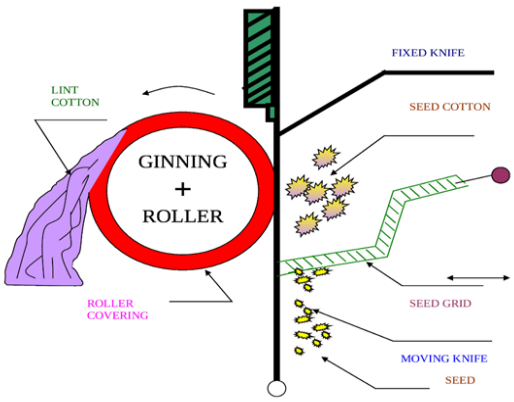


Figure-1: Principle of McCarthy Roller Ginning

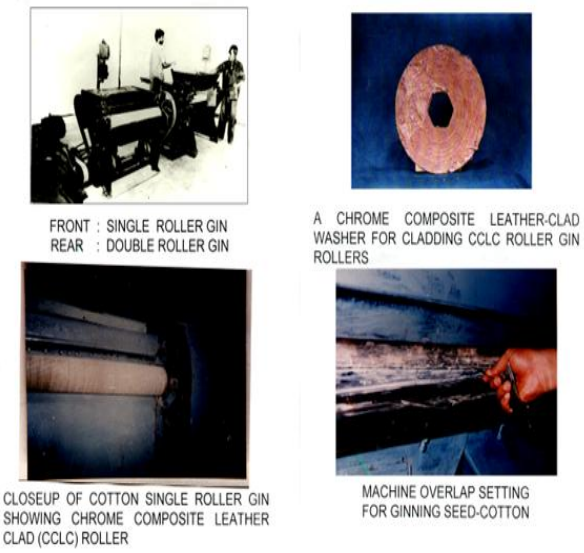


Figure-2 : Cotton Roller Gin Development

As per the Ministry of Environmental Forest standards Reference Number 157, MOEF Notification No.157, dated 4.5.1996, the permissible level of chromium present in the cotton products is 0.1 mg/kg (ppm)(parts per million)for Cr (III) and 0 ppm for Cr(VI). The invisible chromium contamination from CCLC is beyond 1000 ppm and the source CCLC is around 40,000 ppm.

Figure-3: Cotton Gin Roller Investigation Device(GRID)

Chromium is a carcinogenic substance. The chromium leakage is so alarming that it leads to a higher prevalence of cancer among cotton ginning mill and textile workers. Chromium can cause serious health hazards to those who wear cotton garments. Case study and check on gin roller covering materials for cotton double roller gins in Industry 3.0 were considered.

No attempt was made to find an eco-friendly method for cotton fibre separation for many years. Since several progressive ginning and pressing unit owners showed interest in the alternate roll materials for their double roller gins, this major research project has been attempted to find a suitable material that enables faster ginning, longer wearing results, maintenance of good fiber quality, cheaper and eco-friendliness while comparing performance to primarily eliminate the contamination of cotton and its products, air pollution in cotton ginning mills, and other ginning problems at the source through the design and development of an eco-friendly, pollution-free chrome less roller [1].

There is rubberized cotton fabric (RCF) roller, felt (90% wool) rollers, fibre glass woven (FGW) roller, and vegetable dyed tanned leather roller to replace the CCLC rollers, but the mill owners are not buying them because of ginning problems and high price. However, few ginning machinery manufacturers are still not sure about the commercial success of the alternatives to CCLC rollers and enormous awareness is required to be created among the ginning industries.The efficient communication, media, society and cultureis investigated for the sustainable development.

MATERIALS AND METHODS

Sustainable communication, media, society and cultureIISThave been investigated**. "**Sustainable communication, media, society and cultural development is the development that meets the needs of the present without compromising the ability and efficiency of future generations to meet their own communication, media, societal and cultural needs".Case study and check on gin roller covering materials for cotton double roller gins were considered.

When two or more materials are combined to produce a new material, which possesses many superior properties to any one of the constituent materials. Such a material is known as composite materials/ composites. Mechanical tests were conducted to determine the best materials by knowing mechanical engineering properties such as durability, strength, and hardness and cotton technological as well as environmental properties [2].

Roller Construction, Covering, Testing, and Maintenance

Sustainable communication, media, society and culturalIISTsystem has been devised**.** The roller gin roller is the major component of a roller gin stand. CCLC rollers are commonly covered with a packing made of CCLC bonded and stitched together in the

form of 78 to 80 numbers compressed disk washers, depending upon thickness. These CCLC washers are mounted on a hexagonal or square steel shaft at a maximum handheld pressure through a conventional hand press and these roller washers should be sufficiently pressed on the roller shaft. Leather tanneries supply this type of CCLC leather washers in a bulk quantity to the ginning industries in turn employed as CCLC rollers in DR gins [3]. The washers should be sufficiently turned and polished on the lathe to obtain a smooth surface. The hardness of the pressing roller should be such that if the hard pressure of the thumbnail is applied on the smooth roller surface the nail mark should be seen. Such rollers are well-pressed rollers. This could also be known by hearing the peculiar sound. One can become familiar with this by sufficient practice and experience in the line. The fully pressed, finished and spirally grooved gin roller is finally used in gins every day to increase friction and to enable the fibres removed smoothly after ginning operation [4].

PILOT MODEL ECO-FRIENDLY RCF ROLLERS DEVELOPMENT FOR DOUBLE ROLLER GINS

CLOSEUP OF DOUBLE ROLLER GIN MOUNTED WITH RUBBERIZED COTTON FABRIC ROLLER

GINNING OF SEED-COTTON USING RCF ROLLER GIN

BATTERY OF DOUBLE ROLLER GINS MOUNTED WITH RCF ROLLERS (AN ECO-FRIENDLY GINNING PROCESS)

Figure-4 : Evaluating Gin Roller Design and Development

CCLC roller is pressed against the stationary knife at considerable pressure. The roller rotates at a speed of 100 revolutions per minute. This enables the pulling of fibres from the seed-cotton (or *kapas*) due to abrasion between rollers and knife, leads to a continuous rate of wear and tear of the rollers. This action is known as the dust-producing grinding action ofthe CCLC roller and adds to the chromium burden of the environment. This contaminates and pollutes the surroundings as powdered chrome-specific dust (CSD). Data is given in table.

Table-
Chromium Pollution Consolidated Samples' Report and Relevant Eco-Standards for the season-I

Sl. No	COTTON TEXTILE PROCESSING	SUBSTANCE	PERMITTED VALUE , ppm	PRESENT ANALYSIS, ppm	NO.OF TIMES INCREASE THAN ECO.STDS
1	COTTON GINNING	CCLC ROLLER RSPM,SPM	2 ppm for Cr 0.1 ppm for Cr(III)	30783	15,392 212
		LINT COTTON SEED,SEED LINTER	Nil for Cr (VI), 20 µg/m³, US OSHA-500µg/m³, ACGIV TLU for Cr(VI):-	4232µg/m³,1994 143 to 300 ppm	35 71
		Cr in ambient air	52 µg/m³ 1.5 µg/m³	125 ppm 450µg/m³	63 300
2	CARDING	LINT COTTON	2ppm for Cr 0.1 ppm for Cr(III) Nil for Cr (VI)	80 to 44 ppm	22
3	SPINNING	LINT COTTON	2ppm for Cr 0.1 ppm for Cr(III) Nil for Cr (VI)	80 to 44 ppm	22
4	BLOW ROOM	SPUN YARNS	2ppm for Cr 0.1 ppm for Cr(III) Nil for Cr (VI)	25 ppm	13
5	GREY CLOTH	WOVEN FABRICS	2ppm for Cr 0.1 ppm for Cr(III) Nil for Cr (VI)	17 ppm	170
6	FINISHING	WOVEN FABRICS	0.1 ppm for Cr(III) Nil for Cr (VI)	17 ppm	170
7	FINISHING	TEXTILE EFFLUENT	1 mg/1 for Cr 0.1 ppm for Cr(III) Nil for Cr (VI)	550 mg/1	225
8	GINNING AND TEXTILE ENVIRONMENT	GIN HOUSE AIR SPM,RSPM CONCENTRATION	200µg/m³ Hex – 0.05 mg/m³ TA-Luft 0.1 mg/m³ SPM Particle size cut off 45 µm RSPM Particle size below 10µm 200µg/ m³ National Ambient Air Quality Standards for RSPM not to be more than 100 µg/m³ and chromium in ambient air safe limit is 1.5 µg/m³	7240 µg/m³ 2723 µg/ m³,1994 ppm 2495 µg/m³ 190 ppm	362 135,1000 125 95
9.	GINNING AND TEXTILE INDUSTRIES	RSPM in air Cr in air	150 µg/ m³ 1.5 µg/ m³	527 µg/ m³ 397 µg/ m³ 1994	4 265

MECHANICAL TESTING

Hardness test

A hardness test can be defined as the resistance of the material to localized plastic deformation. In this process of hardness test, the specimen is indented by a special tip which may be a steel ball or a diamond cone. The tip first overcomes the resistance of the material to elastic deformation and then a small amount of plastic deformation. Hardness measurements for determining the properties of roller covering have been found to select a better material and to design a new roller. The hardness of roller covering materials was measured at the ginning surface after the rollers have been tried. Brinell's Hardness Test has been carried out by pressing a steel ball known as the indenter into the roller covering. The mean diameter of the indentation left on the specimen is measured after the load is removed. The value of the hardness of various roller covering materials is mathematically calculated by the formula and is given in Brinell's Hardness Number (B.H.N.). B.H.N.(Brinell's Hardness Number) = Load on ball / Area of Indentation ;

Table –1 : Values of Hardness of Various Roller Covering Materials Used In Roller-Gin

S.No.	Name of the Roller covering	B.H.N.
1.	Chrome composite leather-clad (CCLL) roller,	190-230
2.	Fabric and Rubber Packing,	90-110
3.	Walrus Leather,	90-92
4.	Plastics,	200-210
5.	Synthetic Rubber,	130-135
6.	Thermo Plastic Elastomer,	134-140
7.	Rubberized Cotton Fabrics,	90-95
8.	Woven Fibre Glass,	90-100
9.	Cotton,	80-90
10.	Felt	75-80
11.	Rubber,	100-110
12.	Rubber And Cork,	100-110
13.	Fluorinated Ethylene Propylene	110-120

RESULTS AND DISCUSSIONS

Environmental Impact Assessment (EIA) Mitigation Study

Sustainable communication, media, society and culturalIISTsystem has been devised**.**

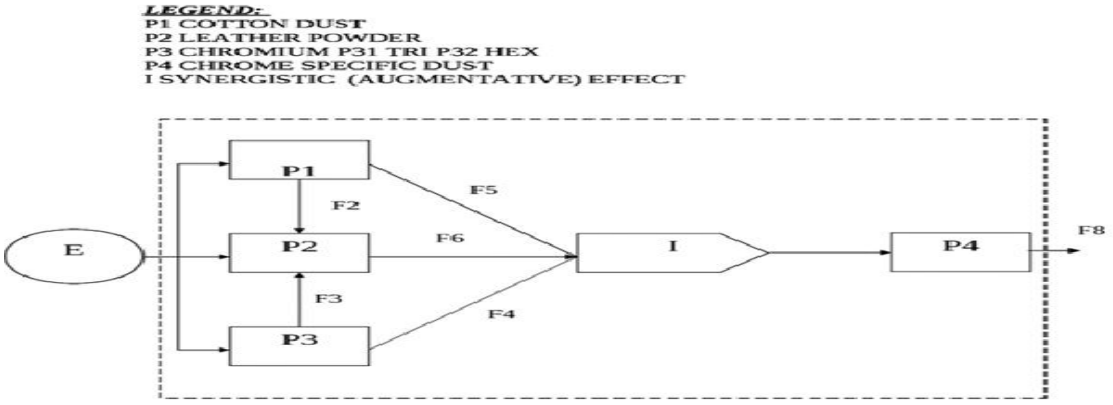
IIST virtual research was done to compare the ginning performance of various roller covering materials. The Roller gin separates the fibre from the seed-cotton (*kapas*). Rollers have been experimented with made from Pandharpur leather - paper washers, coconut coir material, chrome composite leather cladding, vegetable-tanned walrus leather covering, eco-friendly tanned leather covering, coir board roller covering, woven fibre glass roller covering, rubberized cotton fabric roller, felt (90% wool) covering roller. The physical characteristics of the are materials are what given the gin roll it is frictional and wear properties that make the roller ginning process possible. During the ginning process, the covering material is worn away and must eventually be replaced.

Evaluation of Different Roller Coverings Materials on a Roller Gin Roller

The roughness of the covering and its tendency to remain rough seems a likely cause of the greater ginning rate of the proposed experimental coverings. The work focuses on this property and may provide a better understanding of the relationships between covering construction, roller life, ginning rate, and fibre properties [5].

Table -2: Roller Covering Materials and Construction Details of The Trial Rollers; Roller Covering Material: Chrome Composite Leather Clad Roller (CCLC) Covering

Roller Code	Laboratory Gin/GRED and DR Gin: CCLC
Roller Covering Material	Hexavalent and trivalent chromium composite embedded with leather (chrome tanned leather)
Method of Construction	78-80 numbers of Compressed Disks
Core Material	Steel (Square, Hexagonal 50 X 50 mm size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Bonded and Stitched and clamped bolted between end plates



1. 'E' FORCING FUNCTION SUNLIGHT (PHOTO ENERGY) TEMPERATURE, HUMIDITY AND AIR MOVEMENT.
2. P1, P2, P3, P4 ARE PROPERTIES STATE VARIABLES.
3. F1, F2, F3,F3, F4,F5,F6,F7,F8, ARE FORCING FUNCTIONS WHICH ARE OUTSIDE ENERGY FORCES SOUCES OR CASUAL FORCES THAT DRIVE THE SYSTEM.
4. INTERACTIONS 'I' WHERE FORCES AND PROPERTIES INTERCAT TO MODIFY, AMPLIFY OR CONTROL FLOWS.

FIGURE 5 SYSTEMS DIAGRAM MODELLING FOR ENVIRONMENTAL IMPACT OF CHROMIUM SPECIFIC DUST

Evaluating Vegetable Tanned Walrus Leather Roller Covering

Vegetable Tannins are complex glycosides of tanning acids obtained from tree barks and woods. Traditionally vegetable tanning was carried out by immersing hides in a pit of water with layers of tannin-bearing bark or wood sandwiched between them. The objectives of this experiment were to define the physical properties of a roller material that contribute to its ginning rate potential to produce good quality chrome-free-lint cotton and to search for a better roller covering material. However, the ginning rate with the cost of the vegetable-tanned walrus leather covering material is not enough to warrant changing from the conventional CCLC rollers being used in the industry.

Table-3: Roller Covering Materials and Construction Details of the Trial Rollers; Roller Covering Material: Vegetable Tanned Walrus Leather Clad Covering

Roller Code;	Laboratory Gin/GRED and DR Gin: VT
Roller Covering Material	Vegetable-tanned walrus leather
Method of Construction	78-80 Numbers of Compressed disks
Core Material	Steel shaft (square, Hexagonal, 50X50 mm size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Bonded and stitched; Clamped /bolted between end plates

Evaluating Eco-Friendly Tanned Leather Roller Covering

Eco-friendly tanning leather is an innovative eco-friendly technology. This uses only neem oil and liquid soap solution. 2-4 % neem oil and 1-3% liquid soap solution are used for processing the walrus and buffalo leather. The time required to tan a considerable quantity of hides and skins is two to three days. This process is cheaper than the chrome-tanned leather process. However, the ginning rate with the cost of the eco-friendly tanned leather covering is not enough to warrant changing from the conventional CCLC rollers being used in the industry.

Table-4: Roller Covering Materials and Construction Details of the Trial Rollers; Roller Covering Material: Eco-Friendly Neem Tanned Leather Clad-Roller Covering

Roller Code;	Laboratory Gin/ GRED and DR Gin: ECO
Roller Covering Material	Eco-friendly tanned leather
Method of Construction	78-80 Numbers of Compressed disks
Core Material	Steel shaft (square, 50 X 50 mm Size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Bonded and stitched; Clamped between end plates

Physical Characteristics of Various Trial Rollers

Roller code = ECO, VT, CCLC, FRP, RPR, RCF, WFG, Roller length = 190 mm, Roller diameter = 185 mm, Roller hardness = 89-106 B.H.N.

Layers of fabrics = Good number of fibres; Moderate number of fibres

Fabric fibre color = White /Brown

Layers of fabrics at ginning surface = Yes/No

Approximate distance fibre bristles protrude above rubber surface: 0.5 to 1 mm

Rubber compounding: Resilient condition; Rubber Board Standards

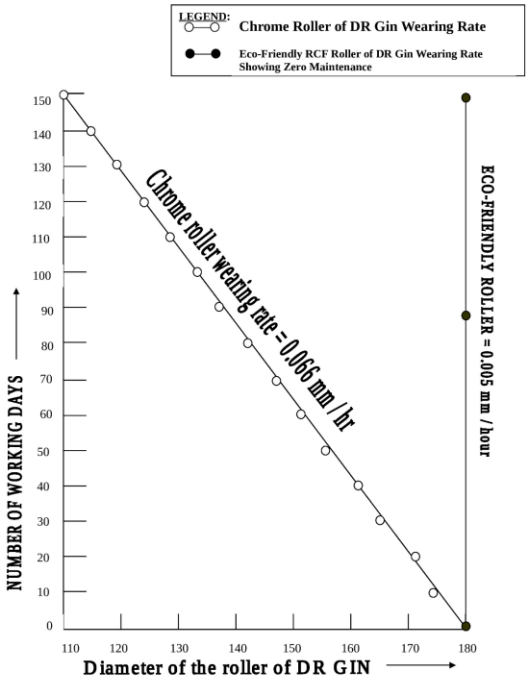


FIGURE 6 : A GRAPH OF WEARING RATE OF DUST – PRODUCING GRINDING OF CHROME ROLLER AND ECO – FRIENDLY ROLLER

Evaluating A Coir Board Roller Covering On A DR Gin

An experimental covering made of a coir board was tested. Final removal of the ginned fibers from the roller-gin cylinder presents problems that depend upon the nature of the covering [6].

Table-5: Roller Covering Materials and Construction Details of The Trial Rollers; Roller Covering Material: Coir Board Roller Covering

Roller Code;	Laboratory Gin/GRED and DR Gin : COIR
Roller Covering Material	Coir board roller
Method of Construction	70 numbers of Compressed disks
Core Material	Steel shaft (square, Hexagonal, 50X50 mm size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Bonded and stitched; Clamped between end plates

Evaluating Woven Fibre-Glass Roller Covering On a DR Gin

An experimental DR gin roller covering, made from woven fibre glass fabrics (FGF), was tested on a DR gin to evaluate its ginning performance and effect on fibre quality. The experimental covering was much better than the present CCLC covering; it ginned at 1.5 times the present rate and the lint quality is very good. The roller temperature has been reduced to 4 to 5 °C (39° C) as compared to 45°C in other coverings. Analysis showed that the fiberglass fibres did not contaminate knitted cloth made from the lint ginned with the roller. Final removal of the ginned fibers from the roller-gin cylinder presents problems that depend upon the nature of the FGF covering. If the fibres are returned to the ginning point, jamming and chokes, commonly known as "back-lash", occur.

Table-6: Roller Covering Materials And Construction Details of the Trial Rollers; Roller Covering Material: Woven FibreGlass Fabrics (FGF) Roller Covering

Roller Code;	Laboratory Gin/GRED and DR Gin : WFG
Roller Covering Material	Woven fibre glass covering bonded with white rubber compound roller
Method of Construction	Compressed disks/spool winding /flat sheet
Core Material	Steel shaft (Square, Hexagonal, 50X50 mm size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Bonded and stitched; Clamped between end plates

Woven fibre glass roller Covering-Roller-II has been evaluated for fibre quality and ginning performance in a DR gin. This type of woven fiberglass roller covering on a roller gin cover has pulled more fibres under the fixed knife, increasing ginning rates reducing heat generated at the surface of the roller at a roller speed of 100 revolutions per minute. The fibre quality and quality of knitted fabrics were good compared to the CCLC covering results and thus free from contamination problems. However, in a DR gin, the covering failed after thirty-five hours of normal ginning. The experimental gin roller coverings (Roller-II) are much better than the CCLC roller coverings they ginned at 1.5 times the rate and resulted in less roller heat, there were significant differences in the fibre quality and spinning test measurements.

However, the ginning rate with the cost of the woven fibre glass material is not enough to warrant changing from the conventional CCLC rollers being used in the industry.

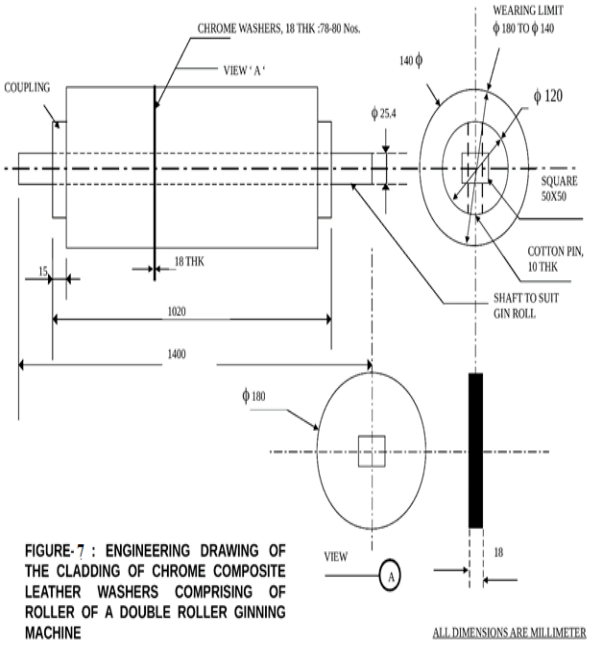


FIGURE-7 : ENGINEERING DRAWING OF THE CLADDING OF CHROME COMPOSITE LEATHER WASHERS COMPRISING OF ROLLER OF A DOUBLE ROLLER GINNING MACHINE

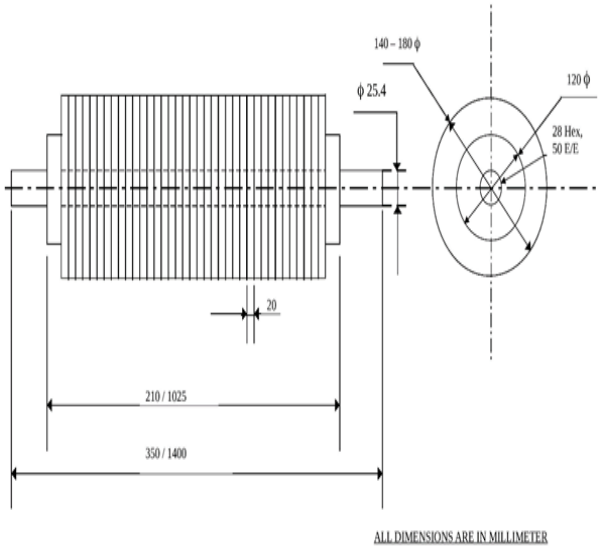
Evaluating Rubberized Cotton Fabric (RCF) Roller Covering Material

The RCF rollers both for laboratory and commercial studies have been designed, fabricated, and experimented on special-built GRED and DR gins. These rollers are covered with packing-type roller covering material made from multiple layers of cotton fabric bonded together with a rubber compound. Four types of roller covering material with different rubber compounding and multiple fabrics composition were tested in GRED and DR gins. Two rollers are abandoned primarily due to higher wear and tear rate, adhesive failure, and ginning is not carried out properly. Two RCF rollers were found effective and successful in ginning out the seed-cotton in an eco-friendly way besides resulting in higher productivity in terms of ginning rate potential and cotton technological parameters.

The RCF rollers made with experimental covering materials are tested (1) to find obvious shortcomings in performance such as short roller life, temperature, and lint contamination (2) to establish the existence of some ginning rate potential. One of the specimens of roller gin covering material is the most superior among all types tested in respect of ginning rate potential (kg of cotton ginned per unit of time at maximum feed rate) and amount of energy consumed (work required to gin a kg of lint). Conventional fabric and rubber roller gin covering material is selected with the following characteristics viz. The manufacturing technology, design engineering features, and assembly experience show that the RCF roller covering can be selected with the following characteristics: hardness of 106 B.H.N. (type Brinell Hardness Number), 7 to 10 layers of fabrics 20 mm length, and fabric thickness of fabrics 1.2 mm, The

rubber compound is resilient and fibre bristles protrude 0.76 mm beyond the rubber surface is maintained despite wear[7].

FIG 8 :ASSEMBLY DRAWING OF RUBBERIZED COTTON FABRIC (RCF) WASHERS FOR MAKING RCF ROLLERS OF DOUBLE ROLLER GINS



Based on the design and development of various rollers with subsequent performance evaluation studies, pollution-free RCF roller has been demonstrated concerning techno-economical and eco-friendliness in ginning industries. The newly developed RCF rollers are successful and effective in functioning and in ginning out seed cotton. Environmental parameters of CCLC roller and RCF roller ginneries are given stating cost economics in a table. Eco-friendly RCF ginnery sounds better in all aspects about cotton technological parameters, techno-economical and environmental aspects.

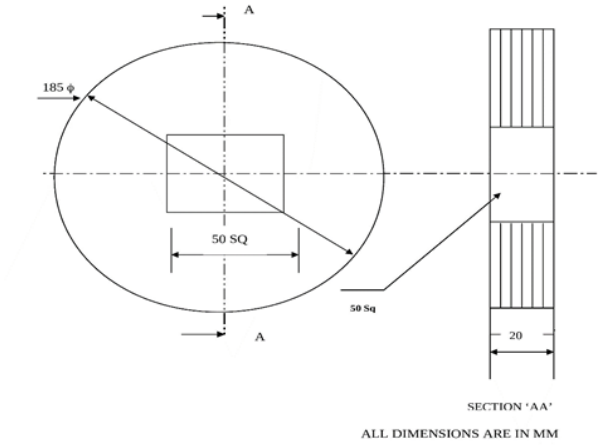


FIG 9 POLLUTION-FREE RUBBERIZED COTTON FABRIC WASHER FOR ROLLER OF COTTON ROLLING GINS

Comparative economics have been worked out for the chrome-less RCF roller ginneries and CCLC rollers ginneries; that is for the 'System before and after modifications' and for commercialization to the ginning industry. However, the ginning rate with the cost of the RCF is not enough to warrant changing from the conventional CCLC rollers being used in the industry.

Table-7: Roller Covering Materials and Construction Details Of The Trial Rollers; Roller Covering Material: Rubberized Cotton Fabric Roller Covering

Roller Code;	Laboratory Gin/GRED and DR Gin: RCF
Roller Covering Material	Rubber packing roller covering
Method of Construction	60 Compressed disks / Flat sheets /spool winding
Core Material	Wood/ Steel shaft (square, ; 50 X 50 mm Size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	Rubber packing bonded with adhesive to roller core; spool windings; Compressed disks are Clamped between end plates

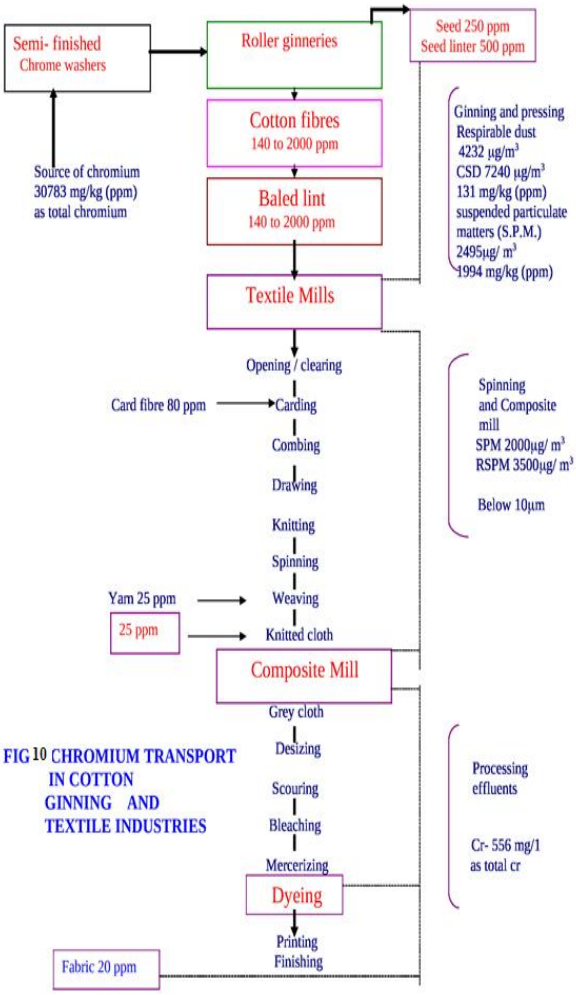


FIG 10 CHROMIUM TRANSPORT IN COTTON GINNING AND TEXTILE INDUSTRIES

Evaluating Felt (90% Wool) Packing Roller Covering

An experimental covering made of rubber packing was tested. Final removal of the ginned fibers from the roller-gin roller presents problems that depend upon the nature of the covering [8].

Table-8: Roller Covering Materials and Construction Details of The Trial Rollers; Roller Covering Material: 90% Wool (Felt) Roller Covering

Roller Code;	Laboratory Gin/GRED and DR Gin: WPR
Roller Covering Material	Wool packing type roller covering
Method of Construction	Compressed disks
Core Material	Steel shaft (square, 50 X 50 mm Size)
Roller Dimensions	190 mm roller length (GRED) 182 mm dia and 1016 mm long 171-178 mm(DR)
Method of fastening material to core	90% Wool, (Felt material)

The research was done to compare the ginning performance of a felt material (90% wool) against the commonly used CCLC covering material. This particular felting used is soft to perform satisfactorily over a long period without wear. This felt material wore well, ginned at an optimum rate while maintaining fibre quality. However, the ginning rate with the cost of the felt material is not enough to warrant changing from the conventional CCLC rollers being used in the industry [9].

Case study and check on gin roller covering materials for cotton double roller gins in Industry 3.0 were considered[10].

CONCLUSION

Sustainable communication, media, society and culturalIISTsystem has been devised**. "**Sustainable communication, media, society and cultural development is a kind of development that meets the needs of the present without compromising the ability and efficiency of future generations to meet their own communication, media, societal and cultural needs".Case study and check on gin roller covering materials for cotton double roller gins in Industry 3.0 were considered.

The heart of the cotton roller ginning machine is the gin roller. A cotton roller gin separates the fiber from the seed-cotton (or *kapas*) using the interaction and interrelation of a fixed knife that rides with some pressure against a rotating roller (known as gin roller), pulling fibres from the seed. Walrus hide, which was used till 1940, was thought to be unequaled for roller coverings. The physical characteristics of this covering material are what give the gin roller its frictional and wear properties are worn away and must eventually be replaced. Replacement of the roller washer is done subsequently. A common material made from a composite of chromium tanned leather is used to cover the gin roller by the roller ginning industry. When cotton is processed the ginned lint would contain about 180 to 250 ppm of Cr (III) and Cr (VI) which are known to be highly carcinogenic. The roller ginning industry would benefit if a satisfactory, cheaper, longer wearing roller covering material and eco-friendly could be found.

Research and experiments show the possibility of obtaining a substitute. Ginning investigations have been carried out to help meet the objective of designing and developing eco-friendly roller coverings for cotton double roller (DR) gins. Various eco-friendly substitutes and methods have been studied and devised, such as felt (90% wool) , vegetable-tanned leather, woven fibre glass fabrics, neem oil-tanned leather, 100% wool material, alternative rubber, and rubber-processing technology, and modification of the commonly employed CCLC roller gins. The research was done to compare the ginning performance of rollers against the commonly used CCLC roller.

Tests showed that the ginning rate of some rollers was significantly very good with CCLC covering. Also, these roller materials were soft to perform satisfactorily over a long period without undue wear. Further virtual work will be done with other materials to see if an alternative sustainable techno-economic-environmental friendly roller covering material can be innovated [10].

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