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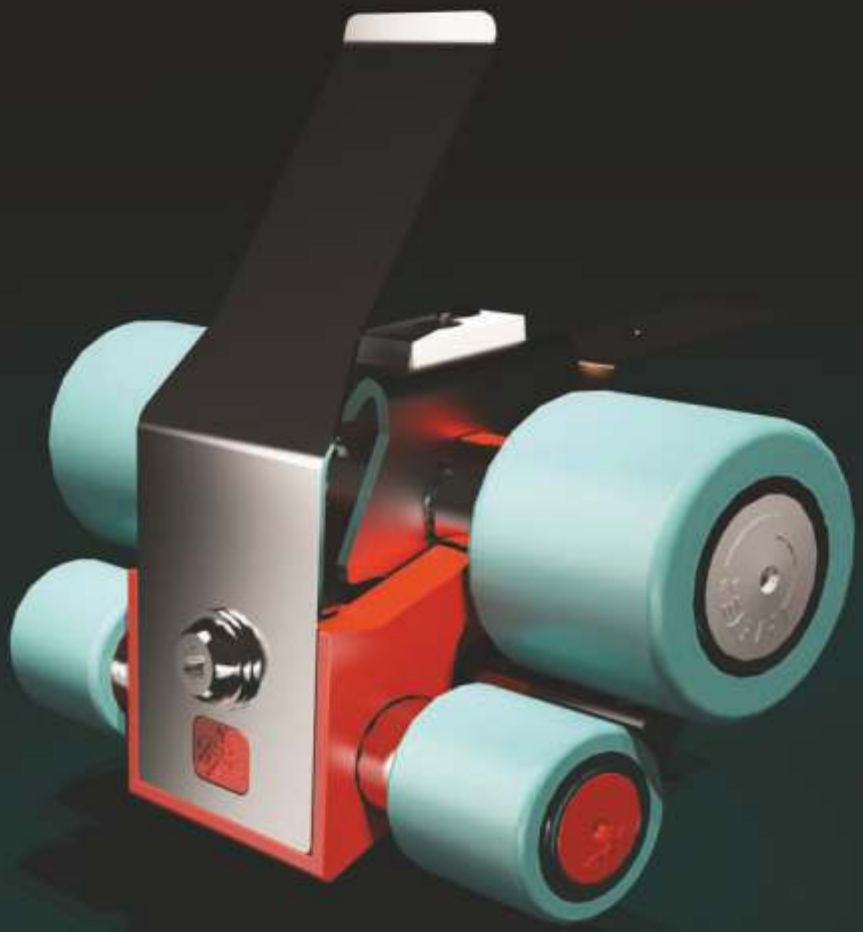

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The Textile Association (India) completes 82 Glorious Years

The Textile Association (India) completes its 82 glorious years on April 09, 2021, which was established on April 9, 1939,

TAI today is the leading and one of the largest national bodies, of textile professionals, striving for the growth of India's largest industry. The association has more than 25,000 strong members through its 26 affiliated Units (chapters), spread throughout the length and breadth of the country.

Heartiest congratulations to the Founders, Trustees, Predecessor Presidents, Governing Council Members, all our esteemed members and sincere thanks for the whole hearted support to the entire textile industry extended over all these years.

With emphasis and commitment to professional ethics and social responsibilities, our renewed vision is to be internationally renowned as a leading association of textile technocrats and professionals promoting scientific and technological knowledge and training with benchmarking performance.

We are happy to announce that Journal of the Textile Association (JTA) is also completes its 81 years in publication. JTA is a prestigious bi-monthly peer-reviewed Journal which is also available in a digital version online on TAI's website www.textileassociationindia.org. Due to Corona pandemic, we are unable to celebrate, but both will be celebrate in physically gathering, after this pandemic is over.

We wish to make TAI more connected with the industry through various ground activities organised by different Units across the country. One such initiative started interacting through JTA. We welcome more and more industry engagement through JTA.

TAI's annual conferences are a prestigious annual events, being organised since last 76 years. These conferences have focused on contemporary and innovative topics with high profile speakers. Eminent industrialists, policy makers, reputed professionals and renowned experts from different parts of the world have presented research papers. Most conferences have been inaugurated by eminent and dynamic personalities of India like the President, Prime Minister, Cabinet Ministers, Governors and Sate Chief Ministers, Secretary to the Ministry of Textiles, Vice Chancellors etc.

I extend my heartiest felicitations to the founders of TAI and the Editorial Board team members of JTA.

Best wishes and greetings on this glorious occasion of 82 years of TAI and 81 years of JTA!!

Ashok Juneja
(National President – TAI)

INDUSTRY 4.0 : The key game changer for Indian Textile Manufacturing Sector in Pandemic period

A revolution in manufacturing and industrial processes has eased the life of humanity and Industry 4.0 is no exception. The advent and usage of computers and robotics in manufacturing led to growth and dependence on the digital world during the third industrial revolution. Industry 4.0, characterized by the integration of digital and physical environments (referred to as Cyber Physical Systems), has resulted in a quantum leap in the automation of production and industrial processes. The convergence of Operational Technology (OT) and Information Technology (IT) with the use of analytics, robotics, artificial intelligence, machine learning and digitalization is enabling industries to create Smart factories leveraging automation and optimization.

The Textile Industry at the global level has already started aligning to this change. The use of real-time production monitoring softwares for optimizing the manufacturing processes and improving quality; digital solutions for machine networking, data management, maintenance support and use of sewbots (sewing robots) in garment manufacturing, give an insight into the fourth industrial revolution in Textiles. The Textile Learning Factory 4.0, training, demonstration and research facility in Germany has been developed to help textile manufacturers to kick-start their digital transformation and overcome the hurdles of implementation such as uncertainty of financial benefits and lack of specialized knowledge.

The Indian manufacturing industry too is following the footsteps towards Industry 4.0 to be competitive at a global level, but at a very slow pace. Under the SAMARTH Udyog Bharat 4.0 (Smart Advanced Manufacturing and Rapid Transformation Hub), an Industry 4.0 initiative of Government of India (Department of Heavy Industry), five Common Engineering Facility Center (CEFC) of I4.0 have been initiated with the vision to spread awareness and create an ecosystem for propagation of Industry 4.0 technologies. The leading textile companies in India have already moved to Industry 4.0 partially with their latest textile machinery having features of automation and data softwares for online monitoring of production and quality. But the challenges of integrating the manufacturing, supply chain and marketing towards achieving Textile 4.0 compliance and the need for textile professionals trained and aligned with this technological advancement still remain.

The disruption of travel and lack of in-person meetings in this current pandemic crisis has reinforced the value of industry 4.0 and accelerated the adoption of new technologies. The companies that had already integrated digital technologies in their processes have been at an advantage during this corona virus crisis and for others, it has been a wake-up call to start on their Industry 4.0 journey and adopt digitalization and cyber physical systems.

The challenges of cyber security, better understanding and integration of IT and OT technologies and the associated costs for fully shifting towards industry 4.0 cannot be ignored. However, the silver lining is that the change in the mindset and adoption of new technology led-solutions has begun. This will lead to the processes becoming more flexible and agile in textile value chain, delivering a quick and effective response to the market needs.

Dr. Deepa V. Raisinghani
Hon. Editor

Biodegration of Synthetic Dyes in Effluents by Immobilized Microbial Cells and Enzymes - Review

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Abstract:
With the increasing demand for clothes to clothe the increasing population, the textile industries have been rapidly expanding globally. This means more fabric to be dyed, more use of synthetic textile dyes, and more of their release into the aqueous environment in the form of effluents. Most of these dyes are azo dyes. Not only does the release of textile effluents into water bodies decrease the aesthetic value, but also harms the life forms that reside within that niche, as most of these synthetic azo dyes are toxic, carcinogenic and mutagenic. There are many physical and chemical methods for dye removal from textile effluents, however, they are not suitable for large scale, as most of them produce residual compounds, are expensive, and may not be safe for workers. Thus, biological, and especially microbial methods offer an attractive alternative. However, cells lose viability and enzymes are expensive, and thus immobilization of microbial cells and enzymes increases both viability and reusability of our dye decolorizing agents, thus making them a cost-effective alternative to the other available technologies. This paper reviews all available immobilization strategies and techniques that are used in dye decolorization.

Keywords: *Bioremediation of Synthetic Dyes, Dye Decolorization, Immobilization, Microbial Enzymes, Textile Effluents*

GRAPHICAL ABSTRACT

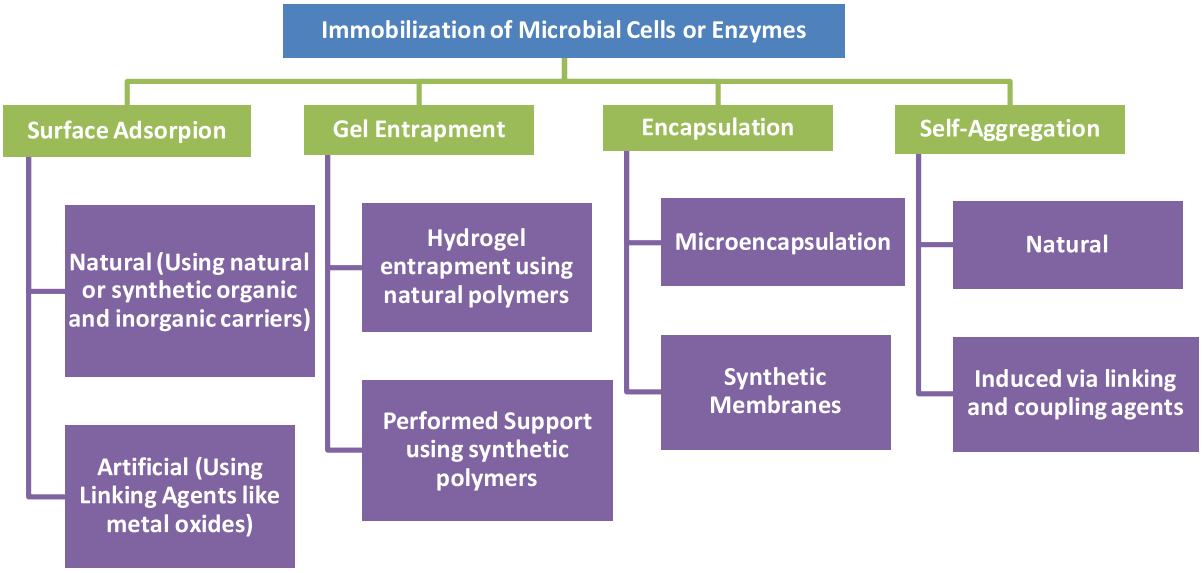

Figure 1 : Immobilization of Microbial Cell

1.0 INTRODUCTION

Azo dyes are one of the major classes of synthetic dyes extensively used for coloring fabrics in the textile industry. These have one or more azo (R1–N=N–R2) groups and aromatic rings, that impart chromophoric properties to these dyes. The azo groups are mostly substituted by sulfonate groups, giving them a variety of shades, excellent attachment to fabrics, resistance to fading and lower energy consumption [1].

Despite being toxic and highly mutagenic, azo dyes are so widely used in the textile, chemical, paper and pharmaceutical industries due to their attractive properties, such as stability to heat, light, water, bleach, detergents and sweat. Their π-conjugated azo bond characteristics and resonance impart these stability traits [2].

Following the use of large quantities of chemical dyes in various dyeing and finishing processes in textile industries, large volumes of dye-containing textile effluents are released into the environment, which poses a grave health hazard to aquatic organisms or humans who may consume the contaminated water or the aquatic organisms [3]. Azo dyes, such as Congo Red, undergo reductive cleavage within the cells and produce aromatic amines that are mutagenic and even carcinogenic. Moreover, due to being synthetic in nature and having complex aromatic structures, these dyes

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are highly recalcitrant, and persist for long in the environment [4].

Various physicochemical techniques such as ozonation, photocatalysis, membrane separation, activated carbon adsorption, electrochemical oxidation, Fenton reagent oxidization and coagulation are used to remove dyes from effluents [5]. Coagulation is the most common commercially used method in which the dyes from the liquid are rapidly transferred to the solid phase [6]. However, this requires expensive coagulants and generates a lot of secondary waste. Other limitations associated with physicochemical methods are the treatment cost, feasibility, stability, extent of dye removal, residual sludge and secondary pollutant generation [7].

Biodegradation of dyes is emerging as an effective and potential approach for the decolorization and detoxification of azo dyes, in which microorganisms degrade dyes and convert them to carbon dioxide and water. Bacteria, actinomycetes, algae and fungi can degrade azo dyes [8]. Both pure cultures and consortia are used in bioreactor studies. Single cultures are more specific and have a limited range of dyes that they can degrade, whereas mixed cultures have a wider range and are more resistant to extreme conditions [9].

In order to improve the efficiency of biodegradation and widen the applications of microbes in dye decolorization, immobilization of both microbial cells and enzymes has received increasing attention. This technology allows them to be reused, decreases biomass wash-out and also imparts greater stability towards a wide range of environmental conditions [1]. These advantages have encouraged the use of immobilized cultures to treat large volumes of dye-contaminated effluents in a continuous reactor. The selection of appropriate matrices is important for whole cell immobilization to retain dye-degrading microorganisms in the reactor for as long as possible [10].

The gel entrapment, surface adsorption, encapsulation and self aggregation are among the many strategies of immobilizing cells and enzymes. Among many matrices used Polyurethane foam (PUF) has become popular for whole bacterial cell immobilization due to its good mechanical strength, high porosity, resistance to microbial attack, easy availability, low cost and large surface area [11].

The only limitation of application of bioreactors in dye removal is the expense of the growth medium used, such as nutrient broth, which is not affordable for use at industrial scales. As a solution, one can use agricultural waste as a growth medium to make the use of bioreactors for dye decolorization more economical [12].

In this paper, we discuss the bioreactor strategies that have been so far used in decolorization of dye-contaminated wastewater using immobilized cells and enzymes.

2.0 Whole Cell Immobilization

Immobilization of whole cells is physically confining intact bacterial or fungal cells to a certain support, without causing any loss of biological activity. There are many methods available for immobilization of cells, such as surface attachment, encapsulation, gel entrapment etc. as shown in Figure 1 [13].

The method of immobilization should depend on the type of application. Some common characters, however, are generally desirable in any system, such as high cell mass-loading capacity, affordable and easily accessible nutrient media, simple procedure, allows high surface-to-volume ratio and optimum mass transfer, is sterilizable and reusable, easy down streaming and economically viable. Many researchers have performed experiments to test the efficiency of immobilized bacterial or fungal cells in decolorizing dyes from textile effluents. Some such reports are summarized in Table 1.

Many bacteria, such as *Brevibacillus laterosporus*, *Pseudomonas sp., Bacillus sp*. and *Aeromonas* exhibit the ability to decolorize dyes effectively, both as individuals and as consortia [14, 15]. The dyes decolorized were Reactive Red 2, Remazol Red, Congo Red, Acid Blue 15, Reactive Orange 16, Acid Yellow 36, and efficiency ranged from 90 to 100% decolorization [11, 12].

Various matrices were used to immobilize the bacterial cells, such as stainless steel sponge, polyvinyl alcohol, polyurethane foam, calcium-alginate beads, refractory brick pieces, marble chips, etc. Fungi are often used individually, or as consortia with bacteria. Most fungi with dye decolorization abilities are white rot fungi, such as *Phanerochaete sordida* and *Trametes hirsuta*. The dyes they can decolorize include Remazol Brilliant Blue R, Indigo Carmine, Basic blue 22 etc., and that too by 90-100% [16].

Decolorization of large volumes of textile wastewater is carried out in bioreactors, wherein the optimum conditions are provided along with the microbial cells or enzymes, and these factors are allowed to interact and degrade the synthetic dyes for the optimized contact period. After this, the decolorized wastewater is released. Various types of bioreactors are used for this purpose, such as Rotating Biological Contactor, which allows maximum contact between the wastewater and the microbial culture. Another type of bioreactor used is the packed bead bioreactor, which is used for dealing with immobilized cells [17].

Table 1: Role of Immobilized Whole Cells in Textile Dye Decolorization

Microorganism Immobilized	Immobilization Support Matrix	Dye Decolorized	Percentage Decolorization	Type of Bioreactor Used	Optimum Conditions		References
					Temp. (°C)	pH	
Bacterial consortium from wastewater treatment plant	Polyvinyl Alcohol Gel Entrapment	Reactive Red 2	100%	Packed Bed Bioreactor	30	7.5	[12]
Brevibacillus laterosporus and *Galactomyces geotrichum*	Stainless Steel Sponge	Remazol red	100%	Up-flow fixed bed reactor	30	7	[15]
Consortium of *Bacillus* sp., *Alcaligenes* sp. and *Aeromonas* sp.	Refractory brick pieces	Acid blue-15	94%	Up-flow immobilized cell bioreactor	29-31	7-8	[18]
Consortium of eight bacteria	Polyurethane foam	Congo red	99%	Up-flow Column Bioreactor	30	7.5	[14]
Consortium of *Stenotrophomonas* sp., *Pseudomonas* sp. and *Bacillus* sp.	Polyurethane foam	Acid red 88	98%	Up flow fixed-film column reactor	20-45	6-7	[11]
Consortium of white-rot fungus and Pseudomonas	Polyvinyl Alcohol Gel Entrapment	Direct Fast Scarlet 4BS	100%	Packed Bed Bioreactor	30	7	[19]
Funalia trogii	Alginate	Acid black 52	93.8%	Stirred Bioreactor	28	8.5	[20]
Irpex lacteus	Polyurethane foam	Reactive Orange 16	90%	Small Trickle Bed Reactor	28	7	[21]
Magnusiomyces ingens LH-F1	Ca-alginate beads	Acid Red B	98%	-	30	5-6	[22]
Mixed culture of anaerobic and aerobic bacteria	PVC packing media	Acid yellow-36	100%	Up-flow anaerobic sludge-filter bed Bioreactor	30-35	7	[23]
Mixed culture of Bacillus vallismortis, B. pumilus, B. cereus, B. subtilis and B. megaterium	Marble chips	Direct red 28	93%	Up-flow immobilized packed bed Bioreactor	37	7	[24]
Phanerochaete sordida	Disc in Rotating Biological Contactor	Basic blue 22	78%	Rotating Biological Contactor	28	5	[16]
Pseudomonas luteola	Polyacrylamide Gel Entrapment	Reactive Red 22	100%	-	25-40	5-9	[25]
Pycnoporus cinnabarinus	Nylon web cubes	Remazol Brilliant Blue R	100%	Packed-bed Bioreactor	37	7	[26]
Trametes hirsuta	Ca-alginate beads	Indigo carmine	96%	Airlift Bioreactor	30	6-9	[27]
Trametes hirsuta	Stainless steel sponges	Direct Blue 78	100%	Fixed-bed Bioreactors	30	7-8	[16]

2.1 Enzyme Immobilization

Immobilizing individual or a group of enzymes for hydrolysis and isomerization reactions are also used as biocatalysts in many industries. Enzymes obtained from single and multicellular organisms have widespread applications in various fields [28]. However, industrial application is often limited by instability, difficulty in recovery and re-use of the enzyme. Immobilization of the enzyme can help overcome these. Apart from more convenient handling, this allows easy down streaming, thus eliminating protein contamination of the product. It also facilitates better recovery and reuse of expensive enzymes, increasing their economic viability and stability [29].

Immobilization allows optimum performance of the enzymes in non-aqueous media. Also, it enables enzymes to participate in multienzyme and chemoenzymatic cascades [30]. Enzymes like laccases and peroxidases oxidize the dyes and convert them to less toxic and colorless products, which can be safely released into the environment. These enzymes are often immobilized using various support matrices, as has been shown in Table 2. Most used immobilized enzymes for dye decolorization include laccases, lignin peroxidases and manganese peroxidases. The microbial sources of these enzymes are mostly white rot fungi such as *Trametes versicolor*, *Pleurotus ostreatus*, *Ganoderma lucidum* etc [28].

The matrices used include gamma aluminium oxide pellets, imidazole-modified silica beads, porous glass beads, iron nanoparticles, chitosan beads and calcium alginate These immobilized enzymes showed high efficacy (80-100%) in decolorization of synthetic dyes such as Indigo Carmine, Remazol Brilliant Blue R, Acid Red 27 and Methyl Green. Complete decolorization was also observed in cases of Indigo Carmine, Remazol Brilliant Blue R and Procion Red MX-5B. Fixed Bed Bioreactors or Airlift Bioreactors are the most commonly used bioreactors for decolorizing textile effluents [30].

Table 2: Role of Immobilized Enzymes in Textile Dye Decolorization

Enzyme Immobilized	Microbial Source	Immobilization Support Matrix	Dye Decolorized	Percentage Decolorization	Type of Bioreactor Used	Reference
Laccase	*Trametes modesta*	γ-aluminum oxide pellets	Indigo Carmine	100%	Enzyme-Reactor	[31]
Laccase	*Trametes versicolor*	Silica gel modified by imidazole (SiIm)	Remazol Brilliant Blue R	100%	Photochemical Reactor	[30]
Laccase	*Trametes versicolor*	Porous glass beads	Dispersed Blue 3	90%	Fluidized Bed Bioreactor	[32]
Laccase	*Cyathus bulleri*	Poly Vinyl Alcohol (PVA) beads cross-linked with boric or nitrate acid.	Acid Red 27	90-95%	Packed Bed Bioreactor	[33]
Laccase	*Myceliophthora thermophila*	Polymethacrylate-based polymers activated with epoxy	Methyl Green	82	Fixed Bed Bioreactor	[34]
Laccase	*Pleurotus ostreatus*	Fe3O4/SiO2 nanoparticles	Procion Red MX-5B	100%	Enzymatic membrane reactor	[35]
Laccase	*Trametes pubescens*	Chitosan Beads	Acid Black 172	68.84%	Enzymatic membrane reactor	[36]
Laccase	*Coriolopsis gallica*	Ca-alginate beads	Remazol brilliant blue R	90.3%	Fixed Bed Bioreactor	[37]
Laccase	*P. florida* NCIM 1243	Cellulose nanofiber	Remazol brilliant blue R	96%	-	[10]
Lignin Peroxidase	*Ganoderma lucidum* IBL -05	Ca-alginate beads	Sandalfix Red C4BLN	93%	Airlift Bioreactor	[38]
Lignin Peroxidase	*Pleurotus ostreatus*	Carboxylated carbon nanotubes	Remazol brilliant blue R	70%	-	[29]

Enzyme Immobilized	Microbial Source	Immobilization Support Matrix	Dye Decolorized	Percentage Decolorization	Type of Bioreactor Used	Reference
Lignin Peroxidase	*Pleurotus ostreatus*	Carboxylated carbon nanotubes	brilliant blue R	70%	-	[29]
Lignin Peroxidase	*Schizophyllum commune* IBL -06	Ca-alginate beads	Remazol brilliant blue R	95.43%	Packed bed reactor system	[39]
Manganese Peroxidase	*Ganoderma lucidum* IBL -05	Ca-alginate beads	Sandal-fix Black CKF	95.7%	Airlift Bioreactor	[40]
Manganese Peroxidase	*Bjerkandera* sp. strain BOS55	Polyethersulfone synthetic membrane	Orange II	89%	Enzymatic membrane reactor	[41]

3.0 FUTURE PROSPECTS

Not only ligninases, but novel enzymes are also being discovered with dye decolorizing abilities. For example, researchers reported a new enzyme PersiManXyn1, which when immobilized on a magnetic graphene oxide nano-carrier, could be applied proficiently removal of dye from textile wastewater. 94% dye removal was reported [42]. Similar applications of nanotechnology in dye bioremediation have also been reported by other researchers. Using magnetite nanoparticles as electron transfer mediators, they can be used to accelerate the anaerobic bioremediation of sulfonated azo dyes [43]. Most enzymes, especially laccase is versatile enough to be engineered prior to immobilization to confer desired properties such as extended active lifetime. Protein engineering thus can make it possible to modify the enzymes so that they become excellent redox catalysts [44].

4.0 CONCLUSIONS

Immobilization of microbial cells and enzymes and their use in various bioreactors for decolorization of synthetic dyes from textile industry effluents has shown to be effective. Up to 100% decolorization has been observed in some cases. In case of cell immobilization, bacterial or fungal cells have been immobilized by adsorption, entrapment or encapsulation in various support matrices. In case of enzyme immobilization, peroxidases and laccases are immobilized. Packed bed and fluidized bed bioreactors were the most commonly used bioreactors for dye decolorization. Enzyme immobilization is an attractive strategy, as it allows reuse, facilitates down streaming and thus makes the process more economic and eco-friendly.

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Effect of Alkalis Treatment with Rapid Wetting Agent & Weight Reducing Agent on Properties of Polyester Fabrics

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ABSTRACT

Two different 100 % polyester samples (one of them shirting and another of suiting) were taken and tested for physical properties like number of ends per inch, picks per inch, warp yarn count and weft yarn count, fabric weight, air permeability, wicking and increase in weight due to wicking. Then the fabrics scoured by sodium carbonate and heat seat. Both the samples then gives weight reducing treatment with different amounts of alkali & rapid weighting agent, weight reducing agent and a combination of both. These samples were tested for all the above mentioned properties. A reduction is occurring in the number of ends per inch, number of picks per inch, warp yarn count and weft yarn count. Also a reduction observed in fabric weight and it's wicking, whereas air permeability and percentage absorbed water was increased as the concentration of alkali increases.

Keywords: *Air permeability, Denier reduction, Tearing strength, Wettability, Wicking power.*

1. Introduction

Among all the textile fibres, polyester is well-known and uses for wearing, blending and many other purposes. Good serviceability, strength, luster, smoothness and very good resistance to heat and sunlight are its unique properties. Moth, carpet beetles mildew and other bacteria have no significant effect on it. Cheapness, easy to produce, and desirable range of physical properties are it's another merits [1].

Polyester has a demerit which is its high crystalline nature. By this, polyester absorbs very less moisture. Due to this less absorbency, it is not like for apparel purpose [2].

It is difficult to wet and rapidly builds up static electrical charges by friction, which is a reason of pilling in the apparel. It exhibit poor dyeability and low soil resistance.

Presently, different methods are used for improving the wettability of polyester fabric, but the most of them have treatment of polyester with boiling NaOH solution at high temperature which reduces the strength and colour value of polyester, change the shade and produces high toxic effluent. So these are not feasible. Using KOH, rapid wetting agent and weight reducing agent minimized the mentioned drawbacks and increase the wettability of PET fabric which will positively improve the comfort property of the fabric [3].

2. Materials and methods

2.1 Materials

2.1. 1. Substrate

Two 100% polyester Fabric samples, one of them is shirting and another is of suiting, were used, purchase locally from Bhilwara cloth market.

2.1. b. Chemicals

LR grade sodium hydroxide and potassium hydroxide was used. The first was manufactured by CDH Laboratory, New Delhi and second was manufactured by ASES Chemical works, Jodhpur. Rapid wetting agent & weight reducing agents

were supplied by Resil Chemicals Pvt. Ltd. Bangalore. Reverse osmosis water was used throughout the process for apply the treatment. Acetic acid and hydrochloric acid used as neutralizing agent.

2.2 Methods

2.2.1 Scouring and weight reducing treatment of fabrics

These treatments are summarized in table 1 for shirting and Suiting fabrics.

Table 1: Scouring and weight reducing treatment for shirting and Suiting fabrics

S. No.	Procedure
Scouring	Polyester fabrics were mild scoured using 10 g/l Na_2CO_3 and 1.0 cc/l nonionic soap at 90°C for 30 minutes followed by washed with RO water, neutralized with 1 cc/l acetic acid, washed and dried. Then Shirting fabric heat set at temperature 170°C andSuiting fabric heat set at temperature 180°C for 45 second.
Weight Reducing Treatment	A) NaOH (5 g/l, 10 g/l, 15 g/l & 20 g/l) + 0.5 g/l rapid wetting agent (RWA) , keeping M: l=1:40 for 60 minutes at 100°C. B) NaOH (5 g/l, 10 g/l, 15 g/l & 20 g/l) + 0.5 g/l weight reducing agent (WRA), keeping M: l=1:40 for 60 minutes at 100°C. C) KOH (5 g/l, 10 g/l, 15 g/l & 20 g/l) + 0.5 g/l rapid wetting agent, keeping M: l=1:40 for 60 minutes at 100°C. D) KOH (5 g/l, 10 g/l, 15 g/l & 20 g/l) + 0.5 g/l weight reducing agent, keeping M: l=1:40 for 60 minutes at 100°C. E) KOH (5 g/l, 10 g/l, 15 g/l & 20 g/l) + 0.5 g/l rapid wetting agent+ 0.5 g/l weight reducing agent, keeping M:l=1:40 for 60 minutes at 100°C. Then all the samples washed with tap water, neutralize with 4 cc/l HCl acid at room temperature keeping M:l=1:40 for 15 minutes, then again washed.

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2.2.2 Fabric Weight (GSM)

GSM was determined using IS: 1964-1970 method. A 10 x10 cm piece was perfectly cut and weighted. Then multiple this weight by 100 for obtaining the GSM.

2.2.3 Air permeability

Air permeability was determined using method ASTM D737-18.

2.2.4 Wicking

Vertical wicking was determined using method AATCC 197. On the basis of this method and article 'Hydrophobicity of Polyester Fibres [3],' an instrument was prepared by self. With the help of this instrument, stop-watch and weighing balance; vertical wicking, wetting time to wet certain length (half of the strip) and increasing in weight was measured.

Figure 1: Instrument for Fabric Stripe Measurement

A fabric strip of 100 x 13 mm. cut accurately and then suspended vertically in a cabinet which is free from air flowing. A trough of distilled water is fitted below this strip in such a manner that the lower end of strip just touch to the water. The observation was made till the water level rose up to just half length (i.e. 50 mm) of the strip. This time is referred as 'wicking time'. The difference between final weight and initial weight of strip was denoted as 'increase in weight' and shown as 'increase in weight in percentage".

3. Results and Discussion

All the samples were treated under optimum conditions for improve the wicking. Results of grey fabrics are shown as 0 (zero) in all the tables and treatments. The results of treated fabrics of mentioned properties i.e. number of ends per inch, picks per inch, warp yarn count and weft yarn count (in denier), fabric weight, air permeability, wicking (No. of seconds to reach water up to 5 cm. of the strip) and increase in weight in % of different experimental Fabric samples are indicated in table 2 to table 9. These are plotted in figure no. 3.1 to 3.40.

3.1 Fabric Weight (GSM)

Due to the above alkaline treatments, decrease in fabric weight from 8.06% to 40.75% occurs. The reason of reduction in weight is hydrolysis of polyester. When polyester react with aqueous solution of alkali at boiling, water gets remove, which dries after completion the reaction. Thus, heating of Fabric samples helps to drive out the water from the fabric and this fast removal of water is responsible for the very high losses in weight. So the alkali treated fabrics are lighter in weight and exhibited improved softness and drapability. This is shown in table no. 6.

Table 2: Effect of alkali along with RWA/ WRA fabric

Fabric Sample	Conc. (gm/l)	Shirting fabric	Suiting fabric
NaOH + Rapid Wetting Agent - 0.5 g/l	0	109.72	181.2
	5	87.41	167.41
	10	75.922	166.58
	15	70.77	164.02
	20	65.01	159.23
NaOH + Weight Reducing Agent-0.5 g/l	0	109.72	181.2
	5	95.64	179.87
	10	92.66	175.37
	15	87.402	174.71
	20	84.302	168.82
KOH + Rapid Wetting Agent - 0.5 g/l	0	109.72	181.2
	5	87.06	180.27
	10	86.68	175.52
	15	81.83	169.95
	20	74.03	160.21
KOH + Weight Reducing Agent-0.5 g/l	0	109.72	181.2
	5	107.32	180.17
	10	106.52	178
	15	105.14	170
	20	107.54	166.4
KOH + RWA - 0.5 g/l + WRA-0.5 g/l	0	109.72	181.2
	5	108.56	172.76
	10	98.872	171.502
	15	93.924	168.766
	20	90.56	167.522

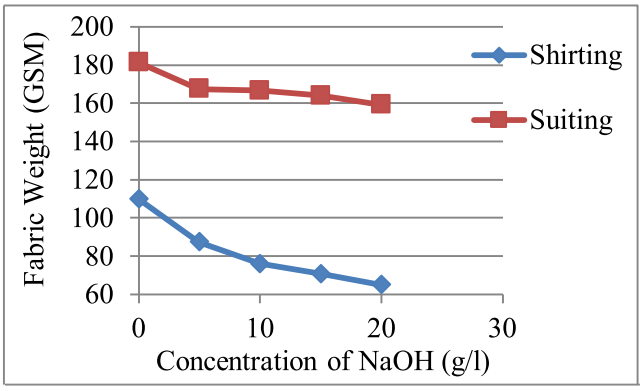

Figure 2: Effect of NaOH + Rapid Wetting Agent treatment on fabric weight (gsm.)

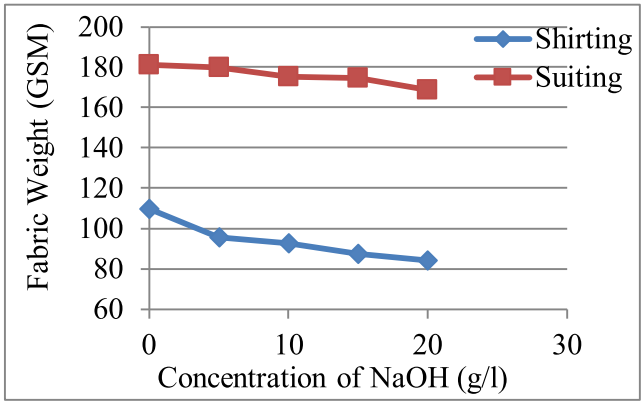

Figure 3 : Effect of NaOH + Weight Reducing Agent treatment on fabric weight (gsm.)

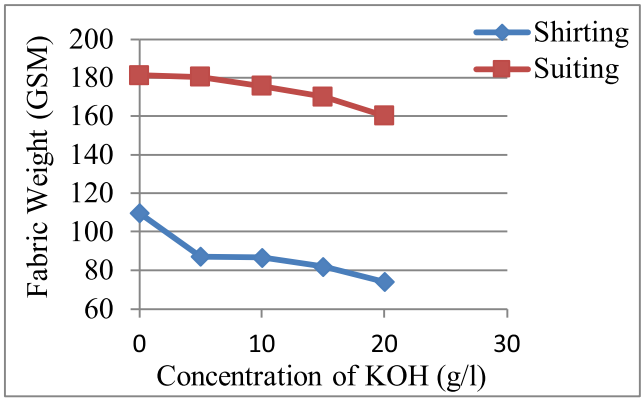

Figure 4 : Effect of KOH + Rapid Wetting Agent treatment on fabric weight (gsm.)

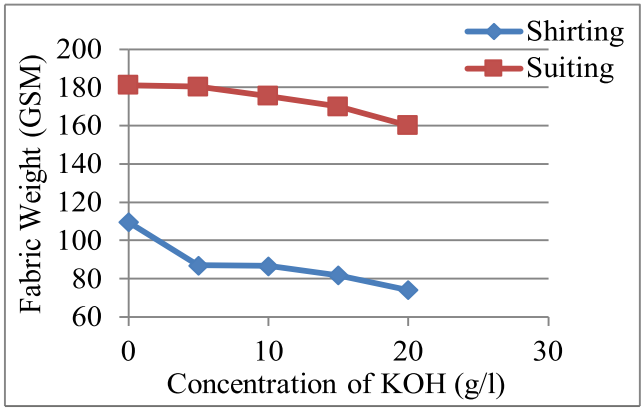

Figure 5 : Effect of KOH + Weight Reducing Agent treatment on fabric weight (gsm.)

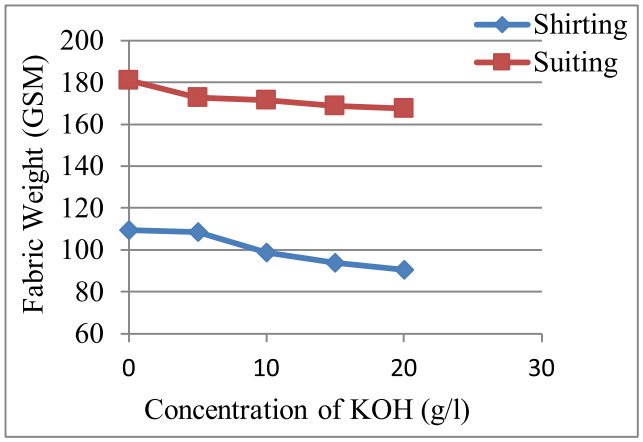

Figure 6 : Effect of KOH + Rapid Wetting Agent + Weight Reducing Agent treatment on fabric weight (gsm.)

3.2 Air permeability

In case of air permeability, it is increases approximately 50% to 136%, when concentration of NaOH+ rapid wetting agent on grey scoured heat set polyester fabric increases from 0 (g/l) to 10 (g/l). Further, increase in quantity of NaOH + rapid wetting agent i.e. concentration from 10 g/l to 20 g/l exhibits increase in air permeability approximately 152.39%.

Any improvement in air permeability negated by the shrinkage in the fabrics apparently, but it is due to reduction in the yarn diameter of polyester fabric [4]. Weight reduction of polyester by caustic treatment increases air permeability of the fabric and also increases the freedom of matrix. These results are shown in table no.7.

Table 3 : Effect of alkali along with RWA/ WRA Air Permeability ($cm^3/cm^2/sec.$)

Fabric sample	Conc. (gm/l)	Shirting fabric	Suiting fabric
NaOH+ Rapid Wetting Agent - 0.5 g/l	0	243.85	213.6
	5	544.43	307.28
	10	575.51	322.3
	15	576.11	355.51
	20	615.46	365.7
NaOH+ Weight Reducing Agent-0.5 g/l	0	243.85	213.6
	5	509.55	254.86
	10	510.49	269.56
	15	518.78	270.05
	20	528.09	277.88
KOH+ Rapid Wetting Agent - 0.5 g/l	0	243.85	213.6
	5	494.39	253.73
	10	511.55	270.2
	15	536.116	311.81
	20	555.26	310.12
KOH+ Weight Reducing Agent-0.5 g/l	0	243.85	213.6
	5	375.03	238.32
	10	377.21	261.346
	15	385.26	271.29
	20	392.7	279.64
KOH+ RWA - 0.5g/l + WRA- 0.5 g/l	0	243.85	213.6
	5	395.64	277.356
	10	409.942	288.95
	15	435.25	304.528
	20	458.052	333.61

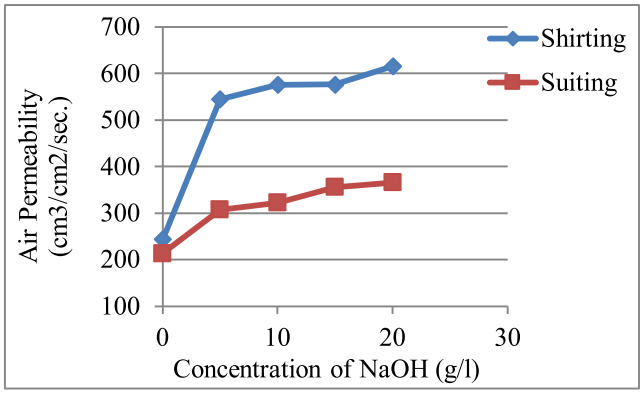

Figure 7 : Effect of NaOH + Rapid Wetting Agent treatment on air permeability ($cm^3/cm^2/sec.$)

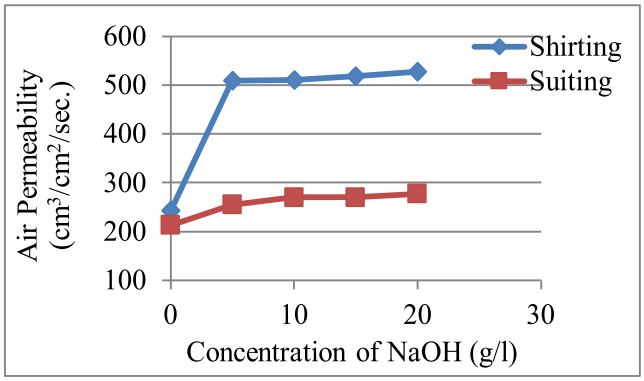

Figure 8 : Effect of NaOH + Weight Reducing Agent treatment on air permeability ($cm^3/cm^2/sec.$)

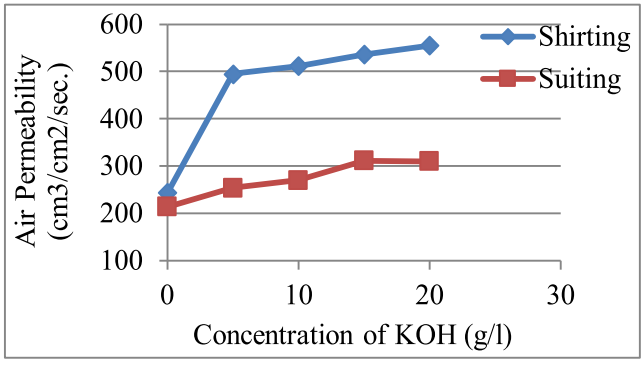

Figure 9 : Effect of KOH + Rapid Wetting Agent treatment on air permeability ($cm^3/cm^2/sec.$)

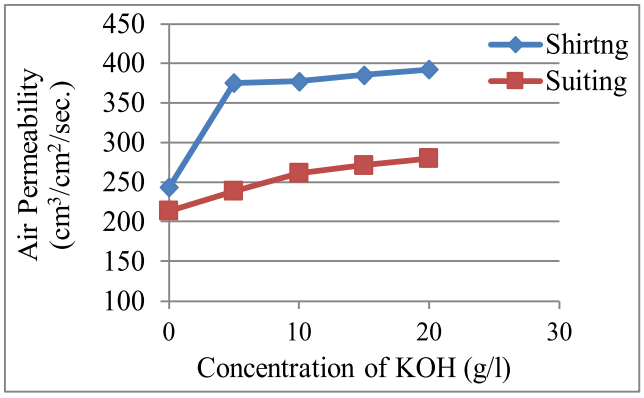

Figure 10 : Effect of KOH + Rapid Wetting Agent + Weight Reducing Agent on air permeability ($cm^3/cm^2/sec.$)

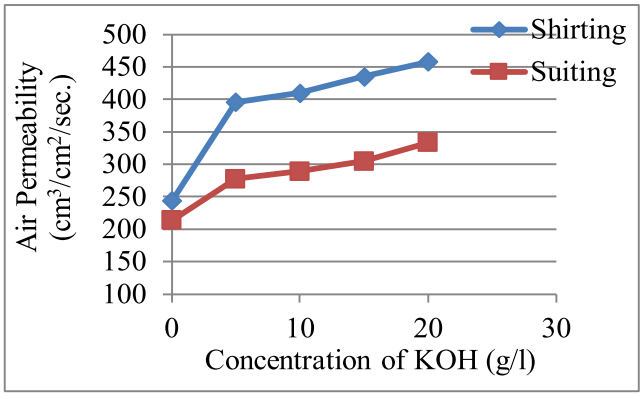

Figure 11 : Effect of KOH + Rapid Wetting Agent + Weight Reducing Agent on air permeability ($cm^3/cm^2/sec.$)

3.3 Wicking

Due to weight reducing treatment using varied quantity of concentration of alkalis, a highly decrease in wicking time (seconds) from34.38% to 96.20% occur, whereas an increase in weight in per cent from 40.81% to 41.11% occur. This is the weight of fabric strip which is increases due to absorption of water up to 5 cm. due to capillary action. Further, increase in quantity of NaOH + rapid wetting agent i.e. concentration from 0 g/l to 20 g/l exhibits increase in fabric weight approximately 50.38%.

Increase in weight in % due to capillary reaction, whereas wicking time decreases. When a polyester fiber partially hydrolyzed, there improves a hydrophilic surface. The wetting times of hydrolyzed samples were significantly reduced after the surface treatment of polyester with an alkali [5]. It finally reduces the wetting time. These results are shown in table no. 3.7 and 3.8

Table 4 : Effect of alkali along with RWA/WRA on wicking time (sec.)

Fabric sample	Conc. (gm/l)	Shirting fabric	Suiting fabric
NaOH+ Rapid Wetting Agent - 0.5 g/l	0	152.4	2919.8
	5	108	189.6
	10	100	144.2
	15	85.8	115
	20	84.8	110.8
NaOH+ Weight Reducing Agent-0.5 g/l	0	152.4	2919.8
	5	110	428.6
	10	99.6	128.4
	15	98.8	100.8
	20	67.4	100.6
KOH+ Rapid Wetting Agent - 0.5 g/l	0	152.4	2919.8
	5	113.6	197.4
	10	111	169.4
	15	106	127.6
	20	103.8	105.2
KOH+ Weight Reducing Agent-0.5 g/l	0	152.4	2919.8
	5	95.2	197.8
	10	75.6	197.6
	15	69.6	189.8
	20	**66**	124
KOH+RWA - 0.5g/l + WRA- 0.5 g/l	0	152.4	2919.8
	5	83.2	66.6
	10	78.6	65.6
	15	75.4	65.2
	20	75.4	**63**

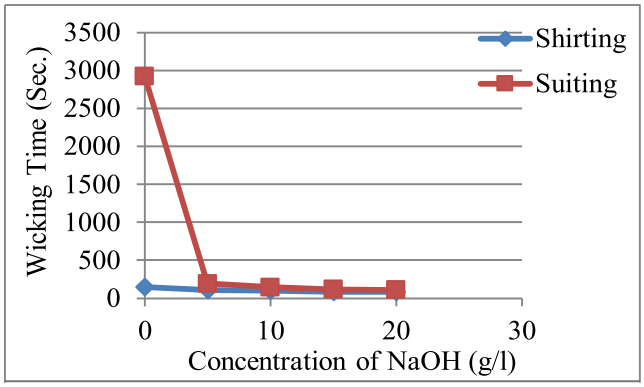

Figure 12: Effect of NaOH + Rapid Wetting Agent treatment on wicking time (sec.)

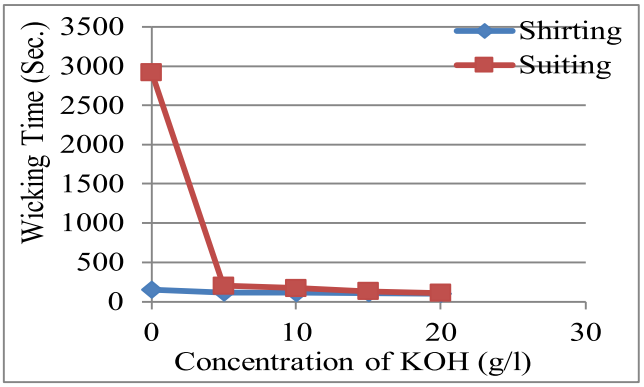

Figure 15 : Effect of KOH + Weight Reducing Agent treatment on wicking time (sec.)

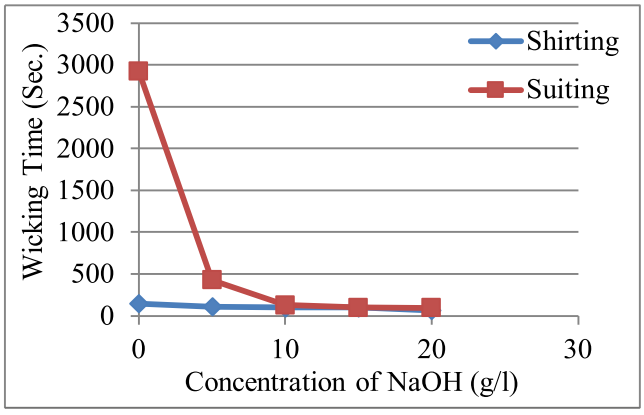

Figure 13: Effect of NaOH + Weight Reducing Agent treatment on wicking time (sec.)

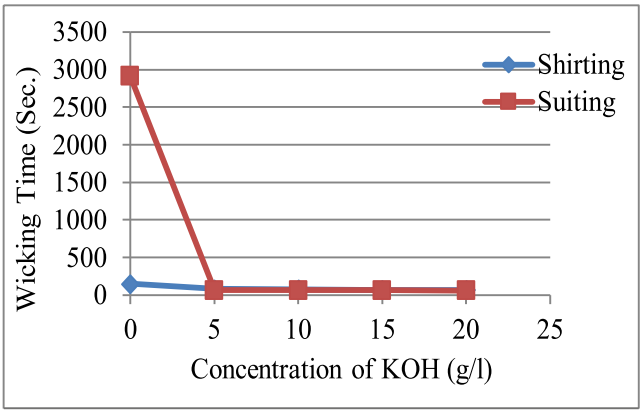

Figure 16 : Effect of KOH + Rapid Wetting Agent + Weight Reducing Agent treatment on wicking time (sec.)

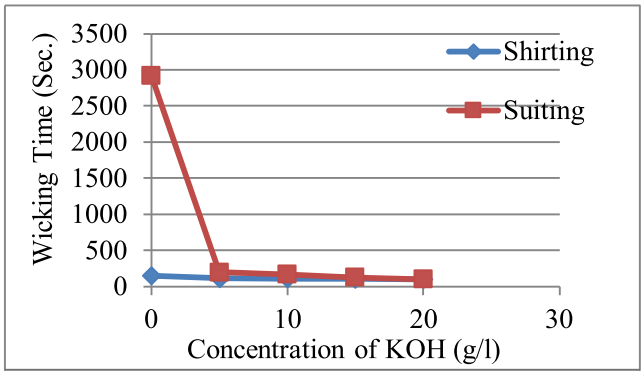

Figure 14 : Effect of KOH + Rapid Wetting Agent treatment on wicking time (sec.)

4. Conclusion

Alkali weight reduction treatment improves the wettability and it may carry out by NaOH and KOH along with Rapid wetting agent and Weight reducing agent. Air permeability increases rapidly, in both the cases i.e. NaOH and KOH, but in case of Suiting fabric, it is more increases. In case of wicking time, it decreases drastically in the case of suiting, whereas in case of shirting, down in time is also significant. In case of Suiting fabric, it decrease about 2920 second to 63 second (46.33th time less), whereas in case of shirting, it decreases 152.4 second to 66 second (2.31th time less). Use of KOH also reduces the pollution load comparatively NaOH.

5. Acknowledgement

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Online Clothing Rental in India: An Empirical Study of Demographic and Lifestyle Factors

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Abstract:
Though clothing rental had been existed before in India, in recent days the online clothing rental market is getting prominent. Many entrepreneurial start ups on online clothing rental have emerged in India recently which shows that the market is gaining momentum among the Indian consumers. The increasing fashion consciousness among the Indian consumers on designer clothing or celebrity clothing, with the constraint of ability to purchase those luxury clothing, consumers would like to rent them for special occasions. This facilitated the growth of online clothing rental business in India. Though several factors or reasons are attributed to this growth, this study focuses on the demographic and lifestyle related factors on the online clothing renting interest among the Indian consumers. Data were collected by conducting a web-based survey using Convenience sampling method. The findings of the study show that there is a significant association between the demographic and life style factors with the online clothing rental interest. Based on the findings the implications for the online clothing rental companies have been provided.

Keywords: *Clothing, consumer demography, consumer lifestyle, consumer preference, online clothing rental,*

1. Introduction

The online clothing rental market in India is getting increasingly prominent over the past few years. Many entrepreneurial start ups on online clothing rental have emerged in India recently which shows that the market is gaining momentum among the Indian consumers. As Indian consumers are becoming more fashion conscious on designer clothing or celebrity clothing concepts and their increasing willingness to wear those clothing without buying or owning them has lead to the growth of this online clothing rental business particularly in countries like India where the majority of the population belongs to middle class and lower class consumers [1]. Though the consumers are interested in wearing the designer or celebrity clothing but their concern about owning or purchasing those clothing from the economical point of view is quite skeptical and also the increasing focus on the concept of sustainability and reducing interest on the fast fashion concepts make these consumer to look out for the option of hiring the clothing rather than owning them. But the behaviour of Indian consumers towards the online clothing rental is still relatively new from the Indian context. Though many companies are entering into this business sector, there are no concrete studies on the behaviour of Indian consumers related to this online clothing rental. This study is aimed at to study the Indian consumers preferences towards the online clothing rental based on their demographic and lifestyle factors.

1.1 Online Clothing Rental

In earlier days, people used to rent clothes for special and important occasions which happened yearly once or more than that. Now, this way of hiring is started happening not only limited to the special occasions, but it goes till day-to-day formal occasions. Clothing rental business is getting prominent and booming among the people in various countries in the world. The major reason behind this booming is the increasing number of consumers who are very much conscious about the environment sustainability. Besides, the consumers who are cost or price conscious also look out for renting the special garments rather than buying them [2].

We have seen the online purchasing has boomed for the past one decade and also it has become one of the primary avenues for new entrepreneurial start-ups. Many start-ups have been established mainly through online business mode only in the past several years. The same trend is also started happening in clothing rental business. Many online clothing rental startups have emerged in Indian online industry witnessing significant growth year-on-year basis. This business model provides opportunity for the customers to rent clothing for every day purposes and also accessories like hand bags, etc. The list of clothing line that can be rented are like designer labels, children wear, maternity wear etc. This online clothing rental business enables clothing and fashion affordable and easily accessible to almost the customers of all market segments [3].

1.2 Global Online Clothing market

The online clothing rental market all over the world was expected to be US$ 1.12 billion with the average growth of CAGR of 9.4%. It is expected to reach US$ 1.85 billion by 2023 with the CAGR of 10.6%. The leading countries in the online clothing market are U.S, France, Italy and UK. In the Asian region, China and India are the countries which see a rapid growth in this market [4] [5].

1.3 Online Clothing market in India

The online clothing rental market was started in India by 2012. The size of online clothing rental market in India is considered to be US $ 3-4 billion. The size of the market is expected to grow continuously because of the existing

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companies and also many people entering in to this business model. The online clothing rental in India is tremendously influenced by the Film industry, mass entertainment media, reality shows etc., so that people are willing to dressing up for the occasions related to wedding parties, office parties, college parties, reality shows etc. These online clothing rental companies offer renting of designer clothes at a reasonable cost which enables the upper middle and middle class customers afford to wear a costly designer labels for particular occasions. The companies also provide several offers to attract customers like free door delivery or free trails at home, etc.

1.4 Online clothing rental segments

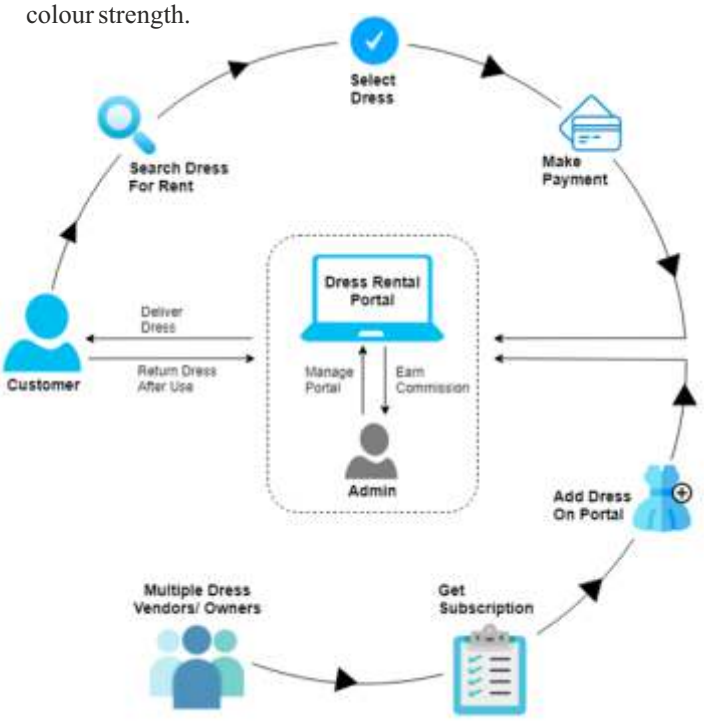
The online clothing rental business is also classified into several segments or categories like men, women, kids, maternity etc. In this the women category is the leading major category with a market share of about 58% in the year 2018. This segment will continuously grow because rapid changes in fashion trends. The kids category segment is also have a significant scope in the growth because of the reason that kids grow faster which requires frequent purchase of the clothes for them. This compels the parents to look of for renting the kids clothes for important occasions [5].

The growth of traditional cloth or ethnic wear segment was expected to be 11.2% and formal clothes segment was expected to have a market share of 48% in 2018. There is a good scope for the maternity wear because these clothes worn during the period of maternity for about 1 year. Later on the clothes are not used mainly. So this segment would see a significant growth particularly among the working women segment. Likewise, several other segments like sportswear, active wear etc. are also getting geared up to enter in this online clothing rental business model [6].

1.5 Business Model

After buying clothes from authentic and well known designers the same is available for renting. Images and brief description about the garment is mentioned on the website through which customers get attracted. First step is to sign up to the website so that the company will receive the email id and phone number of the customer to take orders from them. After the order is placed a stylist will give a call to ask the preference and size of the customer so that she can suggest more proper attire to her. The order has to be placed before three days so that the back end team can ensure the product availability and hygiene. Delivery date should be taken during the order placement and delivery will be done by the delivery guy. Delivery and pick up both are on the company's head and they take care of it by providing ease to customers. Rented clothes will be there for three days with the customer first on the day of delivery, second the day customer wear for the function and third day delivery partner will take it back. So return for the third day. After the clothes arrive, the back end operation team will inspect and repair them. After that it is sent to the dry clean and stain removal outsourced team. When the clothes come back from the dry clean it is stored in either the Experience Center or in Storage. The services offered in this business include Free Delivery, Free Pickup, Cash on Delivery, Stylist call on booking, Pre-paid damage insurance etc. [7].

3.5 Statistical Analysis: The ANOVA results for studying the relationship between resin concentration and colour strength (K/S) of blue and red colour dyed samples are shown in Table 1 and Table 2 respectively. The null hypothesis (Ho) was rejected p-value was less than a pre-determined significance level (0.05). The regression coefficient (R^2) values of blue and red colour dyed cotton fabrics were found to be 0.974 and 0.964 respectively, which indicated a very strong relationship between the resin concentration and colour strength.



Source: www.fatbit.com/launch-designer-dress-rental-portal-with-top-website-features

Figure 1.1: Online Clothing Rental Business Model

1.6 Consumer Lifestyle Factors which Influence Online Clothing Rental

Consumer clothing behaviour is mainly related to the lifestyle of the consumers. The people are very much interested in going out and exploring various things are always tend to be clothing conscious or fashion-conscious people. Besides everyday wear, consumers used to wear various categories of clothing depending on the various occasions. The number and frequency of occasions has increased during this millennium particularly in India mainly because of major influence from western world. The occasions which are related to lifestyle are various types of parties that are conducted by the people including office party, week-end party, college party, wedding party, family party etc. [6]

The main factor which influences the online clothing rental is the increasing online purchasing behaviour of the consumers. A person, who does not have much involvement and experience in online purchase, tends to have less knowledge about the online clothing rental business and is likely to rent any clothes online. The growth of online retailing and purchase is facilitated by the internet penetration among the various segments of people and also the amount of time spent on the internet every day.

Furthermore, the amount of time spent on the internet is related to the Smartphone access or possession of the consumers. The Smartphone penetration in India is increasing day by day and reaches remote parts of India. Also the rise in popularity of fashion blogs & vlogs, TV shows, film industries is also making this online rental market to grow rapidly. In this study, some of the factors considered are social club activities, attending parties, online purchase frequency, smart phone access, and hours spent on the internet [2] [6].

Various studies have been conducted on the factors influencing the clothing rentals. Tu, Jui-Che & Hu, Chi-Ling., (2018) have studied about the factors affecting consumers' willingness to accept clothing rentals and found that a lifestyle factors had significance effect on clothing rentals [8]. Andrea Felsted and Sarah Halzack (2019) stated that the future of Fashion would shift to the platform of rented clothing [9]. Rebecca and Clube (2020) in their study of exploring garment rental as a sustainable business model in the fashion industry studied about the hygienic issues related to the rental clothing and Chunmin Lang (2018) in his study measured how the consumers perceive risks and enjoying fashion renting [10] [11].

The concept of apparel thrifting which was popular in the college shops earlier, now is becoming very popular through the online commerce. These are seasonal sections of a department store which used to pop up during the season and draw the attractions of the teen agers and last long for shorter period of time. The items which were popular in the apparel thrifting like sweaters, culottes, sports coats, tennis shoes, gored skirts, and the much-bemoaned slacks. The lifecycle of the college shop gauges changes in American consumerism over time, but it also offered a more complete understanding of clothing as a primary and enduring aspect of the human experience [12].

For any general public it is very difficult to afford to buy a luxury branded apparel or high priced branded apparel. But the desire for the same could be fulfilled by making availability of those luxury branded apparel on rental basis. This also lead to the sustainability of apparel for a long term usage. The concept of apparel thrifting is a great way to merge local fashion history and culture. It also facilitates the the 'local' adjustment of 'global' concepts of marketing and consumption leads to new formations of value in spatial, temporal and subjective terms. Apparel thrifting also makes the producers, marketers and consumers to focus on the reflexive adaptation of consumer capitalism [13].

2. Materials and Methods

The research design of this study is mainly descriptive in nature. The sampling technique adopted in this study was non-probability, convenience sampling technique, with the respondents who are willing to undertake the survey including respondents who are customers of online clothing renting. Data were collected by conducting a web-based survey to maintain anonymity of respondents and to overcome time and place constraints, thereby helping the study to contact respondents. A total of 280 replies have been received. A total of 271 usable responses were included in the sample for analysis. The data analytical tools used are simple percentage analysis and Chi-square test.

3. Data Analysis

3.1 Descriptive Statistics

Table 3.1: Demographic Analysis

Demography	Details	Frequency	Percent
Age	Below 20	16	5.7
	20-29	126	45.0
	30-39	96	34.3
	Over 40	33	11.8
	Total	**271**	**96.8**
Education	12th	18	6.4
	Diploma	19	6.8
	Degree	148	52.9
	Masters	79	28.2
	Phd	7	2.5
	Total	**271**	**96.8**
Income	Below 3 lacs	4	1.4
	3-5 Lacs	7	2.5
	5-7 Lacs	33	11.8
	7-9 Lacs	81	28.9
	Above 9 lacs	146	52.1
	Total	**271**	**96.8**
Marital Status	Single	100	35.7
	Married	161	57.5
	Widowed	1	.4
	Divorced	4	1.4
	Separated	5	1.8
	Total	**271**	**96.8**
Occupation	Student	40	14.3
	Employee	162	57.9
	Self-Employed	38	13.6
	Not Working	9	3.2
	Homemaker	19	6.8
	Retired	3	1.1
	Total	**271**	**96.8**

From the demographics descriptive table, it is observed that majority 45% of the respondents were in the 20-29 age group (126 numbers), majority 52.9% of the respondents having educational background of Degree (148 numbers), majority 52.1% of the respondents having annual family income of above 9 lakhs (146 numbers), and majority 57.5% of the respondents were Married (161 numbers), most 57.9% respondents have an employee profession (162 numbers).

3.2 Simple percentage analysis

3.2.1 Frequency of Attending Parties

Table 3.2 gives the details about the frequency and percentage of attending parties by the respondents.

Table 3.2: Frequency of attending parties

Party Frequency	Frequency	Percent
Never	1	0.4
Rarely	22	7.9
Sometimes	123	43.9
Very Often	88	31.4
Always	37	13.2
Total	**271**	**96.8**

It is observed from the table 3.2 that 43.9% (123) of the respondent agreed on attending parties and events sometimes, followed by 31.4% (88) said they attend parties very often, 13.2% (37) said they used to attend parties always and 7.9% (22) said they used to attend it rarely with 0.4% (1) said that they never attended any parties. So it is inferred that the majority of the respondents attend parties sometimes.

3.2.2 Type of Parties attended

Table 3.3 gives the details about the type of parties attended by the respondents.

Table 3.3: Types of parties attended by respondents

Type of party	Frequency	Percent
Office party	155	31
College party	77	15.4
Wedding/Family party	222	44.4
Others	46	9.2
Total	**500**	**96.8**

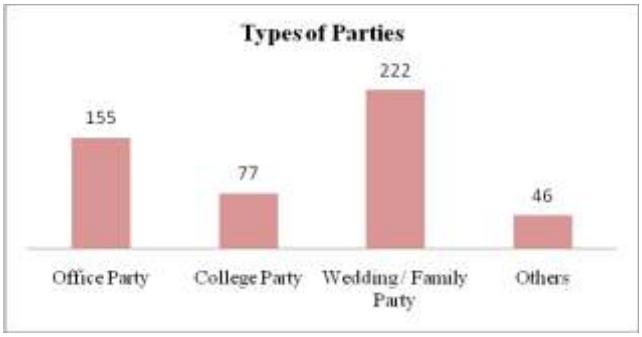


Figure: 3. 2 Types of parties attended by participants

It is observed from the table 3.3 that the types of parties attended by respondents were 44.4% (222) wedding/family party, 31% (155) office party, 15.4% (77) college party and 9.2% (46) other parties. So majority of the party attended by the respondents was wedding/family party.

3.2.3 Accessing the online cloth renting website through Smartphone

Table.3.4 gives the details about the respondents' access the online clothing rental portal through Smartphone

Table 3.4: Accessing the online cloth renting website through Smartphone

Access	Frequency	Percent
Yes	194	69.3
No	77	27.5
Total	**271**	**96.8**

It is observed from the table 3.4 that 69.3% (194) of the respondents accessed the online clothing rental portal through Smartphone, the 27.5% (77) of the respondents did not access the online clothing rental portal. So the majority of the respondents accessed the online clothing rental portal for renting the clothes.

3.2.4 No. of hours spent on Internet

The table 3.5 gives the details about the number of hours spent on the internet by the respondents.

Table 3.5: No. of hours spent on Internet

Hours	Frequency	Percent
1	13	4.6
2	21	7.5
3	119	42.5
4	118	42.1
Total	**271**	**96.8**

It is observed from the table 3.5 that 42.5% (119) respondent were spent 3 hours on internet, an almost equal participation of 42.1% (118) were spent on 4 hours, 7.5% (21) were spent 2 hours and 4.6% (13) were spent about 1 hour a day. So majority of the respondents spent an average of 3 – 4 hours on internet per day.

3.2.5 Member of Social Club

The table 3.6 gives the details about the social club membership details of the respondents.

Table 3.6: Member of Social Club

Member	Frequency	Percent
Yes	90	32.1
No	181	64.6
Total	**271**	**96.8**

It is observed from the table 3.6 that 32.1% (90) of the respondents were members of social clubs and 64.6% (181) of the respondents were not members of a social club. So the majority of the respondents were not members of a social club.

3.2.6 Online Purchase Frequency

The table 3.7 gives the details about the online purchase frequency of the respondents.

Table 3.7: Online Purchase Frequency

Online Purchase	Frequency	Percent
Seldom	25	8.9
Sometimes	106	37.9
Often	89	31.8
Very Often	51	18.2
Total	**271**	**96.8**

It is observed from the table 3.7 that 37.9% (106) respondents did online purchase 'sometimes', 31.8% (89) respondents did online purchase 'often', 18.2% (51) respondents did online purchase 'very often' and 8.9% (25) respondents did online purchase 'seldom'. So the majority of the respondents did online purchase 'sometimes'.

3.2.7 Online Cloth renting

The table 3.8 gives the details about the online cloth renting behaviour of the respondents.

Table 3.8: Online Cloth Renting

Renting	Frequency	Percent
Yes	122	43.6
No	149	53.2
Total	**271**	**96.8**

It is observed from the above table 3.8 that 53.2% (149) respondents have not rented clothes online and 43.6% (122) respondents have rented clothes online. So the majority of the respondents have not rented clothes online.

3.3 Chi-square Test

3.3.1 Demographic variables vs Online Clothing Rental

Table 3.9 gives the details about the chi-square test results between demographic variables and the online clothing rental.

Table 3.9: Chi-square Test: Demographic variables vs Online Clothing Rental

Demographics	Pearson Chi-Square Value	df	Asymp. Sig. (2-sided)
Age	3.970	3	.265
Education	11.698	4	.020
Income	15.475	4	.004
Marital	16.855	4	.002
Occupation	10.946	5	.052

From the table 3.9, it is observed that,

- There is a significant association between education ($p<0.05$) , and the online cloth renting.
- There is a significant association between the income ($p<0.05$) and the online cloth renting.
- There is a significant association between marital status ($p<0.05$) and online cloth renting.
- There is no significant association between the age ($p>0.05$) and the online cloth renting.
- There is no significant association between the occupation ($p>0.05$) and the online cloth renting.

3.3.2 Lifestyle vs Online Rental Clothing

Table 3.10 gives the details about the chi-square test results between lifestyle and the online clothing rental.

Table 3.10: Chi-square Test: Lifestyle vs Online Clothing Rental

Life style	Pearson Chi-Square Value	df	Asymp. Sig. (2-sided)
Attend party	9.711	4	.046
Social club	25.513	1	.000
Hours spent	18.441	3	.000
Online purchase frequency	20.951	3	.000
Smart phone	28.341	1	.000

From the table 3.10, it is observed that,

- There is a significant association between attending party ($p<0.05$), and the online cloth renting.
- There is a significant association between the member of social club ($p<0.05$) and the online cloth renting.
- There is a significant association between hours spent ($p<0.05$) and online cloth renting.
- There is significant association between online purchase frequency ($p<0.05$) and the online cloth renting.
- There is significant association between the accessing online clothing rental portal through Smartphone ($p<0.05$) and the online cloth renting.

4. Findings and Discussions

The findings of this study show that related to approximate no. of hours spent on internet, it is seen that the percentages of 2-3 hours and more than 4 hours respondents are almost equal. Half of the respondents were accessing the internet mostly in their homes (48%). A very less percentage of the respondents (3%) don't shop apparels online. Most of the respondent agreed on an attending mostly wedding/family parties than any other types of parties. It is found that 67% of respondents are part of social clubs.

The significant association between education and the online cloth renting shows that the consumers who have good education qualifications may have considerable awareness about online clothing rental which would further influence them to go for online clothing rental whenever required. The online rental clothing companies should come up with promotional strategies based on the education qualification of consumers. The findings also show that there is a significant association between the income and the online cloth renting, which is very evident that income of the consumers play an important role in the online clothing rental

behaviour. The finding of significant association between marital status and online cloth renting is quite interest that married peoples are often get invited for wedding parties and they tend to attend those wedding parties of neighbours and colleagues than the unmarried people. This also provides opportunity for the companies to target the married people or couples by special offers or packages for both the husband and wife or the whole family together. Though there is no significant association between occupation and the online clothing rental, the companies should take this an opportunity to develop clothing and fashion designs based on the requirements of the particular occupational groups.

It shows that party attending behaviour has a significant association with the online clothing rental behaviour so online rental companies can promote or sponsor various parties by following the concept of win-win strategy. Likewise the online clothing rental companies can have a business association with the various social clubs by providing unique offers to the members of a particular social club with which the company has business association. The significant association between online purchase frequency and the online cloth renting, provides a good scope for the online clothing rental companies because the online purchase among the Indian consumers will grow in the upcoming years. The companies should make aware the customers with new offers and discount are a prime way of engaging the customer with company's promotional activity. Offers going during festivals and end of season should be promoted on website which will help more actions and page view on the website which in turn can be converted into sales.

5. Conclusions

The concept of sharing economy will gain much attention among the business and the other stakeholders of the industry. Though the online clothing rental industry has taken-off with good results, but it is too early to predict the real scope and future of this business segment [14]. Online clothing rental industry would tend to grow when the penetration of internet and Smartphone intensifies to the remote corners of India. Combined with the increasing conscious of sustainability and willingness to change or adapt new practices among the customers, the preference towards rental clothing would be given due consideration in the upcoming days. This business segment still has its own challenges which have to be taken care and overcome so that the business could be performed efficiently and effectively. In this study the focus is given on demographic factors and several lifestyle factors. In future the study may be conducted by involving several other factors like sustainability, psychographic etc., so that more research findings can be brought out which would help the companies to formulate the operational and promotional strategies accordingly.

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New Horizon for Gond: Tribal Art of Madhya Pradesh

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Abstract
The Indian folk art with printing and embroidery plays an important role in creating new designs. Escalating demands of consumers requires modification in the fashion industry with respect to design, colour, style and technique. An attempt was made to develop a design pool using tribal art of Madhya Pradesh which is commonly known as Gond. Gond motifs were adapted for centre design, border design and butti design. In all fifty motifs/designs were documented and categorized keeping in mind their suitability for the product development. All the documented designs were subjected to visual evaluation. Best seven designs from the categories were selected by the panel of ten judges for product developed in appliqué work. One motif was selected, for the placements of each article. Muslin and poplin fabrics were selected for preparation of file folder. Preparedarticles were assessed by college going girls belonging to age group of 20-25years and finally the suitability and acceptability of the file folders were determined and it was found that developed products were highly appreciated. The acceptability percent of the product had a positive response of 75.22%.

Keywords : *Applique work ,Documentation, Gond art , Product Development, Tribal art*

1. Introduction

India had always been known as the land that portrayed cultural and traditional vibrancy through its conventional arts and crafts. Every region in India has its own style and pattern of art, which is known as folk art. It is categorized as "folk" and "tribal"—stylized figures, flat renderings, repetitive motifs, and themes immersed in ritual, religion and festivity dominate.Some of the most famous folk art or paintings of India are Patachitra and Saura paintings of Orissa, Kalamkari and Nirmal paintings of Andhra Pradesh, Apian paintings of Uttrakhand, Pichwai paintings of Rajasthan, Warli Painting of Maharashtra, Kalighat pats of West Bengal and Madhubani paintings of Bihar etc. There are many kinds of ritualistic folk art like Patachitra, Pichuai, Alpana, Kolam etc. One such art form called "Gond" of Madhya Pradesh state.

Many researchers use the folk art as source of inspiration and adapttraditional motifs to make them suitable to incorporate them into textile products like adaptation of Warli, Madubani and Kalamkari for different apparels like kurta, suits, sarees and dupataas. Gond designs are good source to be used on textile products. Recently, these designs are being used on many textile items through different surface enrichment techniques such as silk screen printing, embroidery etc. It is one of the ways to transfer these folk motifs on to the fabric through appliqué work. Appliqué is a fascinating needle work art form referred to the superimposition of one piece of material upon another usually by the means of stitches [1].

Appliqué is a useful surface enrichment technique as it allows easy use of scrap and waste fabric pieces, to create unique patterns. The purpose of study is to preserve, diversify and to document the Gondart. Attempt is made through the fusion of the motifs with some techniques of appliqué work and embroidery.Gond designs can to be used on textile products.Folders are of great utility but fewer options are available in terms of design. Incorporating design elements can help in improving the aesthetic quotient and boost the demand. While creating file folders, waste and scrap fabrics can be reused, makean eco-friendly product.

1.1 Objectives of the Study

The objectives of the present study are:

- To document the motifs of Gond art
- To amalgamate motifs of Gond art with appliqué work
- To find out the acceptability of the file folders made with Gond art motifs.

1.2 Review of Literature

The literature reviewed investigates the field by reviewing research in this area. It was found that red, yellow, black, blue, green, purple and white are the main colours used in Gond Painting. Boasting of a vivid and lively colour palette, most Gond paintings are as dynamically hued as the artists' positive approaches towards life. Compositions are bright and cheerful inducing a festive and bright emotion in the viewer [2].

Gond Paintings are the living expression of the people of the tribe and deeply linked with their day to day life. Religion, myths, magic, witchcraft, customs, convections and taboos, all have inspired tribes for creativity. Their art is generally functional, ceremonial or occasional. Compositions and panels are simple and content in rhythm. The entire work is in freehand creation. The art has greater creativity and aesthetics and traditional value [3].

The decline in the traditional role of the Pardhan Gond has led to responsive adaptation of the oral narratives to the medium of visual art. This now provides an artistic identity and currency to a significant group, it has brought some members of the Pardhan community from selected villages to establish residence in Bhopal, and it renders a case study of empowering tribal cultures to utilize contemporary narrative forms and platforms [4].

In fashion world; there is always a demand of novel and artistic products. The blend of Aipan design with appliqué is providing an imaginative and fresh collection to the people

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who want to adopt their tradition with minute modernization. Adapting and improving the designs is easier to produce, use, fix, and maintain. With the changing world of fashion the field of textile demands for unique, designs which give us the opportunity to use the adapted traditional motifs [5].

The Gond myths of origin and history explain the relationship between the Gonds and the Pardhans: the Pardhan is described as the youngest of twelve Gond brothers and the only one who is able play the sacred Bana fiddle and awaken the great god Baradev from his slumber in the saja tree [6].

2. Materials & Methods

The various steps to achieve the objectives are as follows:

Documentation and Categorization of Gond Art Designs: Images of Gond art were collected and documented from books, magazines, and internet. Then the pictures were segregated into various categories.

Selection of Motifs: Selection of motifs was done through panels of 30 respondents belong to age group 18-25 years. Respondents were College going girls from Jaipur city.

***Evaluation*:** The best seven motifs out of 28 motifs were selected by the respondents for carrying out the work.

Layout and variation of designs: The seven most preferred motifs were arranged in different layouts. They were arranged for the corner design, centre design, allover and border design through CorelDraw 13. Seven new layouts of designs were evaluated by the same respondents. The most preferred design was used for product development.

***Product Development*:** Out of the previously selected design, one design was applied for product development. File folders were prepared through appliqué work.

Acceptability Index- To assess the percentage acceptability of the product, an acceptability index calculated. The formula is as follows-

$$\textbf{Acceptability Index} = \frac{\text{Maximum accepting frequency}}{\text{Total Scores}}$$

3. Results and Discussion

The results of study undertaken have been discussed and presented in the following section.

3.1 Documentation and categorization of Gond Art

Firstly, Gond art images were sourced from books and journals, articles and websites. Gond Art images were documented. These documented designs were further classified into seven categories on the basis of the motifs used, namely- deer motifs, peacock motifs, folklore motifs, bird motifs, animal motifs, fish motifs and elephant motifs.

Category A- Deer Motifs			
			
A1	A2	A3	A4
Category B- Peacock Motifs			
			
B1	B2	B3	B4

Category C- Folklore Motifs			
			
C1	C2	C3	C4
Category D- Bird Motifs			
			
D1	D2	D3	D4
Category E- Animal Motifs			
			
E1	E2	E3	E4
Category F- Fish Motifs			
			
F1	F2	F3	F4

Category G- Elephant Motifs			
			
G1	G2	G3	G4

Figure 3.1. Documentation of motifs

Table 3.1. Acceptability Score of Gond Art Motifs

Design No.	Score	Percentage
B4	119	79.34
A2	112	74.67
F4	92	61.34
C2	87	58.00
E1	82	54.67
G3	80	53.34
D3	79	52.67

Out of these 28 motifs, best seven motifs from each category were selected for the further designing. The above table revealed that design B4 got the highest score of 79.34% and the lowest score is 52.67 was seen in design D3.

3.2 Adaptation and evaluation of Gond art designs

A total of 7 designs were chosen for adaptation, keeping in mind their utility for appliqué work. The designs/motifs were adapted without distorting the originality of the basic design. The designs were accessed on a five point scale by the respondents. The design B4 scored highest score and was selected as for product development.

			
A2	F4	C2	B4
			
D3	G3	E1	

Figure 3.2. Selected designs for product development

3.3 Development and evaluation of motif placement and layout

The selected motif (B4) was experimented with different layout and placement. Seven suitable arrangements for folders BL1, BL2, BL3, BL4, BL5, BL6 and BL7 were developed. Aftergetting the feedback from the panel of judges, the arrangement which scored highest points was selected as the most preferred placement and layout arrangement.

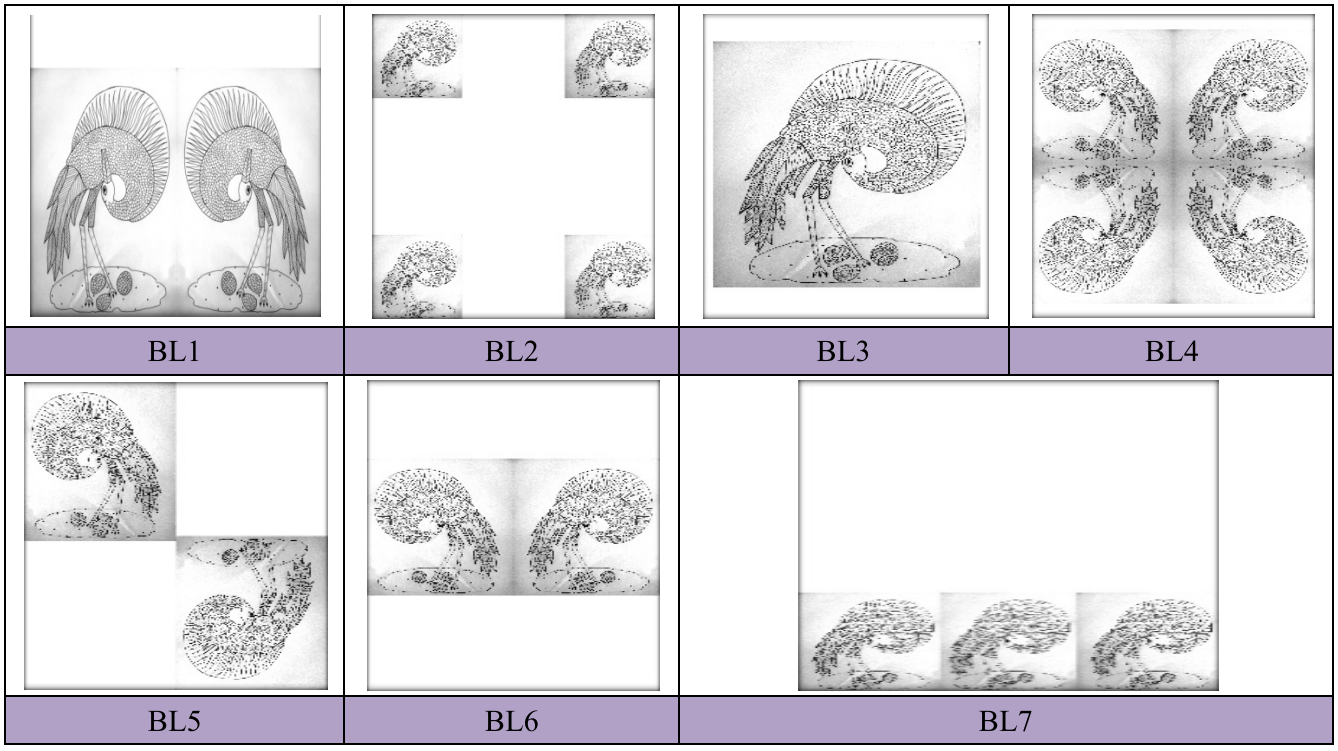


Figure 3.3 : Motif placement and layout

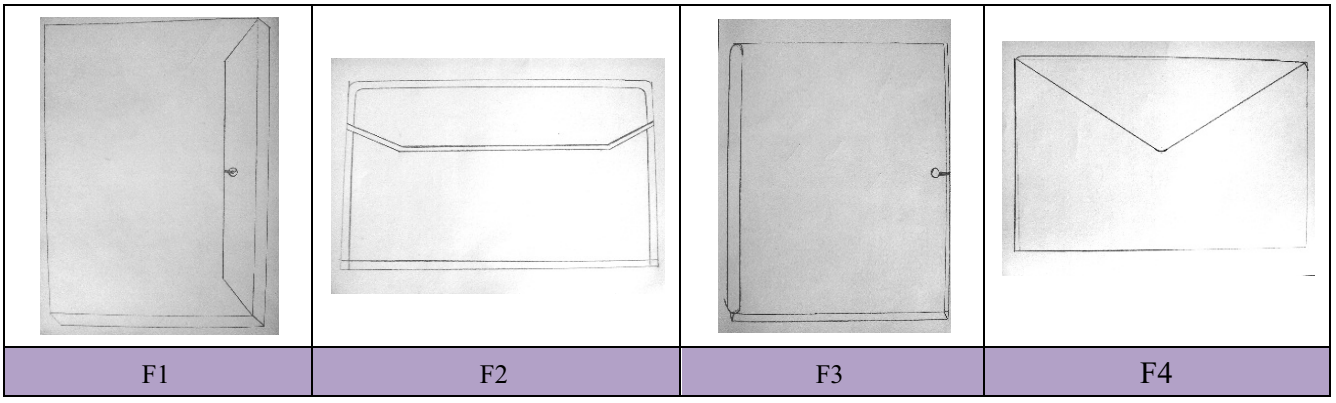
Table 3.2. Acceptability Score of Layout of Selected Motif

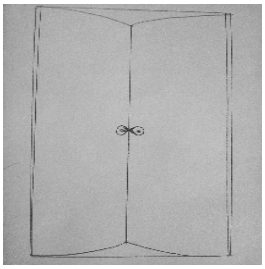
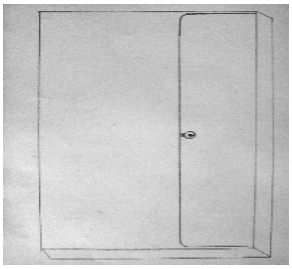
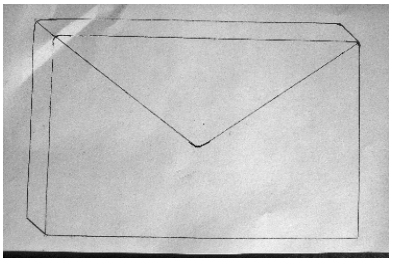
Design No.	Score	Percentage
BL1	118	78.67
BL2	103	68.67
BL3	90	60.00
BL4	111	74.00
BL5	86	57.34
BL6	88	58.67
BL7	101	67.34

From the above table it was found that BL1 got the highest score of 78.67% as compared to the rest of the layout whereas BL5 got the lowest score of 57.34%.

3.4 Evaluation and selection of folders

The designs of folder were accessed on a five point scale by the respondents. The hand drawn sketches were shown and total scores were calculated for each of the designs. The design which scored highest points was selected as the most preferred design.



F5	F6	F7

Figure 3.4 : Hand drawn sketches

Table 3.3. Acceptability Score of Folder Designs

Design No.	Score	Percentage
F1	88	58.67
F2	112	74.67
F3	79	52.67
F4	80	53.34
F5	69	46
F6	91	60.67
F7	83	55.34

From the above table it is revealed that Design F2 got the highest score(74.67%) compared to the rest of the folder designs whereas, the lowest score is 46% seen in design F5. Hence the style of F2 was selected for product development.

3.5 Preparation and development of folders using Gond art motifs through appliqué technique

For developing the folder in appliqué work the most preferred motif (B4), arrangements of motifs (BL1) and style of folders (F2) were selected to preparethe article. The appliquéd work was done onto the folders in a predetermined arrangement. Fabric scraps and leftover fabrics were used for the base of the folder and the appliqué. Button hole stitch was used to finish and fix the appliquéd fabric edges. Embroidery was supported with hand painting technique to add minute details.


Front	Back

Figure 3.5 : ***Development of folders using Gond art motifs***

Table 3.4. Acceptability of the Product

Criteria of Evaluation	Score	Percentage
Design Elements	124	82.67
Cost	117	78.00
Technique Employed	116	77.33
Overall Appearance	114	76.00
Aesthetic Appeal	106	70.67
Neatness	100	66.67

3.6 Evaluate and determine the acceptability of the product

The acceptability of the file folder was accessed on the basis of cost, technique employed, neatness, design element, overall appearance and aesthetic appeal.

The developed products were highly acceptable in terms of design element, cost, technique employed overall appearance, aesthetic appeal and neatness. However maximum score was obtained for design element (82.67%) followed by cost (78%) and technique employed (77.33%) other criteria next in order were overall appear (76%), aesthetic appeal (70.67%) and neatness (66.67%). The file folder created was appreciated.

4. Conclusion

The Gond art is a freehand creation and has a creative, aesthetic and traditional value. The blend of Gond design with appliqué provides an imaginative and fresh collection to the people who want to adopt their tradition art in contemporary products. Adapting and improving the designs are easier to produce. The present work will not only help in the preservation of Gond art but broaden the design base for the textiles products. The file folder developed proved to be an innovative step for designing. Such products can be used for creating utility and decorative purpose. This type of work will motivates people to come up with an ingenious work, which indirectly help in preserving the art of Madhya Pradesh. This further suggested that there is a lot of scope of Gond art motifs to be used in creating such products.

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Wickability of Tencel, Polyester and Cotton Fibre Yarns Spun on Ring and Rotor Spinning Systems

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Abstract
This paper investigated the effect of twist factor and wicking time on wickability of tencel, polyester and cotton fibres yarns spun on ring and rotor spinning systems. The ANOVA results of the experimental study shows all these factors have a significant effect on both properties. Tencel fiber yarn always has higher wickability and wicking rate as compared to cotton and polyester. Rotor yarn always has higher wicking height as compared to their ring spun counterparts.

Keywords : *Polyester yarn, Ring yarn, Rotor yarn, Tencel yarn, Yarn wicking*

1 Introduction

The behaviour of a textile when come into the contact with water is one of the important properties of textiles. This property of textile is known as wicking. If wicking of a textile is good it can be used for various number of applications like sportswear, medical products, footwear and exercise garments. Numerous studies have been done on wickability of spun yarn. According to Harnett and Mehta[1], wicking is the spontaneous flow of water driven into a porous system by capillary forces. Norman[2] analyzed that speed of water in the capillaries reduced by the random arrangement of fibres in the yarn. Lord[3] observed that wicking height is likely to be a function of twist multiple, type of fiber, type of yarn structure and packing as well as migration. Kucukali *et al*[4] studied the wicking properties of cotton-acrylic rotor yarns and knitted fabrics. They observed that wicking height of the yarn tended to increase with increase of acrylic ratio and had a significant impact on wicking performance of single jersey knitted fabrics. Perwueiz *et al*[5] studied the capillary flow in PET, PA yarns and glass fibers using a technique based on the analysis of CCD images taken during the capillary rise of colored liquid in yarns. Chattopadhyay and Chauhan[6] studied the wicking behaviour of ring and compact spun yarns and observed that ring yarns wicked faster than compact yarns and coarser yarns wicked faster than finer ones. Sengupta and Murthy[7] analyzed that for the ring spun yarns, the wicking time increase steeply as twist increase whereas for the open-end spun yarns the increase is gradual.

2. Material and Methods

2.1 Fibres

The tencel, polyester and cotton fibres were used in the present study. The cotton fibre (DCH 32) was obtained in form of combed sliver from an industry. The specifications of tencel, polyester and cotton fibres are given in Table 2.1.

2.2 Preparation of ring yarn samples

Yarns of 29.5 tex were spun from Tencel, polyester and cotton fibres using five different tex twist factors ranging from 28.71, 33.50, 38.28, 43.07 & 47.85 were prepared.

Table 2.1 Specifications of Tencel, Polyester and Cotton Fibre

Fibre	Length mm	Linear density, dtex	Tenacity, cN/tex	Breaking elongation %	Modulus, cN/tex
Tencel	38	1.40	31.3	7.2	731.3
Polyester	38	1.33	56.2	10.8	698.9
Cotton	33.1[a]	1.18	24.9	6.5	525.5
[a]Span length, 2.5%					

Combed cotton sliver was used for making cotton yarns. A predetermined quantity of fibres was processed in a Lakshmi Reiter's blow room line. The conversion to drawn sliver was carried out by using a MMC carding machine and Lakshmi Rieter's drawframe DO/2S. Two drawing passages were given to the card sliver; the linear density of finisher sliver being adjusted to 3.69 ktex. The finisher sliver was converted into 492 tex roving on an OKK fly frame, which was used to produce 29.5 tex yarn on Lakshmi Rieters'G5/1 ring frame using a spindle speed of 12,000 rpm.

2.3 Preparation of Rotor yarns

29.5 tex yarns were spun from tencel, polyester and cotton fibres on rotor spinning machines at twist factors ranging from 28.71 to 47.85. For all fibres, two passages of drawing were given for rotor-spun yarns. The linear density of finisher sliver being adjusted to 3.69 ktex. The yarns were spun on TRITEX miniature OE rotor spinning machine. The rotor spinning parameters involved a 43 mm rotor rotating at 45,000rpm and an opening roller speed of 8,000 rpm.

3. Tests

3.1.1 Yarn wicking

Vertical wicking height was measured by the method used by Sengupta and Murthy[7]. A 30 cm length of yarn was taken. One end of yarn was tied into clip, and other end, to a hook of a small weight (2.90g). The yarn was hung on the notch of a nail fixed to a wooden plank held by an iron stand. Yarn was slowly lowered down into the measuring jar containing 3% Reactive Red dye M8B till the weight just touched the dye solution. The yarn was further lowered down into the measuring jar in such a way that the lower end, of about 1cm was below the liquid surface. Simultaneously stopwatch was pressed and the rise of dye solution from the fluid surface in

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the yarn was continuously watched through the eyepiece. Wicking height was measured in 5 min at intervals of 1 min. Ten readings were taken for each sample. Wicking rate was calculated by ratio of wicking height and wicking time.

4. Results and Discussion

The influence of fibre type, yarn type, twist factor, on the wickability has been tested for significance using ANOVA at 95% level of significance. The ANOVA results are shown in Table 4.1. As can be observed from results that all the factors significantly affect the wicking height and wicking rate.

Table 4.1-ANOVA Results for Wicking and Abrasion Properties

Process variable	Wicking height	Wicking rate
A	s	s
B	s	s
C	s	s
D	s	s
A*B	s	s
A*C	s	s
A*D	s	s
B*C	ns	ns
B*D	ns	s
C*D	ns	s
s- Significant at 95% confidence level; ns-Non significant at 95% confidence level		
A-Fibre type; B-Tex twist factor; C-Yarn type; D-Time		

4.1 Effect of Fibre Type

Figs. 4.1-4.2 shows the wicking height and wicking rate of tencel, polyester and cotton fibre yarns spun on ring and rotor spinning system at twist factors ranging from 28.71 to 47.85. It can be observed from the results that both wicking height and wicking rate is significantly different for different fibres yarns spun on ring and rotor spinning system at all twist factors. Tencel fibre yarn has maximum wicking height and wicking rate as compared to polyester and cotton fibre yarns and cotton has the lowest. Tencel fibre yarns have highest wicking height due to its pore nano-structure which consists of countless, hydrophilic, crystalline nano-fibrils which are arranged in a very regular manner. The fibrils themselves do not absorb water but water absorption only takes place in the capillaries between the fibrils. The space between these micro fibrils acts like capillaries giving rise to enhanced capillary effect. Swelling occurs in the non-crystalline regions and capillaries between the micro fibrils and nano-fibrils so tencel has greatest wicking height as compared to polyester and cotton[8-9]. Though cotton is also a cellulosic fiber and its moisture absorption is very high, yet it has lowest wicking height as compared to polyester and Tencel fibres yarns. This is because the cotton is a natural fiber and has irregular capillaries due to fiber roughness, cross-sectional shape and length which inhibit the fluid flow. With an increase in the non-roundness of a fibre, the specific area increases, thus increasing the proportion of capillary wall that drags the liquid. Also cotton collects moisture despite flowing it out and swells4 when come into contact with water. Polyester fibres yarn is very smooth in appearance and have perfectly round cross-section with regular capillaries and it does not get swell when come into contact with water hence water movements takes place only on the surface of fiber that gives higher wicking height of polyester as compared to cotton yarns[10-11].

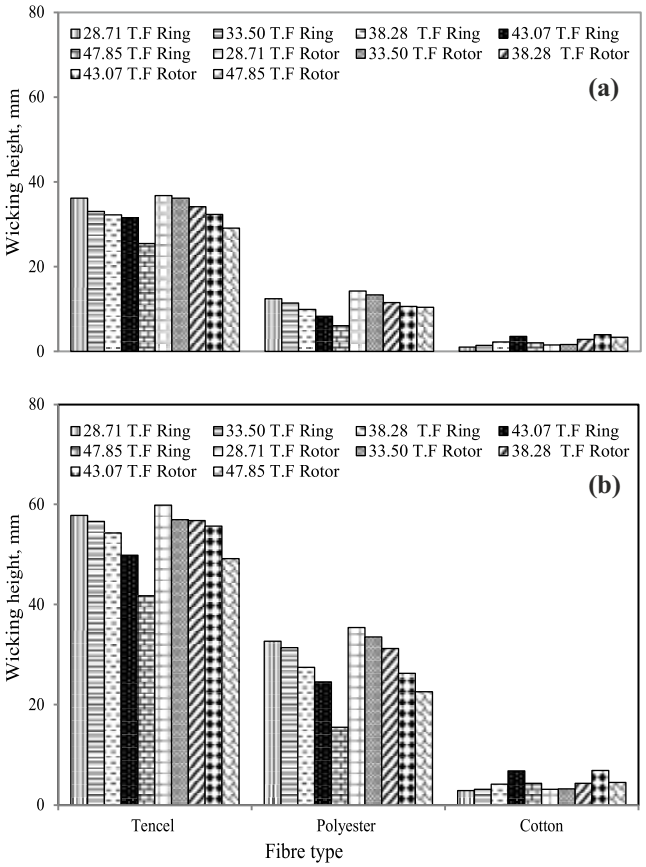

Fig. 4.1-Wicking Height of Tencel, Polyester and Cotton Ring and Rotor Spun Yarns[(a) 1 min and (b) 5 min]

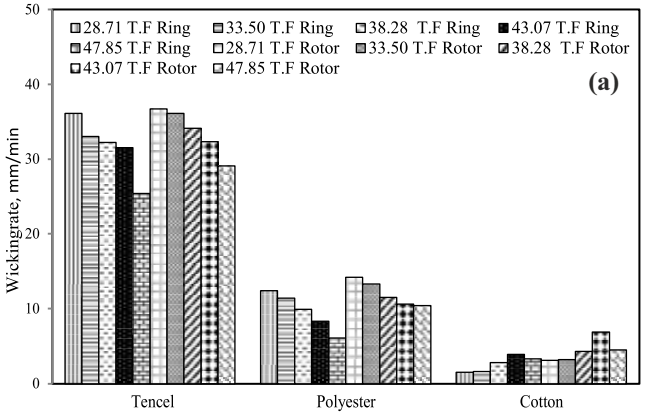

Fig. 4.2-Wicking Rate of Tencel, Polyester and Cotton Ring and Rotor Spun Yarn [(a) 1 min]

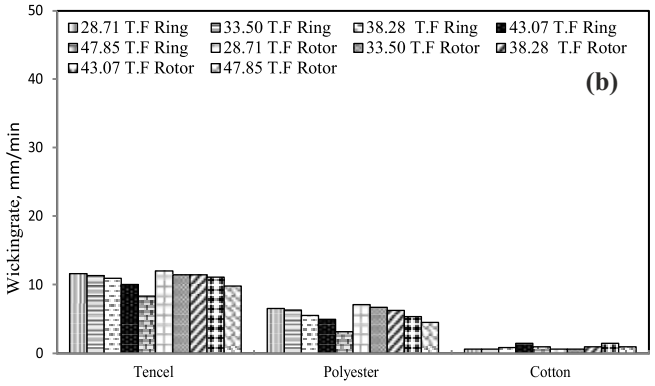

Fig. 4.2-Wicking Rate of Tencel, Polyester and Cotton Ring and Rotor Spun Yarn[(b) 5 min]

4.2 Effect of yarn type

Figs.4.3-4.6 shows that wicking height and wicking rate of ring and rotor spun tencel, polyester and cotton yarns at different twist factors. It can be observed from results that for all the yarn samples rotor yarns have significantly higher wicking height and wicking rate when compared with their ring spun counterparts. The higher wicking height and wicking rate of rotor spun yarn is due to lower packing factor and softer skin of the yarns which makes the fibers in these yarns to be wet and wicks more quickly as compared to ring spun yarns. As ring spun[4,7,11-12] yarns are more aligned towards the yarn axis and more compact than rotors. So wicking height of ring spun yarn is lower than rotor spun yarn.

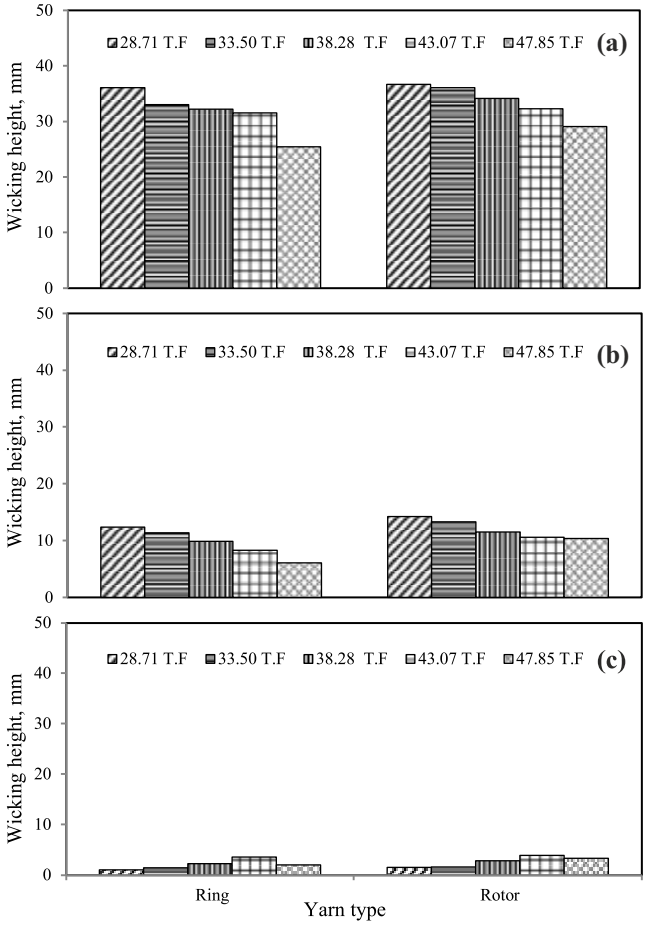

Fig. 4.3- Wicking Height of Ring and Rotor Yarns in 1 min[(a) Tencel,

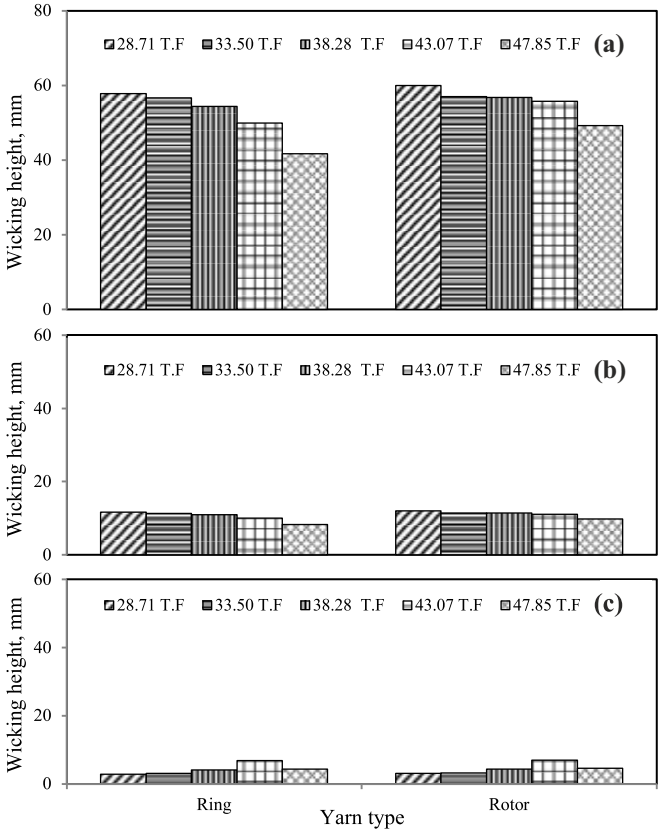

Fig. 4.4- Wicking Height of Ring and Rotor Yarn in 5 min[(a) Tencel,

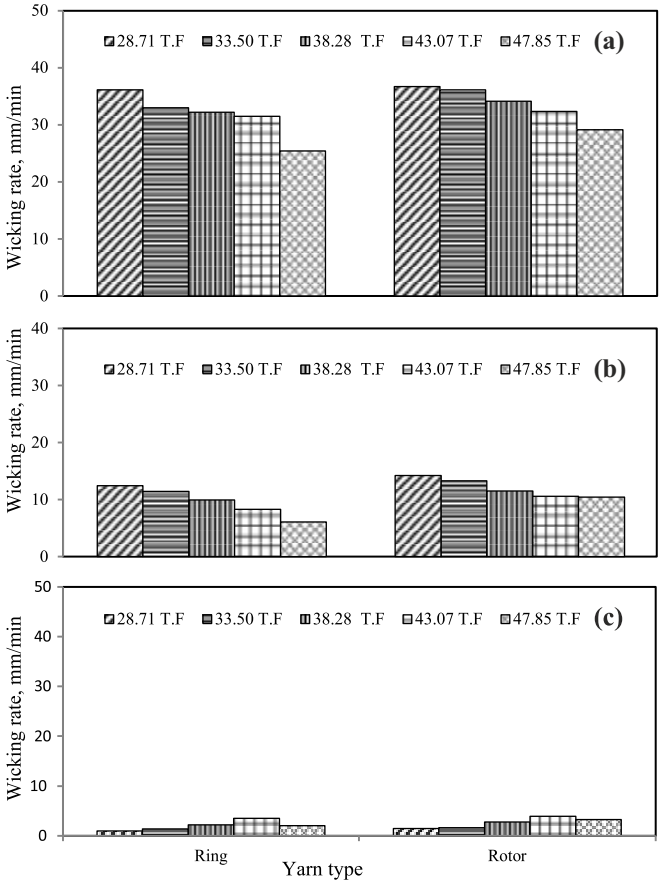

Fig. 4.5- Wicking Rate of Ring and Rotor Yarn in 1 min[(a) Tencel, (b) Polyester, and (c) Cotton]

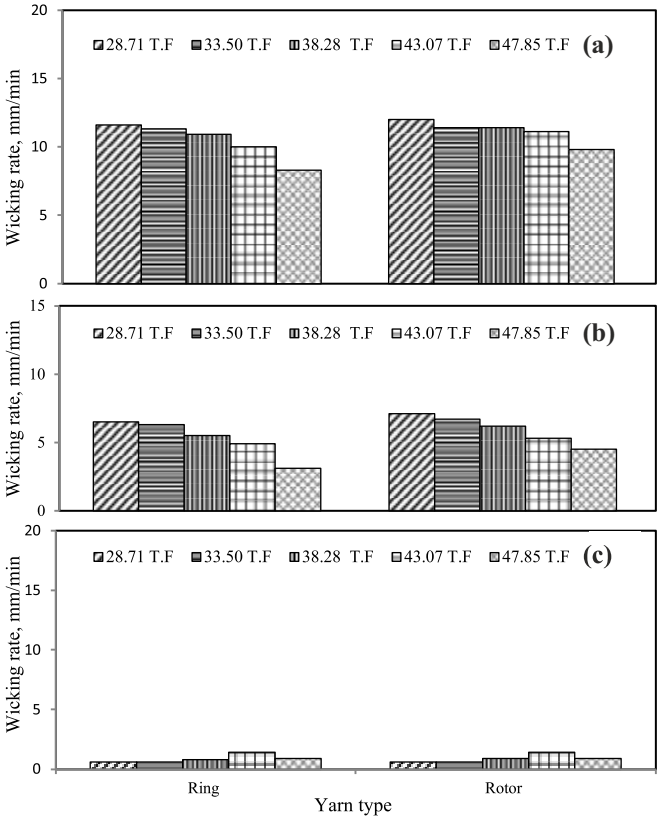

Fig. 4.6- Wicking Rate of Ring and Rotor Yarn in 5 min[(a) Tencel, (b) Polyester, and (c) Cotton]

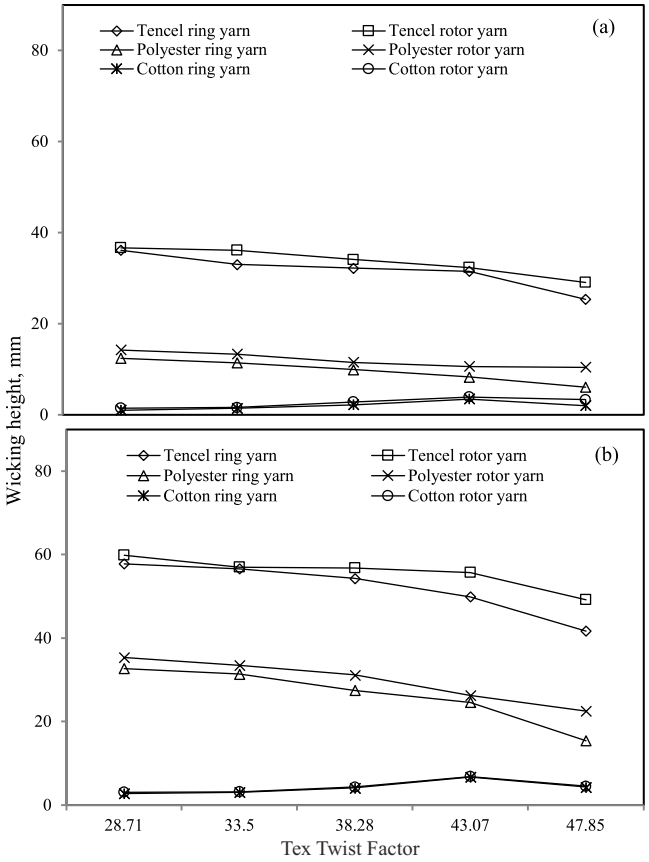

Fig. 4.7- Wicking Height of Tencel, Polyester and Cotton Ring and Rotor Spun Yarn at Different Twist Factors [(a) 1 min and (b) 5 min]

4.3 Effect of twist

Fig. 4.7- 4.8 shows the influence of twist factors on ring and rotor spun tencel, polyester and cotton fibers yarn. From the ANOVA Table 3.1, it is observed that the twist influences the wicking height and wicking rate significantly and the influence of twist factor on wicking height and wicking rate is different for tencel, polyester and cotton yarns. In case of tencel and polyester yarns the wicking height continuously decreases with increase in twist factor for both ring and rotor spun yarn whereas in case of cotton yarns the wicking height increases upto twist factor 38.28 and thereafter it decreases for both yarn types. With the increase in twist factor for tencel and polyester yarns, the decrease in wicking height and wicking rate can be attributed to decrease in size of capillary channel between the fibers and increase in tortuosity that results to wick a longer path for a constant wicking height and hence lower wicking height is observed. But in case of cotton yarns, wicking height increases with increase of twist factor at low levels and reaches the maximum at twist factor of 38.28 and thereafter it decreases. This behaviour is due to that at lower twist level the yarn is loosely packed and when additional twist is inserted into the yarn, constituent fibers tend to move inward and the becomes more compact[13].This appears to reduce the effective radii of inter fiber capillaries and enhance the wicking. The wicking reaches the maximum when the yarn is nearly closely packed. After that with the introduction of additional twist into the yarn the decrease in wicking height and wicking rate can be attributed to decrease in size of capillary channel between the fibers and increase in tortuosity.

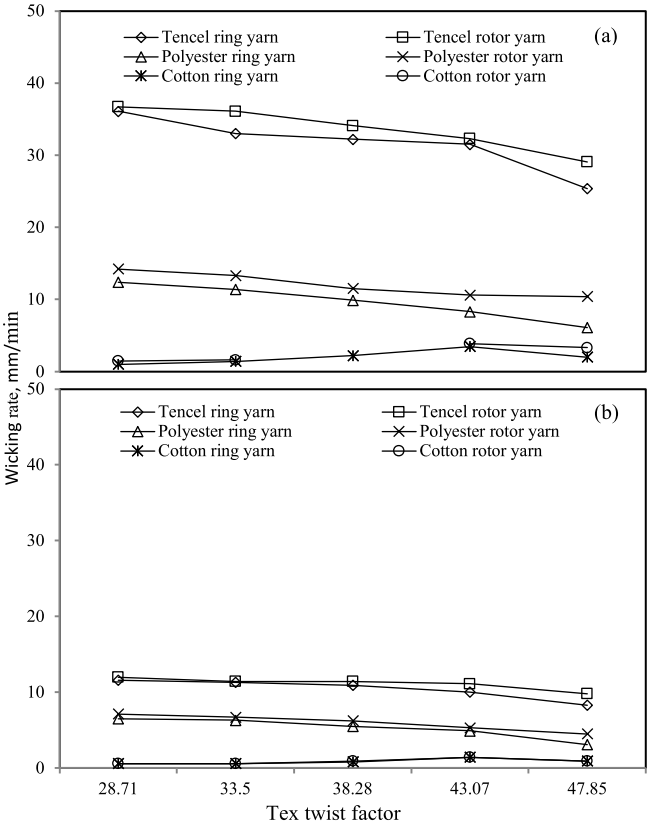

Fig. 4.8- Wicking Rate of Tencel, Polyester and Cotton Ring and Rotor Spun Yarns at Different Twist Factors [(a) 1 min and (b) 5 min]

4.4 Effect of time

Figs. 4.9-4.10 show that there is significant effect of time on wicking height and wicking rate. Wicking height continuously increases with increase in wicking time whereas wicking rate decreases continuously with the time. The decrease in wicking rate[14] with increase in time for any given yarn can be attributed to the gravity of water column within capillary which acts against the capillary pressure.

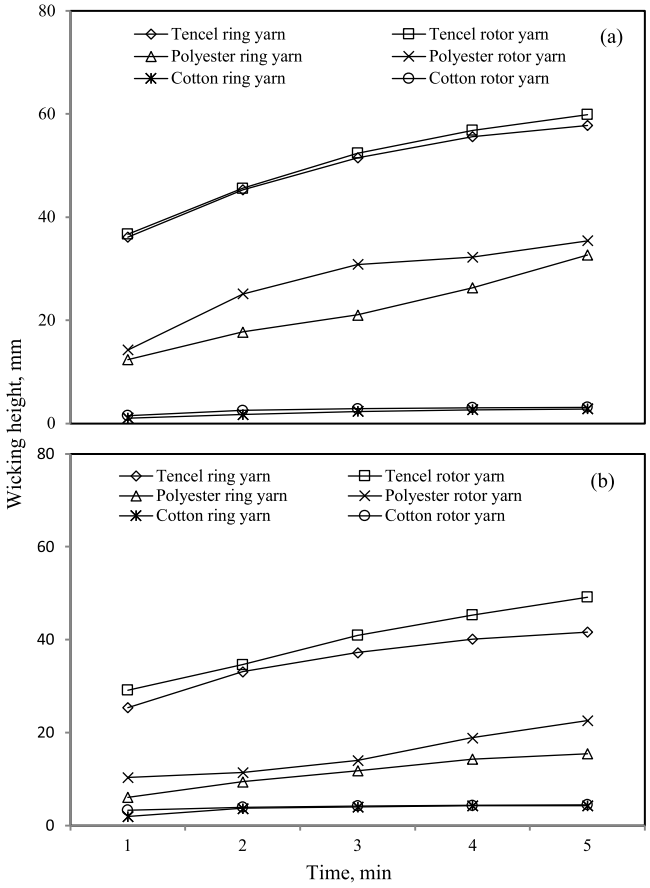

Fig. 4.9- Wicking Height of Tencel, Polyester and Cotton Ring and Rotor Spun Yarns at Different Time [(a) 28.71 T.F and (b) 47.85 T.F]

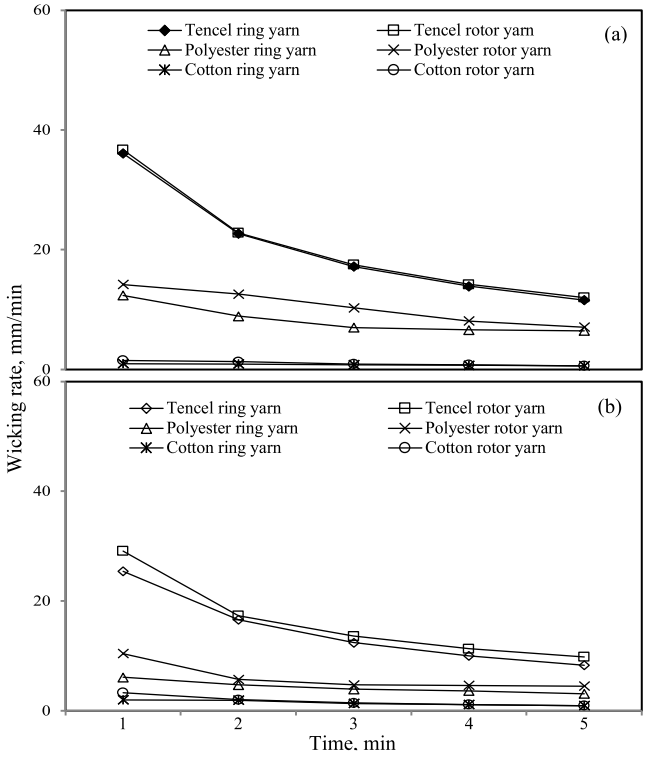

Fig. 4.10 (a) -Wicking Rate of Tencel, Polyester and Cotton Ring and Rotor Spun Yarns at Different Time [(a) 28.71 T.F and (b) 47.85 T.F]

5. Conclusions

5.1 Tencel fibre yarn has maximum wicking height and wicking rate as compared to polyester and cotton fibre yarns and cotton has the lowest value.

5.2 For all the yarn sample, rotor yarns have significantly higher wicking height and wicking rate as compared to their ring spun counterparts.

5.3 The influence of twist factor on wicking height and wicking rate is different for tencel, polyester and cotton yarns. For tencel and polyester yarns, the wicking height continuously decreases with increase in twist factor for both ring and rotor spun yarns whereas in case of cotton yarns the wicking height increases up to twist factor 38.28 and thereafter it decreases for both yarn types.

5.4 Wicking height continuously increases with increase in wicking time whereas wicking rate decreases continuously with increase in wicking time.

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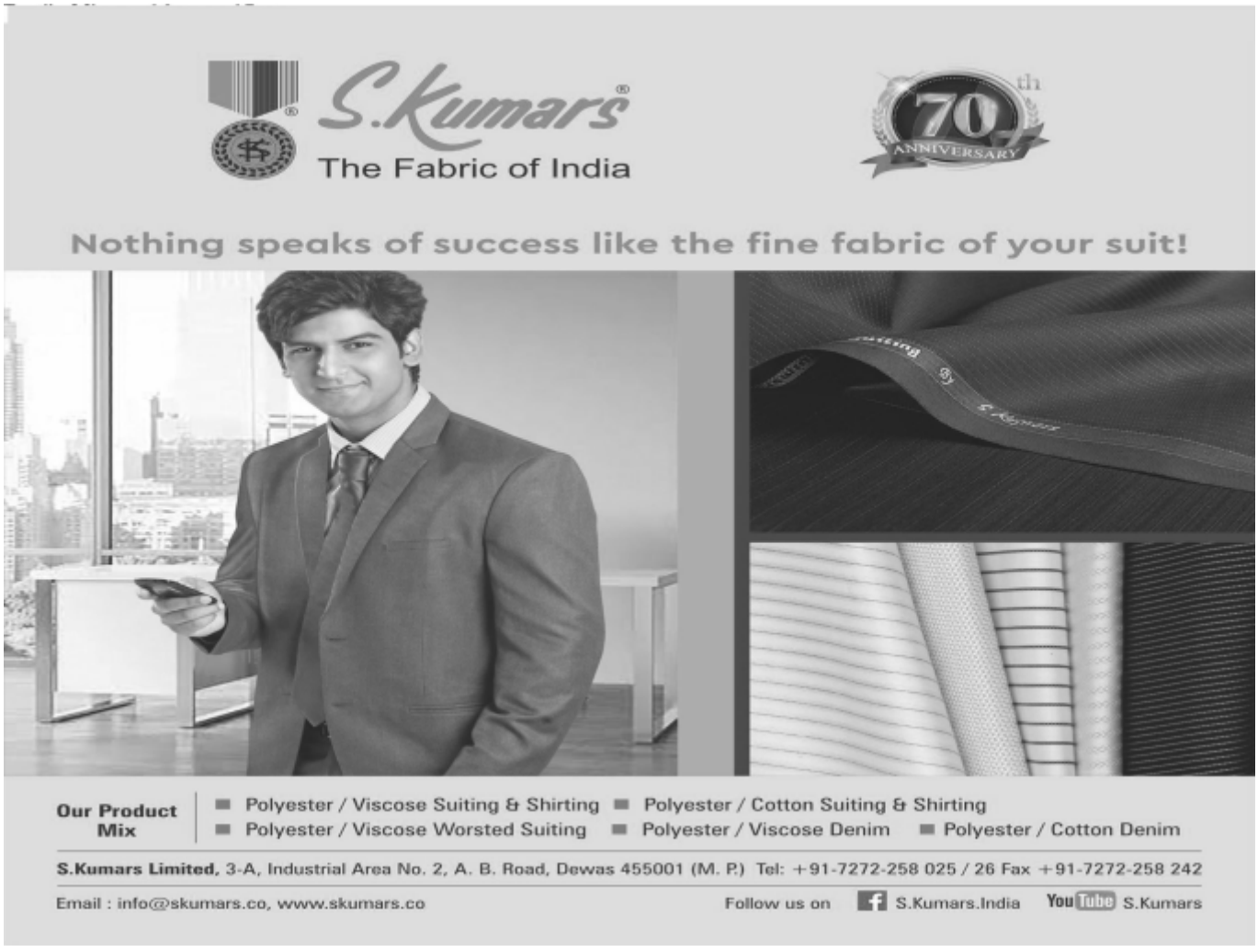

Study on Arachis Hypogaea Shell Extract for Controlling the Growth of Escherichia coli on Cotton Fabric

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Abstract

Antimicrobial textiles continue to increase in popularity as they are fresh smelling, skin friendly and high performance due to long lasting antimicrobial potential. These days, most of the consumers are aware that microorganisms cause deleterious effect on textiles and human hygiene. By imparting antimicrobial properties to the fabric, we can increase the hygiene factor and thus making a fabric, more pleasant to wear. This study was done on the extraction of antimicrobial finish from groundnut shell and its application on cotton fabric (cambric). Extraction was performed by using hydrous (water) and solvent (ethanol, methanol) extraction methods. Different concentrations of groundnut shell (20%, 40%, 60%) with ethanol, methanol and water were taken and Agar Diffusion method (AATCC147) was used for testing antimicrobial efficacy of extract. It was observed that 20% methanol extract gave better inhibition zone against E.coli. Antimicrobial finish was applied on the fabric by using exhaustion and pad -dry -cure method. It was observed that the fabric, which was treated with groundnut shell extract along with 12% citric acid, gave better inhibition zone as compared to fabric treated with only groundnut shell extract. Fabric sample treated with extract and 12% of citric acid showed clear zone of inhibition till 5th wash. After 6th, 7th and 8th wash, the clarity reduced but zone of inhibition was still present. Thus, it was proved that groundnut shell possesses good antimicrobial properties and citric acid increases the durability of finish on cotton fabric. Thus, it was interpreted from the study that agro processing industry waste and food industry waste can be used and applied for benefit of mankind.

Keywords: *Antimicrobial, Culture, Durability, Escherichia coli, Flavonoids, Inhibition Zone, Phenolic Compounds, Wash fastness*

1. Introduction

The word "Textile" is derived from the Latin term "texture" for woven fabrics. Now-a-days most of the textiles are made up of synthetic fibres. In older times, the textiles were made up of cellulosic fibres (like cotton and linen) and protein fibres (like wool, silk). Method of construction includes weaving, spinning, plaiting or braiding strips etc. Both hand and machine methods of production are used. Decorations and further modifications of the textile include dyeing, surface painting, embroidery, and beads. The variety of materials, production techniques, and decorations often result in composite item [1]. There are two properties of fibres Primary and secondary. Primary property includes tenacity, flexibility, cohesiveness or spinning quality and high fibre length to width ratio. Secondary properties include specific gravity, elongation, resiliency, moisture regains, electrical conductivity, abrasion resistance, chemical resistance and biological resistance. There are two types of bacteria; gram positive and gram negative. Present study was conducted on gram negative bacteria *E.coli* (*Escherichia coli)*. They are motile with peritrichous flagella. *E.coli* is a facultative anaerobe. It inhabits in lower portion of intestines and warm blooded animals where it is a part of normal flora. Some strains can cause gastroenteritis, urinary tract infections, diarrhoea and dysentery. These bacteria grow on the surface of fabrics, on provision of nutrients from human skin. Human skin releases salts, sugars and other nutrients during perspiration and oil from oil glands. During growth of bacteria, they multiply on the worn fabric, produce strong odour on the fabric and also cause the bio-deterioration of the fabric. Hence, there is strong requirement of antimicrobial fabrics based on natural plant extracts because antimicrobial fabrics based on synthetic compounds are non-biodegradable, deleterious to the skin, cause skin irritation and allergies. On the other hand, natural bioactive compounds are biodegradable i.e. eco-friendly, do not cause skin allergies and moreover, they exhibit fragrance. They have been widely used as antimicrobial agents for textiles in finishing process. Antimicrobial textiles based on eco-friendly finishes continue to increase in popularity due to their skin friendly nature and fragrance. Herbal oils and extracts from lemongrass, aloe vera, almond, neem, sheesham bark, clove, garlic and apricot can be used as natural finish and applied on fabrics. Agro-processing industry and food industry generate large amount of solid waste. This solid waste can be used wisely and can be employed in useful application. This solid waste is rich in lignin, which is a bio macromolecule. Extraction of lignin biomolecule from groundnut shell can be helpful in an efficient waste management [18]. Investigators have extracted lignin biomolecules which can be applied on the wool fabric. This enhances functional properties of the fabric like UV protection, antibacterial activity and antioxidants [2]. Ground nut shell extract can also be used as dye to colour the fabrics. Researchers used roasted pea nut skin. Peanut shell was also used to extract dye which can be applied on wool, silk and cotton fabrics at different temperatures. Silk and wool absorbed more dyes as compared to cotton [3]. Present study was conducted on antimicrobial effect of groundnut shell extract against *E.coli,* when applied on cotton fabric [4]. Peanut or ground nut is a species that belong to legume family. Groundnut shell is the good substrate as it is the waste of agro processing industry. It is considered as an organic waste of agriculture and its use as natural finish on fabrics, is an appropriate method of environment waste management. Peanut shell is an agriculture waste, is also

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considered as Lignocellulosic waste. There is a huge amount of low value lignocellulosic material that are usually burned or wasted. Botanical name of ground nut is *Arachis hypogaea*. The chemical composition of peanut shells varies with the peanut variety and shelling conditions. Their approximate composition is crude fibre 60%, cellulose 25%, water 8%, crude protein 6%, ash 2% and fat 1%. Ground nut hull is considered as agricultural waste. It has been estimated that around 8 million tons of groundnut shell is produced every year. Hulls constitute 25% of the total mass produced and are not being utilized. Groundnut shell is an abundant and inexpensive product. Majority of it is burned, dumped or left to degrade naturally. There is a great need to utilize this natural resource. Peanut shell contains many bioactive compounds such as poly phenol, flavonoid, luteolin, carotene [5] [6]. Thus, this study was done to analyse the antibacterial effect of groundnut extract, containing bioactive compounds, against the test organism i.e. *E.coli.*

2. Objectives:

- To analyse the antimicrobial effect of groundnut shell extract on cotton fabric.
- To standardize the extraction process of antimicrobial finish from the groundnut shell.
- To standardize the method of application of the extracted antimicrobial finish on the cotton fabric.
- To evaluate the efficiency of antimicrobial finish, when applied on cotton fabric.

3. Methodology:

The present study was done in the laboratory of Microbiology and the laboratory of Fabric and Apparel Science at the Institute of Home Economics.

3.1 To standardize the extraction process of antimicrobial finish from the groundnut shell:

3.1.1 Preparation of groundnut shell powder:

To prepare groundnut shell powder, groundnut shell was separated from the seed, then, the shells were washed thoroughly for 2 to 3 times with distilled water. The shells were dried in the oven, which was preheated at 150 ˚C**.** The shells were dried until the weight of the shells became similar to initial weight of the shells, taken before washing [Plate 3.1]. After the drying process, the shells were grounded in mixer grinder to make a fine powder and then this powder was stored in an airtight container [Plate 3.2].

Plate 3.1 Washed Groundnut shell

Plate 3.2 Groundnut shell powder

3.1.2 Extraction of finish from groundnut shell:

Two methods were used for extraction of finish:

Hydrous Extraction Process:

In Hydrous Extraction process, the dried shell powder was mixed in distilled water at different concentrations (20%, 40%, and 60%). These mixtures were kept in separate sterilized conical flasks and plugged with cotton plug. Then the cotton plugged flasks were sealed with Parafilm and covered with aluminium foil to prevent the finish from any bacterial and fungal contamination. Then the sealed flasks were kept in orbital shaker at 30˚C temperature, 100 rpm for 24 hours. After 24 hours incubation and shaking, the mixture was sieved through nylon mesh and filtered with the help of Whatman no 1 filter paper, in a freshly sterilized conical flask. Flasks containing final extract were cotton plugged, sealed and kept in refrigerator at 4 ˚C, for further testing.

Solvent Extraction Method:

In Solvent Extraction process, the dried shell powder was mixed with different concentrations (20%, 40% and 60%) of methanol and ethanol separately [7]. These mixtures were kept in separate sterilized conical flasks and plugged with cotton plug. Then the cotton plugged flasks were sealed with parafilm and covered with aluminium foil to prevent the finish from any bacterial and fungal contamination. Then the sealed flasks were kept in orbital shaker at 30 ˚C, 100 rpm for 24 hours. After incubation, the mixture was first sieved with nylon mesh and then with Whatman no 1 filters paper in freshly sterilized conical flask. Flasks containing final extract were cotton plugged, sealed and kept in refrigerator at 4 ˚C, for further testing.

3.2 To standardize the method of application of extracted finish on cotton fabric:

3.2.1 Pre-treatment of the selected fabric or desizing of the fabric:

Desizing is a method to remove any sizing material present on the fabric and make it suitable for further processing. During desizing of the fabric, the fabric samples were soaked in 0.5% of the sulphuric acid solution at 60 ˚C to 70 ˚C for 15 to 20 minutes. After this, the samples were taken out, squeezed and rolled in polythene sheets. Then the fabric samples were dried in an oven at 40 ˚C for 4 hours. Then the samples were rinsed in distilled water and neutralised with

0.5% sodium carbonate solution, washed and then dried. The evaluation of the fabric was done by the iodine test, for the presence of starch.

3.2.2 Application of antimicrobial finish on cotton fabric:

Antimicrobial finish was applied on cotton fabric (cambric) by two methods:

(i) Exhaustion method

(ii) Pad-dry-cure method

Exhaustion Method

In Exhaustion method, pre-treated fabric was used for application of finish; the fabric sample was cut into 1" X 1" size, and then immersed in selected concentration of the extract and citric acid for 10 to 12 hours at 4˚C in refrigerator [19]. After 10 to 12 hours, fabric samples were taken out and kept in sterilized Petri dish to avoid contamination. For drying process, fabric samples were kept in an oven at 80 ˚C for 5 minutes after this, the samples were kept out of the oven to cool down, and then the fabric samples were subjected to curing at 150 ˚C for 3 minutes. Then the samples were taken out of the oven to cool down.

Pad-dry -cure method

In pad-dry-cure method, the treated fabric samples (undergone exhaustion treatment), were kept in zip lock bag with little amount of finish, then passed through paddling mangle at 0 psi with 2 dips and 2 nips for maximum wet pick. After padding, the fabric was dried by removing water ant then subjected to curing. For curing, the treated fabric samples were kept in an oven at 150 ˚C for 3 minutes [8]. The padding mangle consists of two rollers which are placed one over the other. The rollers perform the role of squeezing the fabric and leave the fabric with 100% wet pickup.

3.3 To evaluate the efficiency of antimicrobial finish, when applied on cotton fabric:

3.3.1 Determining the best process of extraction with the help of agar plate diffusion method (AATCC 147):

Gram negative bacteria, *E.coli* was used in this study, the culture was freshly revived by streaking on nutrient agar plates and then inoculated in nutrient broth. To determine best concentration of extract, agar plate diffusion method was performed [9]. In this method, nutrient agar plate was taken; a well was punched in the centre of the plate by using sterile borer. The punched plate was then swabbed with freshly grown *E.coli* culture by using sterilized cotton swab. The well was then filled with 100 µl groundnut shell extract, and then the plates were kept in incubator at 37 ˚C, by taking care that extract must not spill from the well. After 12 hours of incubation, the plates were examined for zone of inhibition [10]. For calculating zone of inhibition, the average width of zone of inhibition was considered. The formula for zone of inhibition is W= (T-D)/2 where W= width of zone of inhibition (mm), T= Total diameter of well and clear zone (in mm), D= Diameter of the well created by borer (mm) [11].

3.3.2 Determining the concentration of citric acid:

Citric acid was used as binding agent; it creates covalent cross linkages between the fabric and finish, when applied on the fabric. Thus, citric acid was an effective agent to enhance the wash fastness of the finish on to the fabric. To determine an effective concentration of citric acid, the finalized extract concentration was mixed with different concentrations of citric acid (2%, 4%, 6%, 8%, 10%. 12% and 14 %). Freshly prepared nutrient agar plates were taken, they were punched in the centre by using sterilized borer, and then the plates were inoculated with freshly revived test organism (*E.coli),* by using sterilized cotton swab. Finalized extract concentration of ground nut shell extract was mixed with different concentrations of citric acid, and 100 µl **of** it was poured in the well. Then the plates were kept in the incubator at 37˚C overnight, next day the plates were examined for the zone of inhibition. Finalized zone of inhibition was considered, by taking the average of width of zone of inhibition from either side of the well.

3.3.3 Qualitative testing of fabric by Agar plate diffusion method (AATCC 147):

Treated fabric sample with finalized concentration of extract and citric acid was used for further testing. Freshly prepared nutrient agar plates were taken and inoculated with freshly revived *E.coli* culture using sterilized cotton swab. The treated fabric sample (test sample), was kept in the centre of the plate with the help of sterile forceps. The fabric sample was gently pressed onto the agar surface to maintain uniform contact, and then the plates were kept in the incubator at 37 ˚C overnight. Next day the plates were analysed for the presence of inhibition zone [12] [13]. Finalized zone of inhibition was considered, by taking the average of width of zone of inhibition from either side of the well.

3.3.4 Testing the wash durability of the finish on treated fabric sample using Laundrometer:

To test the antimicrobial potential and efficacy of finish after washing, the wash durability test was performed on the treated fabric sample. Laundrometer was filled with water at required level, 0.5% soap solution was prepared, and temperature was fixed at 40 ˚C. Treated fabric samples were dipped into the soap solution. Duration for each wash cycle was fixed for 5 minutes. The procedure was repeated for 10 washes. Washed fabric samples were subjected to further testing. Washed fabric samples were analysed for antimicrobial potential by agar plate diffusion method (AATCC 147)[14][15][16].

4. Result and Discussions:

Present study was conducted in three phases:

4.1 To standardize and to determine the best extraction process of antimicrobial finish from the groundnut shell:

Groundnut shell extract in ethanol with concentration 20%, 40% and 60% was tested for antibacterial potential against *E.coli* (test organism), range of width of inhibition zone was observed from 1.25mm to 4mm [Plate 4.1] and groundnut shell extract in methanol with concentration 20%, 40% and 60% was tested for antibacterial potential against *E.coli* (test organism), range of width of inhibition zone was observed from 0.5mm to 6.5mm and extract in water (aqua extract) did not show any inhibition against *E.coli* [Table 4.1]. It was

observed that 20% methanol extract gave highest value (6.5mm) of zone of inhibition against *E.coli*. Thus, 20% ground nut shell extract in methanol (concentration) was finalized for further study. In control samples i.e. ethanol, methanol and water, no zone of inhibition was observed against test organism (*E.coli).*

Table 4.1. Different concentrations of groundnut shell extract in organic solvents, water and observed zones of inhibition (mm)

Sr. No.	Herbal Extract	Zone of Inhibition (Average width of zone of inhibition in mm)		
		Ethanol	Methanol	Water
		E.coli	*E.coli*	*E.coli*
1.	20%	4	6.5	-
2.	40%	2.5	0.85	-
3.	60%	1.25	0.5	-
4.	control	-	-	-

4.2 To standardize and to determine the method of application of extracted finish on cotton fabric:

4.2.1 Pre-treatment of the selected fabric or desizing of the fabric:

Fabric samples were treated with 0.5% of sulphuric acid solution (60-70˚C **).** The fabric samples were removed, squeezed and rolled in polythene sheets. They were kept in oven maintained at 40 ˚C for 4 hours than fabric was rinsed and neutralized with 0.5% sodium carbonate solution, washed and dried. The evaluation of the fabric was done by adding Iodine, it was observed that colour of the solution remained yellow and did not turned blue-black. Thus, it was concluded that starch was completely removed from the fabric.

4.2.2 Application of antimicrobial finish on cotton fabric:

The combination of exhaustion method and pad-dry-cure method was considered for the application of finish on the fabric. In Exhaustion method, pre-treated fabric was used for application of finish, the fabric sample was cut into 1" X 1" size, and then immersed in selected concentration of the extract and citric acid for 10 to 12 hours at 4˚C in refrigerator. After 10 to 12 hours, fabric samples were taken

20% Groundnut extract in Ethanol

20% Groundnut extract in Methanol

20% Groundnut extract in Water

Control Plate (Only Ethanol)

Control Plate (Only Methanol)

Control Plate (Only Water)

Plate 4.1 Comparisons between Solvent and Hydrous extraction methods using 20% Groundnut shell extract concentration against E.coli

out and kept in sterilized Petri dish to avoid contamination. For drying process, fabric samples were kept in an oven at 80 ˚C for 5 minutes after this, the samples were kept out of the oven to cool down, then the fabric samples were subjected to curing at 150 ˚C for 3 minutes. Then the samples were taken out of the oven to cool down. The treated fabric samples (undergone exhaustion treatment), were subjected to pad-dry-cure method . The fabric samples were kept in zip lock bag with little amount of finish, then passed through paddling mangle at 0 psi with 2 dips and 2 nips for maximum wet pick. After padding, the fabric was dried by removing water and then subjected to curing. For curing, the treated fabric samples were kept in an oven at 150 ˚C for 3 minutes.

4.3 To evaluate the efficiency of antimicrobial finish, when applied on cotton fabric:

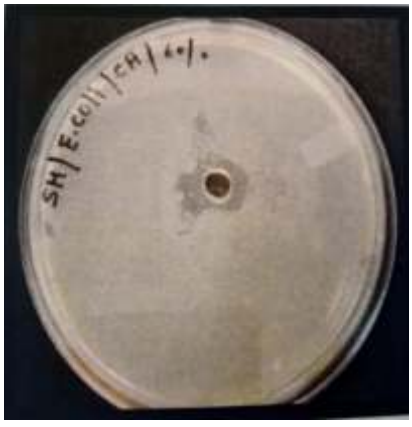
Citric acid was used as the binding agent in the study. It helps to crosslink the finish to the surface of the fabric[17]. For determining the best concentration of citric acid, finalized extract concentration (20% groundnut shell extract in methanol) was mixed with different concentrations of citric acid (2%, 4%, 6%, 8%, 10%) and this combination was subjected to qualitative assessment method i.e. agar plate diffusion method, and zone of inhibition was observed for each concentration of citric acid. It was analysed that as the concentration of citric acid increased in the extract, the size of the inhibition zone was also increased. The range of inhibition zone observed was 1.5mm to 6.0 mm against the test organism (*E.coli*). It was concluded that 12% citric acid concentration was the best concentration, as maximum size of zone of inhibition i.e. 6.0mm was observed. The zone of inhibition was not observed in control (only 12% citric acid) sample[Table 4.3][Plate 4.3]. Hence, 20% groundnut shell extract in methanol with 12% citric acid was considered to be the best combination, as it gave an effective antimicrobial potential with maximum size of zone of inhibition.

Table 4.3. Different concentrations of citric acid with 20% groundnut extract and zone of inhibition observed:

Sr. No.	20% ground nut shell extract with % citric acid	Zone of Inhibition (mm)
		E.coli
1.	2%	1.5
2.	4%	1.7
3.	6%	2.1
4.	8%	2.5
5.	10%	4.2
6.	12%	6.0
7.	Control 12%	-

20% Groundnut shell Extract + 2% Citric Acid

20% Groundnut shell Extract + 4% Citric Acid



20% Groundnut shell Extract + 6% Citric Acid

20% Groundnut shell Extract + 8% Citric Acid

20% Groundnut shell Extract + 10% Citric Acid

20% Groundnut shell Extract+ 12% Citric Acid

Plate 4.3 Determining the effective concentration of citric acid with finalized concentration of extract (Conti.....).

Control (Only 12% citric acid)

Plate 4.3 Determining the effective concentration of citric acid with finalized concentration of extract.

4.3.1 Application of the finish on the fabric:

Cotton fabric samples of size 1"X 1" were selected and finish was applied on the fabric. First sample was cotton fabric treated with 20% groundnut shell extract in methanol. Second sample was cotton fabric treated with 20% groundnut shell extract in methanol + 12% citric acid as binding agent. Treated fabric samples were subjected to qualitative assessment test (Agar plate diffusion) against the test organism (*E.coli*). The treated fabric samples (First sample) with 20% groundnut shell extract in methanol exhibit clear zone of inhibition. The treated fabric samples (second sample) with 20% groundnut shell extract in methanol with 12% citric acid also gave zone of inhibition with more clarity as compared to the first sample. From the above results, it was interpreted that 20% groundnut shell extract in methanol has good antibacterial potential but after adding 12% citric acid into it, enhances the antimicrobial potential. Thus, it was concluded that 20% groundnut shell extract in methanol with 12% citric acid, as binding agent showed effective and enhanced antimicrobial potential.

Treated fabric with 20% Groundnut shell extract

Treated fabric with
20% Groundnut shell extract + 12% citric Acid

Plate 4.3.1 Testing of treated fabric with extract, extract + citric acid, on the basis of zone of inhibition / its clarity against the test organism (E.coli)

4.4 Testing the wash durability of the finish on treated fabric sample using Laundrometer :

Wash durability test was performed to test the efficacy of finished fabric samples after washing. Treated or finished fabric samples were subjected to 1 to 10 washes. Different wash cycles were set in the Laundrometer. Treated fabric samples with 20% ground nut shell extract in methanol showed clear zone of inhibition up to 2nd wash. Zone of inhibition was also observed in fabric samples which were subjected to 3rd wash, 4th wash and 5th wash but clarity was reduced. The fabric samples which were subjected to 6th, 7th, 8th, 9th and 10th wash exhibited bacterial growth.

It was analysed that fabric samples treated 20% groundnut shell extract in methanol with 12% citric acid showed clear zone of inhibition after 1st, 2nd, 3rd,4th and 5th wash. The fabric samples which were given 6th, 7th and 8th wash also exhibited zone of inhibition, but clarity was reduced. The fabric samples which were given 9th and 10th wash exhibited bacterial growth.

It was observed that after adding 12% citric acid in the extract, the treated fabric samples exhibited the zone of inhibition with more clarity as compared to treated fabric samples with extract only. Also the zone of inhibition persists up to 8th wash as compared to 5th wash in case of fabric samples finished with only 20% ground nut extract in methanol [Table 3]. Hence, it was interpreted that fabric samples which were treated with 20% groundnut shell extract in methanol with 12% citric acid showed an effective antimicrobial potential as compared to fabric samples treated with only 20% ground nut shell extract in methanol.

Table 4.4 Treated fabric samples and observation of zone of inhibition before washing and after each washing stage :

Sr. No.	Stage of washing	Treated fabric samples with 20% groundnut shell extract in methanol	Treated Fabric samples with 20% groundnut shell extract in methanol + 12% citric acid
		(*E.coli*) Zone of Inhibition (mm)	(*E.coli*) Zone of Inhibition(mm)
1.	Before washing	++	++
2.	1st wash	++	++
3.	2nd wash	++	++
4.	3rd wash	+	++
5.	4th wash	+	++
6.	5th wash	+	++
7.	6th wash	-	+
8.	7th wash	-	+
9.	8th wash	-	+
10.	9th wash	-	-
11.	10th wash	-	-

5. Summary and Conclusion:

The present study was done to show an effective antimicrobial potential of groundnut shell extract on woven cotton fabric (cambric). Antimicrobial finish was extracted from groundnut shell by hydrous (water) and solvent (ethanol, methanol) extraction methods. Different concentrations of extract (20%, 40% and 60%) were prepared by using water and organic solvents. These extracts were examined by qualitative assessment method i.e. agar plate diffusion method and it was observed that 20% groundnut shell extract in methanol gave highest zone of inhibition of about 6.5 mm. Thus, it was determined that 20% groundnut shell extract in methanol exhibited highest antimicrobial potential.

Citric acid was used as binding agent in the study as it creates covalent cross linkages between the finish and the fabric. Different concentrations of the citric acid (2%, 4%, 6%, 8%, 10% and 12%) were mixed with finalized 20% ground nut shell extract in methanol. This mixture was applied on the cotton fabric and was subjected to qualitative assessment by agar plate diffusion method (AATCC 147 method). The cotton fabric samples (cambric) of size 1" X 1" were selected. Pre-treatment of the fabric was done by desizing method and finalized 20% groundnut shell extract with different concentrations of citric acid was applied on to the fabric samples by Exhaustion method and Pad-dry-cure method. It was concluded that 20% groundnut shell extract in methanol with 12% citric acid gave highest zone of inhibition i.e. 6.0 mm in size. Zone of inhibition was obtained beneath the fabric. It was analysed that cotton fabric treated with 20% groundnut shell extract in methanol with 12% citric acid exhibited more clarity in zone of inhibition as compared to cotton fabric treated with only 20% groundnut shell extract in methanol. The wash fastness and the durability of the finish were also tested for ten washes. Washing of all the treated fabric samples was performed in the Laundrometer and evaluated by qualitative assessment method or Agar Plate Diffusion method (AATCC 147 method). The results were evaluated on the basis of presence of zone of inhibition beneath the fabric, clarity of the zone of inhibition and presence of bacteria beneath the fabric (absence of zone of inhibition). It was observed that 20% ground nut shell extract in methanol with 12% citric acid gave clear zone of inhibition against the test organism (*E.coli*) and zone of inhibition persists till 8th wash. In contrast, in case of only 20% ground nut shell extract, clear zone of inhibition observed till two washes and zone of inhibition persists till 5th wash, against the test organism (*E.coli*). Thus, it was concluded that citric acid act as binding agent, creates covalent cross linkages between the finish and the fabric and finally enhances the durability of the finish on the fabric and also increases the antimicrobial potential of the ground nut shell herbal extract.

Hence, it was concluded from the study that 20% groundnut shell extract with 12% citric acid shows an effective antimicrobial potential against the gram negative, test organism (*Escherichia coli*).

Thus, it was proved from the study that ground nut shell extract can be used for finishing of the fabrics and development of antimicrobial fabrics which can be used in various textiles applications i.e. home furnishing, healthcare products and pharmaceutical products in future. Present study also gives an idea that agro-processing waste and food industry waste can also be used and applied for the benefit of human kind.

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Mr. Vilas Gharat

Mr. Vilas Gharat, Managing Director, Gharat & Associates, have more than 50 years of experience in all composite sectors of Textile Industry. Out of which more than a decade in Operations and HR with emphasis in Business Process Consulting. Mr. Gharat have Specialization in various field of textile value chain like;

- Change Management, Business Development and Project Management
- Project Management, Business Development
- Supply Chain Management
- Resource Allocation
- Process Reengineering
- Change Management, Production and Business
- Planning Function
- Training and Mentoring CEO's

He has wide experience in:

- Business Consultant for Oswal Hammerle, for their upcoming state of art technology plant for manufacture of sophisticated Yarn Dyed Shirting Project, primarily catering to the needs of international garment manufacturers. This is a Joint Venture project of Oswal group and F.M. Hammerle (Austria)
- His previous assignment involves restructuring and transformation of a large Textile units
- He worked with various executive capacities as Executive Director -Suvin Advisors Pvt Ltd.; Senior President in S Kumar's., Technical & Commercial Advisor in J. K. Cotton Mills, Senior President in Morarjee Brembana Ltd., Birla's in Indonesia, Oswal Hammerle, Bhojsons, Nigeria etc.

Awards:

Mr. Gharat was awarded with Best General Manager Award in MSTC - National Award for energy conservation for Simplex Mills & MSTC and Best Vendor Award from Johnson & Johnson.

Mr. Gharat was awarded with FTA by The Textile Association (India) in 1999,

Mr. Vilas Gharat is a President of The Textile Association (India) - Mumbai Unit during 2017-2019 and 2019-2021.

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Case Study on Beam Gaiting Downtime Reduction

Mr. Vilas V. Gharat

Loom Downtime Reduction:

It has been observed that day by day Loom technology is improving at rapid speed resulting into very high-speed machines. There are many units installing such high speed machines and unable to get desire production due to high machine downtime.

Please find below Loom downtime analysis which has been carried out in one of modern weaving unit. The highest downtime is due to BEAM GAITING and hence I would like to present my paper on simple method of reduction of down time known as SMED.

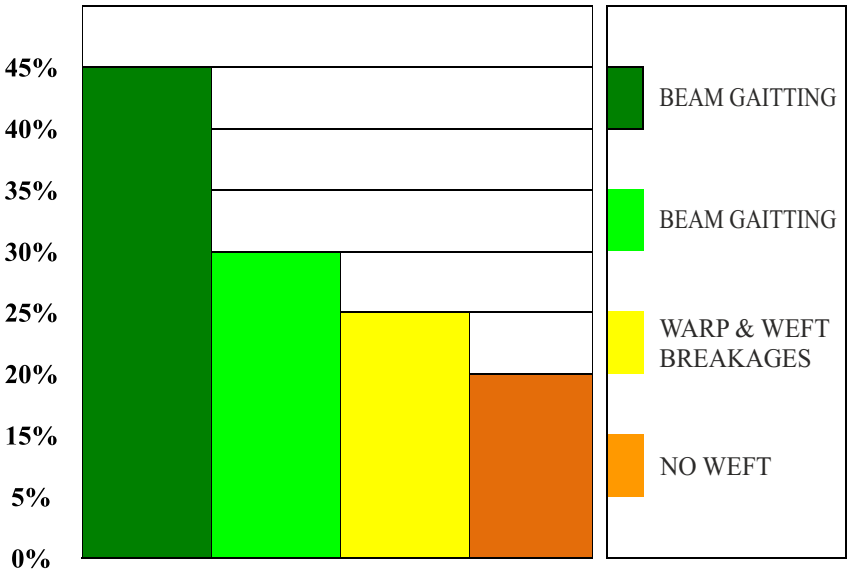

Figure 1: Loom downtime analysis

What is S.M.D.?

It is known as Single Minute Exchange of Dies and its Japanese technology developed by Mr. Shigeo Shingo. It is one of the lean methods for drastic reduction in changing time in production process.

It provides a rapid and efficient way of converting current product to next product in shortest time. It is "Revolutionizes Basic Concept of 'Set-Up Change'."

Before explaining how it can be used in Beam Gaiting activities for reduction downtime, I would like to give you very common example of above method.

Generally, we require 5 to 10 mins to change car flat tire but in car race such as Formula One we observe all four tires and other activities are carried out by group of experts in few seconds. It is same method they are adopting known as SMED.

From the above it is very clear that we cannot afford to waste the time in a race. The operations are fast; tools are in its place and also man power.

Replacing the Flat Tyre of Car

1. Find Jack, Tommy bar, spanner, in short tools.
2. Place and locate Jack below the car and lift the jack.
3. Loosen the nuts.
4. Remove the wheel
5. Bring another wheel

6. Locate and insert new wheel
7. Tighten the nuts.
8. Remove the jack and collect the tools.
9. Place it back in the car
10. Final tightening of the nuts

Ability to Distinguish:

It is very important to master the distinction between Internal and External activities. Please find chart of Internal and External activities of tire changing activities.

Table 1 : Distinguish between internal and external activity

Sr. No.	Activity	Internal	External
1	Find Jack, Spanner, Tools		x
2	Place & Locate Below the Car		x
3	Loosen the Nuts	x	
4	Remove the Wheel	x	
5	Bring Another Wheel		x
6	Locate & Mount New Wheel	x	
7	Tighten the Nuts	x	
8	Remove Jack & Tools		x
9	Final Tightening of Nuts	x	
10	Place them Back in the Car		x
	Total	**5**	**5**

If you observe above chart you will notice that 50% activities are external which can be carried out in advance and kept ready to complete in actual changing time. The same method can be adopted in case of Beam Gaiting as mentioned below.

SMED for Beam Gaiting

Please find below case study taken in one of modern textile unit having rapier looms with 20 shafts. Initially beam gaiting actual operations recorded in Video – noting step by step timings. Then the chart is prepared as mentioned below.

No.	Start	End	Total	Activity
1				Loom Stop
2				Tension Release/Pkg Removal/Cover Opening
3				Beam cut/cloth winding/ temple Lifting
4				Reed removal
5				Emptying beam
6				Beam unloaded
7				Heald frame support removal
8				Removing leno and mounting on stand
9				Taking away empty beam
10				Taking out drop pin bars
11				Heald frame removal
12				Suction cleaning starts
13				Taking away heald frame/ drop pin Bar and reed
14				Bringing curtain
15				Air cleaning
16				Width setting
17				Fixing reed pieces
18				Taking out opener
19				Maintenance
20				Setting tape guide
21				Removing curtain
22				Measuring reed length / greasing
23				Temple plate setting / rapier hook Fixing
24				Stroke setting
25				Checking alignment
26				Bringing beam trolley
27				Beam loading starts
28				Rapier fixing (rh)
29				Drop-pin fixing / cover fixing (rh rapier stroke), fixing bottom h/f Support
30				Ends straightening / transfer trolley Out from loom
31				Fixing of beam barrel support rollers
32				Parallelizing of ends
33				Beam locked
34				Reed fixing
35				Threading of beam gaiting cloth
36				Tying of knots
37				Heald frame top support fixing
38				Pulling of warp sheet
39				Relocking of beam
40				Temple setting / thumb ends fixing / Feeder threading
41				Cover fixing (rh opener)/ bottom h/f Support / suction pipe fixing
42				Main motor start / design Feeding (plain)
43				Ends drawing started
44				Loom started (picks inserted)
45				Leno fixing (spool)
46				Leno device fixing
47				Leno setting

No.	Start	End	Total	Activity
47				Leno setting
48				Ends drawing started in heald wire
49				Spool ends drawing / design feeding / Weft applied as per pattern
50				Threading of false selvedge
51				Missing heald wire fixing
52				Loom started / drop pin support fixing
53				Double end and pattern checking (heald frame lifted in sequence)
54				Loom started
55				Cloth torn
56				Wrong drawn attended
57				Sample worked (for stop marks)
58				Contrast color sample worked
59				Loom running in
60				Sample checking 0n screen
61				Loom started for production

Then all above activities are separated as Internal and External with time taken to complete those activities. The recorded shooting is shown in slow motion to team of loom shed beam gaiters', fitters and supervisors. We had very long session of brain storming for how to carry out external activities in advance and execute at time of change in minimum time same as Formula 1 race video.

Finally, we carried out changes as per following chart and carried out following steps.

Steps-1: Present status

· Video shooting

Step-2: Internal and external set up time

Internal set-up:

· Those activities which need stopping the equipment

· Like, removal and mounting of Beam

External set-up:

· Those activities which can be carried out without stopping the equipment i.e. loom

Please find table below showing segregating Internal & External activities just for information.

ANALYSIS OF FILM - FOR INTERNAL & EXTERNAL ACTIVITIES
CHRONIC LEVEL - MONTH - AVG. TIME - 594 MINS.
TARGET SET - PHASE I - 45 MINS.

Sr. No.	NOW	PLN	II	MEN	TOTAL	ACTIVITY	%	COM	%	EXT	INT	REMARK	Cronic Level
1	78.0	0.0		1	78.0	MAINTENANCE	29	78	29	X		WITH PREVENTIVE SCHEDULE & OFFLINE MAINTENANCE	Chronic level of
2	21.0	5.0	P	4	21.0	BROKEN ENDS - ENDS DRAWING STARTED IN HEALD WIRE	8	99	37		X		594 mins.
3	18.0	3.0	P	2	18.0	SUCTION CLEANING STARTED	7	117	43	X		WITH TWOSUCTION UNITS	calculated after
4	15.0	0.0	P	2	15.0	BRING BEAM FROM DRAWING IN DEPT.	6	132	49	X			collecting previous
5	15.0	0.0	P	2	15.0	COVER FIXING (RM OPENER)/BOTTOM H/F SUPPORT/SUCTION PIPE FIXING	6	147	55	X			six months data from
6	12.0	3.0	P	2	12.0	WIDTH SETTING	4	159	59		X		Weaving
7	10.0	4.0	P	2	10.0	SETTING TAPE GUIDE	4	169	63		X		
8	8.0	3.0	P	2	8.0	STROKE SETTING	3	177	66		X		
9	6.0	0.0	P	2	6.0	TENSION RELEASE/PKG REMOVAL/COVER OPENING	2	183	68	X			
10	6.0	0.0		2	6.0	DROP-PIN FIXING/COVER FIXING (RH RAPIER STROKE), FIXING BOTTOM H/F SUPPORT	2	189	70		X	EXT & PARALLEL WITH MODIFICATION TROLLEY	
11	6.0	6.0		0	6.0	LOOM RUNNING IN FOR SAMPLE PRODUCTION	2	195	72		X		
12	5.0	3.0	P	4	5.0	TYING OF KNOTS	2	200	74		X		
13	5.0	0.0		2	5.0	SPOOL ENDS DRAWING / DESIGN FEEDING / WEFT APPLIED AS PER PATTERN	2	205	76		X	INT. PALL, CLUBBED WITH ACTIVITY 2	
14	5.0	5.0			5.0	CONTRAST COLOUR SAMPLE WORKED	2	210	78		X	LOOM RUNNING	
15	4.0	2.0	P	2	4.0	REED REMOVAL	1	214	80		X	PARALLEL ACTIVITY	
16	4.0	3.0	P	2	4.0	AIR CLEANED	1	218	81		X	PARALLEL WITH TWO PEOPLE	
17	4.0	0.0			4.0	CLOTH TORN	1	222	83	X			
18	3.0	0.0	P	2	3.0	CHECKING ALIGNMENT	1	225	84				
19	3.0	0.0			3.0	MISSING HEALD WIRE FIXING	1	228	85			WITH O. IMP. IN PREPARATORY DEPT.	
20	3.0	2.0			3.0	DOUBLE END AND PATTERN CHECKING (HEALD FRAME LIFTED IN SEQUENCE)	1	231	86				
21	2.0	0.0	P		2.0	ENDS STRAIGHTENING / TRANSFER TROLLEY OUT FROM LOOM	1	233	87		X	PARALLEL WITH STROKE SETTING	
22	2.0	2.0			2.0	REED FIXING	1	235	87		X		
23	2.0	0.0	P	1	2.0	HEALD FRAME TOP SUPPORT FIXING	1	237	88			PARALLEL WITH REED FIXING	
24	2.0	2.0			2.0	PULLING OF WARP SHEET	1	239	89		X		
25	2.0	2.0	P		2.0	TEMPLE SETTING / THUMB ENDS FIXING , FEEDER THREADING	1	241	90		X		
26	2.0	0.0	P	2	2.0	LENO DEVICE FIXING	1	243	90			INT. PARALLEL WITH BROKEN ENDS DRAWING	
27	2.0	0.0	P	2	2.0	THREADING OF FALSE SELVEDGE	1	245	91			INT. PARALLEL WITH BROKEN ENDS DRAWING	
28	2.0	2.0			2.0	SAMPLE WORKED (FOR STOP MARKS)	1	247	92		X		
29	2.0	0.0			2.0	SAMPLE CHECKING ON SCREEN	1	249	93	X			
30	1.0	0.0	P		1.0	EMPTYING BEAM	0	250	93	X			
31	1.0	0.0	P	1	1.0	REMOVING LENO AND MOUNTING ON STAND	0	251	93	X			
32	1.0	0.0	P	1	1.0	TAKING OUT DROP PIN BARS	0	252	94		X		
33	1.0	0.0	P	2	1.0	HEALD FRAME REMOVAL	0	253	94		X		
34	1.0	0.0	P	1	1.0	TAKING OUT OPENER	0	254	94		X		
35	1.0	0.0	P	2	1.0	THREADING OF BEAM GAITING CLOTH	0	255	95		X		

36	1.0	0.0	P	1	1.0	MAIN MOTOR START / DESIGN FEEDING (PLAIN)	0	256	95	X						
37	1.0	0.0		1	1.0	ENDS DRAWING STARTED	0	257	96	X						
38	1.0	1.0			1.0	LENO FIXING (SPOOL)	0	258	96		X					
39	1.0	1.0			1.0	LENO SETTING	0	259	96		X					
40	1.0	0.0	P		1.0	LOOM STARTED / DROP PIN SUPPORT FIXING	0	260	97	X						
41	1.0	0.0	P		1.0	WRONG DRAWN ATTENDED	0	261	97	X						
42	0.5	0.0	P		0.5	BEAM UNLOADED	0	262	97	X						
43	0.5	0.0	P		0.5	HEALD FRAME SUPPORT REMOVAL	0	262	97	X						
44	0.5	0.0	P		0.5	TAKING AWAY EMPTY BEAM	0	263	98	X						
45	0.5	0.0	P		0.5	TAKING AWAY HEALD FRAME / DROP PIN BAR AND REED	0	263	98	X						
46	0.5	0.0	P		0.5	BRINGING CURTAIN	0	264	98	X						
47	0.5	0.0	P		0.5	FIXING REED PIECES	0	264	98	X						
48	0.5	0.0	P		0.5	REMOVING CURTAIN	0	265	98	X						
49	0.5	0.0	P		0.5	MEASURING REED LENGTH / GREASING	0	265	99	X						
50	0.5	0.0	P		0.5	TEMPLE PLATE SETTING / RAPIER HOOK FIXING	0	266	99	X						
51	0.5	0.0	P		0.5	BRINGING BEAM TROLLY	0	266	99	X						
52	0.5	0.0	P		0.5	BEAM LOADING STARTS	0	267	99	X						
53	0.5	0.0	P		0.5	RAPIER FIXING (RH)	0	267	99	X						
54	0.5	0.0	P		0.5	FIXING OF BEAM BARREL SUPPOER ROLLERS	0	268	99	X						
55	0.5	0.0	P		0.5	PARAL LEASING OF ENDS	0	268	100	X						
56	0.5	0.0	P		0.5	BEAM LOCKED	0	269	100	X						
57	0.5	0.0	P		0.5	RELOCKING OF BEAM	0	269	100	X						
58	0.0	0.0	P		0.5	LOOM STOP	0	269	100	X						
59	0.5	0.0	P		0.5	BEAM CUT / CLOTH WINDING / TEMPLE FIFTING	0	269	100	X						
60	0.0	0.0	P		0.5	LOOM STARTED (PICKS INSERTED)	0	269	100	X						
61	0.5	0.0	P		0.5	LOOM STARTED	0	269	100	X						
62	0.0	0.0	P		0.5	LOOM STARTED FOR PRODUCTION	0	269	100	X						

After conducting many trails, we could get following result with one-month summary. The earlier time for beam gaiting was of 594 mins. Gradually it reduced step by step …

- Step 1 594 Mins.
- Step 2 269 Mins.
- Step 3 112 Mins.
- Final 49 Mins.

Saving 545 Mins. (9 Machine Hrs. for every beam gaiting).

Summary:

Sr. No.		Before	After
1	Average Time	594	45
2	Internal Activity	60	22
3	External Activity	7	45
4	Parallel	30	47
TOTAL	**Time**	**112**	**49**

What is Beam Gaiting?

Beam Gaiting is a way of changing style on looms i.e. sort change. In broadly it can said as, the drawn weavers beams are fixed on **Weaving Machines**, threads are tied and heald shafts are coupled. This operation is called Beam Gaiting.

Why we choose Beam Gaiting?

After data analysis we found that major portion of loom detention was due to gaiting activity i.e. 7 to 9 Hours detention per Gaiting.

How to implement SMED activity?

1. Data collection for past three months
2. Training on SMED
3. Internal TQM Cell
4. Formation of cross functional teams
5. Video shooting of existing Beam Gaiting process
6. Viewing of video with team members
7. Brainstorming-continuous by all team members including HOD
8. Recording formats

TAI ODISHA Unit organized National Seminar

The Textile Association (India) – Odisha Unit established in 1990 conducted first time in its history, One day National Seminar in association with Indian Institute of Handloom Technology (IITH), on the theme "Scope and Opportunities of Textile Garment Development in Odisha" at Indian Institute of Handloom Technology (IITH), Bargarh Western Odisha, the heart of handloom activities and development on 16th March 2021. This seminar was targeted to attract handloom

Mr. M. Anandan, Head of Office, IIHT welcomed the gathering in the campus. He mentioned that Odisha has a rich cultural heritage; it reflects in the hand woven fine fabrics for its excellent tie and dye technique. The current product and its beauty are not only fascinating the people of Odisha but also other parts of India since long. The transformation of fabric into garment will not only give another scope for producers of Ikat material but also create avenues for new entrepreneurs and new era for garment industry in Odisha. This kind of transformation of Ikat fabric in garment and allied products will enhance production of fabric and increase the involvement of entrepreneurs in the field of Textiles Manufacturing in Odisha. Such involvement would definitely increase the output of present textile market and also boost the overall scenario of textile industry in Odisha. This aspect of diversification of Odisha fabrics and textiles in garment and its allied products will boost the economy of existing entrepreneur of Odisha state. Also he mentioned that the e-book which is published is a compilation of articles covering various aspects of handloom and textile technology and garment manufacturing will definitely help in enrichment of existing knowledge and practices of textile work in Odisha.

Dr. S. P. Mishra, President, TAI, Odisha Unit in his inaugural address informed the gathering about TAI Odisha and future activities for the handloom clusters of Odisha. He mentioned that Odisha is famous for its handlooms, bandhani crafts, beautiful and gorgeous textiles. These products are internationally acclaimed. Odisha also one the largest producers of hand spun and hand-woven silk producing 85 MT of different varieties of silk. In addition, there are around 80,000 acres for cotton cultivation producing 4.00 lakh bales. However, Odisha lacks to have behind textile products as it has not produced any remarkable textile products for last few years. There are only around 1500 power loom units in the state. There is a scope for development in textile activity and there are few garment industries created their manufacturing units in this state professionals to aware about handloom activities.

Dr. B. B. Jena, Chairman TAI Odisha highlighted about the purpose of this seminar. Mr. Sambit Satapathy, Hon. Secretary, TAI Odisha spoke on TAI Activities and requested to be the member of TAI Odisha Unit.

Shri Ashok Juneja, National President, TAI Central conveyed his best wishes message to the entire team of

Inauguration

organizing committee for their initiative & the grand success of the event. With their first initiative, Textile & Garment sector will develop further in the State of Odisha and will be the tremendous potential for the growth of Textile & Garment resulting employments to many and also the deliberation of presentation during the Seminar will be beneficial to all & compilation of e-book which will be a good document for further reference.

There were 9 papers slated for the seminar and the first session was chaired by Dr. B. B. Jena, Chairmn, TAI Odisha. The second session was chaired by Dr. A. K. Dash, Vice President, TAI Odisha. At the end of the seminar to create interest among the students, Mr. Sambit Satapathy conducted a quiz among the students with awards to the winners.

At the end of the seminar, students and participants gave their impression about the seminar. It was decided to have gatherings at the cluster level in future in Bargarh district.

Following papers were presented on this seminar:

1. Scope and Opportunities of Textile and Garment Development in Odisha, Dr. A. K. Dash.
2. Cotton Cultivation in Odisha, Dr. S. P. Mishra
3. Small Scale Garment Industry : Investment and Cost, Mr. Bibhuti Pradhan
4. Development and Application of Tribal Art and Design, Ms. Tapasi Mohanty
5. Skilling Odisha in Handloom and Apparel Sector, Mr. Pravat Kumar Sahoo
6. Nanocellulose and its Application in Textiles, Ms. Arpita Samanta
7. Innovative Utilization of Waste in Handloom Textiles to Adopt Sustainable Fashion, Ms. Sujata Chand & Ms. Kirti Ghosh.

The meeting was concluded with vote of thanks By Mr. Sambit Satapathy, Secretary, TAI, Odisha.

Post Event Report of 76th All India Textile Conference

Indian Textiles: Global Focus - Fiber to Fashion

The Textile Association (India) – Madhya Pradesh Unit established in the year 1945 and now having more than 1700 strong membership. After the enormous success during 1956, 1984, 1977, 1991, 2009 & 2016, The Textile Association (India) – M.P. Unit has successfully hosted **76th All India Textile Conference** at Indore on the theme "**Indian Textiles: Global Focus – Fibre to Fashion**" on **05th & 06th March, 2021** at Jall Auditorium, Indore. Despite of the impact of Corona pandemic situation in M.P. State, TAI - M.P. Unit hosted this conference successfully by following all precautions carefully and guidelines of Central/State Govt. The conference was attended by eminent businessmen and technical experts associated with the textile industry from across the country.

Chief Guest along with other dignitaries lightening the lamp

Chief Guest Shri Shankar Lalwaniji delivering his inaugural address

Conference on the day one 05-03-2021, started with the National Anthem and the prayer of Ganesh and the lighting of the Lamp. The dignitaries present on the occasion were **Shri Shankar Lalwaniji,** Member of Parliament and the Chairman of the Conference Committee; **Dr. Ved Pratap Vedik** renowned writer and expert of foreign policy matter; Upper Collector & Revenue Commissioner **Shri Rajneesh Shrivastava; Shri Ashok Juneja,** President, TAI Central; and **Shri Ashok Veda,** Vice-Chairman, TAI Central and others dignitaries.

Shri Ashok Juneja and Shri Ashok Veda welcomed Chief Guest of the Conference & Member of Parliament **Shri Shankar Lalwaniji** and Upper Collector & Revenue Commissioner **Shri Rajneesh Shrivastava** respectively**,**

Shri Ashok Juneja, in his speech mentioned that the textile industry is the second largest sector in the country after agriculture and about 45 million people are directly employed & whereas 110 million people are getting indirect employment through their associations with the industry. Further he said that many large groups are now investing in M.P. which will generate huge employment.

The First Session started with the inspirational speech of **Dr. Arun Rishi** focusing on the Total Quality People (TQP) with emphasis on people's healthy life –style and clapping by hands.

Mr. Badruddin Khan delivering his presentation

Mr. Manish Daga delivering his presentation

Then it was followed by the presentation on "Commodity Future Exchange" by **Mr. Badruddin Khan** from MCX. It helped to know the aspects, need and types of the commodity exchange as expertise through his presentation about the concept of hedging.

The next presentation was give by the "Cotton Guru" **Mr. Manish Daga** on the Cotton Industry of India. He captivated

our thoughts towards the important aspects like the quality, prices demand, yield and future of cotton in India, concluding with his quote. "Difficulties like a bag full of cotton are heavy for those who see it, and light for those who handle it".

The next speaker was **Mr. Kailash Agrawal**, who engaged us in the history of cotton textile industry and his experience in the field of cotton grown in the State. It was continued by **Mr. Ketan Sanghvi,** President, ITME Society. He shared his experience of textile machinery industry as well and the role of ITME.

Mr. Kailash Agrawal delivering his presentation

Mr. Ketan Sanghvi delivering his presentation

A presentation was delivered **Mr. Vishal Londhe** from Sedex, on the role of his company in extending various services in value chain management. Then **Dr. Ved Pratap Vedic** gave a briefing on the History of export and import of clothes, especially cotton clothes from India to other countries in ancient times.

Mr. Vishal Londhe delivering his presentation

Dr. Ved Pratap Vedic delivering his presentation

The next informative session was by **Dr. Ramesh Tewani** on the effect of medicines on human body and guiding us to modify one's life with healthy eating habits.

Mr. Ashok Pal delivering his presentation

Mr. Nilesh Trivedi delivering his presentation

Moving towards the end of the event **Mr. Ashok Pal,** the Vice President of ICC mentioned the latest innovative developments in Card Clothing and helping the textile industry. **Mr. Nilesh Trivedi,** Assistant Director, MSME provided the knowledge about different Government Schemes for MSME Sector which was very useful information for the younger industrialists to grab the new opportunities.

The Last speaker of day one was **Smt. Seema Mishra,** who interacted with the audience by sharing her passion towards the Handloom industry in India.

Smt. Seema Mishra delivering her presentation

Mr. V. P. Gupta proposing vote of thanks

The day one of the Conference concluded with the vote of thanks proposed by **Mr. V. P. Gupta.**

Indore 06th March, 2021 (Day 2)

The All India Textile Conference 2021, day two commenced with the speech of **Dr. Mahavir Jain,** renowned Heart Specialist, who motivated all by stating the importance of staying healthy and also the ways to keep happy.

Conference continued with the lecture by **Mr. Amit Choudhary** on Human Rights and shared about the Schemes and Policies of UNO for the welfare of Labour sector. He also advised the Industry about the implementation of various policies, which are required by importers before placing orders.

Next speaker of the day was **Mr. S. Pal**, Director M.P. Locations, Vardhman Group and President, TAI M. P. Unit. He appraised about the human relations aspect and the social welfare schemes for the welfare of workers in the textile industry.

An informative session was taken by CA **Mr. Sunil Jain**, who showered on us his knowledge of GST related policies and their implications in the near future.

A presentation was then made by **Mr. Girish Patvardhan**, Labour Law Consultant on the new Labor Codes passed by the Parliament and which are likely to be implemented shortly.

Mrs. Seema Mishra took the opportunity to address all more about Handlooms, its history, the present State of Handloom Industry, India and the Handloom Cluster at Kasrawad.

The next lecture was by **Dr. P. N. Mishra** who interacted with the audience through his speech, with reference to Mahabharat and Ramayan. He related the epics with the management of an individual or our organization. He also stated the relevance and importance of these epics in one's life through his speech based on his own life experiences of life examples.

The last speaker of day 2 was **Mr. Kamlesh Bhandari**, who apprised us not only about the achievements of our textile industry but also revealed the failures and draw backs of our textile industry. He stated the difference between being a Manager and the Entrepreneurs with some examples, which encourage one to be an Entrepreneurs and not only a Manager.

On behalf of the Textile Association (India) awarded the **'Lifetime Achievement Award'** to **Shri V. P. Gupta.** Also **'Excellence Award'** has been awarded to **Shri Ashok Juneja,** National President, TAI Central and **Shri Ashok Veda,** Vice Chairman, TAI Central by the hands of chief guest Shri Shankar Lalwaniji which was a historic membranes moment for all.

Conference Souvenir/Proceedings have been released by the Chief Guest along with the other dignitaries.

Shri Ashok Juneja receiving Excellence Award by hands of chief guest

Shri Ashok Veda receiving Excellence Award by hands of chief guest

Shri V. P. Gupta receiving Lifetime Achievement Award by hands of chief guest

Release of Conference Souvenir/Proceeding by the dignitaries

Smt. Vijaya Jain, having a great personality was the Conference Anchor, who has conducted the entire conference in decent Hindi.

Mr. Ashok Veda proposing vote of thanks

View of the audience

Lastly **Mr. Ashok Veda** thanked everyone, who has devoted their time and energy to make the Conference successful. He also thanked all the Sponsors, Supporters, Speakers & Delegates for their support with a very warm and grateful gesture.

After the end of conference, to boost the textile industry, an entertainment program of **Fashion Show** was organized coordinated by **Dr. Dipesh Agarwal,** Hon. Joint Secretary, TAI – M.P. Unit and G. C. Member which was the showcase of beautiful Indian garments, apparels along with Indian Handloom Culture was presented.

View of the Fashion Show

Overall 76th All India Textile Conference was organized with a grand success and everyone has appreciated about the conference and hospitality. Mr. Ashok Veda and his entire organizing committee were thanked for accepting the challenge of organizing the conference under the impact of a Corona pandemic situation.

Group Photo along with the Chief Guest and the dignitaries

Post Event – TEXCON 2021
Shri Vaishnav Institute of Textile Technology

Shri Vaishnav Institute of Textile Technology (SVITT) under Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore has organized a two days 4th National Textile Conference **"TEXCON-2021"** on 18th & 19th February, 2021. The theme of conference was "**New World of Textiles: Shaping the Future". TEXCON-2021** was aimed at bringing together the entire extended textile fraternity on one platform for the intellectual interface of varied domains.

Day 1: 18th February 2021

Inaugural Session

The inaugural ceremony commenced with the lightening of the lamp (Virtually) by a group of dignitaries, Chief Guest, **Mrs. Dipali Goenka**, CEO & Joint Managing Director, Welspun India Ltd, Honorable **Shri Purushottamdas Pasari**, Chancellor of Shri Vaishnav Vidyapeeth Vishwavidyalaya, **Dr. Upinder Dhar**, Vice Chancellor of Shri Vaishnav Vidyapeeth Vishwavidyalaya, **Dr. R. K. Datta**, Director of Shri Vaishnav Institute of Textile Technology, **Shri Kamalnarayan Bhuradiya**, Honorary Secretary of Shri Vaishnav Vidyapeeth Trust.

Dr. R. K. Datta, Director, SVITT & the Chairperson of TEXCON-2021 briefed about TEXCON-2021. Dr. Upinder Dhar welcomed all the dignitaries and the participants from the various parts of India and Abroad. He highlighted the glorious history of textile revolution and briefed about the journey of textile from old un-mechanized process to mechanized process to present modern and smart textiles. Shri Purushottamdas Pasari, talked about the journey and contribution of Shri Vaishnav Trust in education, medical and other philanthropic services since last 137 years.

Mrs. Dipali Goenka, emphasized on the importance of functionalities of new textiles by adopting nano-technology to create more scientific clothing, like fire-repellent, self-cleaning, water-repellent, composite materials, and color-adaptive fabrics. Welspun has always focused on consumers needs and catered to innovative products. She urged to ensure sustainability, traceability and reduce environmental impacts in this sector by utilizing a circular economy model which is emerging importance. Finally, Shri Kamalnarayan Bhuradiya proposed the words of thanks.

Renowned professional of Industry and Academia; 10 speakers from 9 renowned Indian Institutes, 2 speakers from Industry, 2 speakers from abroad and 1 speaker from GoI delivered their lectures in the conference.

Students, research scholars and faculty members of 13 institutes presented their papers in 5 concurrent sessions. Journal of Textile Association (JTA), The Yarn Bazaar and Textile Value Chain were the Media Partner for this 4th National Conference.

Plenary Session-I

Dr. Surinder Tandon, Managing Director, Tandon Textile Innovations, Christchurch, New Zealand delivered a lecture on Wool Ideal for Apparel Fashion and Functionality. **Dr. A. K. Samanta,** Professor and Former Head, Department of Jute and Fiber Technology, IJT, University of Calcutta, Kolkata, India, presented a research paper on Eco-Friendly

Approaches for Improving Fastness, UV Protection, and Anti-microbial Properties. **Dr. Surjeet Sengupta,** Principal Scientist, Head (MPD), ICAR- NINFET, Kolkata, discussed on Agro-Jute: A Solution for Green Cultivation. This Session was chaired by **Dr. K. N. Guruprasad**, Director, SVIS, SVVV, Indore.

Plenary Session-II

Dr. Apurba Das, Professor, Department of Textile and Fiber Engineering, IIT Delhi, gave a talk on Electrostatic Spray Coating Technology for Thermoplastic Composites. **Dr. Pavan Manvi**, Scientist, Institute for Textile Technique of RWTH Aachen University, Germany, discussed on Eco-friendly Approach to Develop Anti-drug Resistant Textiles. **Dr. V. D. Gotmare,** Chairman, CKMC, KVIC, Ministry of MSME, GoI, discussed on Khadi for Sustainable Textiles. **Mr. N. D. Mhatre,** Director General (Tech.), ITAMMA, Mumbai, talked on Vocal for Local in Textile Engineering Industry. This session was Chaired by **Dr. S. M. Ishtiaque**, Emeritus Professor, Department of Textile and Fiber Engineering, IIT Delhi, and Dr. R. K. Datta, Director, SVITT, SVVV, Indore**.**

Total 20 technical papers were presented in the three Concurrent Technical Sessions in first day of conference. They are broadly in the field of Sustainability, Technical Textiles, and garment sector.

First concurrent technical session was chaired by **Dr. S. R. Shah**, Head of Textile Chemistry Department, MS University, Baroda. Second Concurrent technical session was chaired by **Dr. G. Bose**, Retired Principal Scientist, ICAR-NIRJAFT, Kolkata, and **Dr. Shrikant Pandey**, Head of Mechanical Department, SVITS, SVVV, Indore. Third concurrent technical session was chaired by **Dr. Pradeep Joshi**, Director General & Dean Amity University, Noida, and **Dr. Anand Babu**, Head of Civil Department, SVITS, SVVV, Indore.

Day 2: 19th February 2021

Plenary Session-III

Dr. Abhijit Majumdar, Professor, Department of Textile and Fiber Engineering, IIT Delhi, delivered a lecture on Circularity in Textile Supply Chain. **Dr. Manoj Tiwari,** Associate Professor, NIFT, Jodhpur, Rajasthan, discussed on Changing Paradigms: Apparel Industry 4.0. **Dr. Ravindra D. Kale,** Professor, Department of Fibers and Textile Processing Technology, Institute of Chemical Technology, Mumbai, talked on Dyeing of Nylon Fabric Using Nano Emulsion. Chairpersons for the session were **Dr. Santosh Dhar**, Dean, Faculty of Doctoral Studies and Research, SVVV, Indore, and **Prof. Deepak Kulkarni**, Principal, Govt. Polytechnic, Nagpur & Chairman TAI Vidarbha.

Plenary Session-IV

Dr. V. Ramesh Babu, Head and Associate Professor, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore, delivered a lecture on Covid-19 Pandemic Spurs Innovation in Healthcare Textile. **Mr. Ashwani K. Goel,** Vice President (Tech.), Vardhman Yarns, Mandideep, discussed on Effective Utilization of Online Monitoring System in Spinning Mills. **Dr. Bibhu Prasad Dash,** Head, Department of Textile Engineering, College of Engineering and Technology, Bhubaneswar, described FEM Analysis for Textile Reinforced Composites. **Dr. Pradeep Joshi,** Director General & Dean, Amity University, Noida, described the Impact of COVID -19 on Purchase of Fashion Apparel. **Dr. Mukesh Kumar Singh,** Director, UPPTI, Kanpur, described the Importance of Medical Textiles. This Session was chaired by **Shri R. P. Gautum**, Advisor, Maral Overseas Ltd. and **Dr. Namit Gupta**, Director, SVITS, SVVV, Indore.

Total 13 technical papers were presented during the two Concurrent Technical Sessions on second day of conference. They are broadly in the field of Textile Engineering and Textile Chemical Processing. 4th concurrent Technical session was chaired by **Dr. Kavita Sharma**, Professor & Coordinator, SVIFS, SVVV, Indore, and **Dr. B. Basu**, Retired GM, Reliance Group of Industry.

The 5th Concurrent Technical Session was chaired by **Dr. Ashwin Thakkar**, Head of Textile Technology Department, L. D. College of Engineering, Ahmedabad and **Dr. M. P. Gautam**, Professor, SVIFS, SVVV, Indore.

VALEDICTORY CEREMONY

The Chief Guest of the Valedictory Ceremony was **Shri Ashok Juneja**, President, The Textile Association India (TAI). In Valedictory Ceremony Dr. R. K. Datta presented conference report. Dr. Upinder Dhar, Vice Chancellor, Shri Vaishnav Vidyapeeth Vishwavidyalaya, said that the textile industry is as mother of all other industry of India and play an important role for industrial revolution. He emphasized on the industry – educational institute linkage and he said that TAI and SVITT should work together to resolve the problem related with industry. He said that 'we should focus on application based research in collaboration with industry'. The brochure of TEXCON-2022 was also released.

Shri Ashok Juneja, in his keynote address, said that Indian Textile Industry is Sunrise Industry. Textile sector is the second largest employment provider after the Agriculture Sector. He emphasized on new technology adaption, automation, and digitalization. Shri Juneja also welcomed the recent Union Budget 2021, a positive step forward to reboots the Indian textile sectors. He advised to students and faculties to remain connected with industry and TAI for the latest development.

Vote of thanks was proposed by **Mr. Pavan Kumar Gupta**, Organizing Secretary, for TEXCON 2021.

Savio

Interview with Mr. K. Mohanrao

Interview with Mr. K. Mohanrao, Director (Technical), Siva Swati Textile, Guntur

Q.: Could you please tell us a little bit about Siva Swati Textiles?
Ans.: Siva Swati Textiles was started in the year 2005 with an installed capacity of 60,624 spindles. We are processing counts between Ne 40 and Ne 60 in both warp and hosiery. Our registered office is at Ganapavaram, Guntur District, Andhra Pradesh.

Q.: You have been associated with Savio for years. Please tell us about your experience with Savio.
Ans.: Savio makes excellent machines. We appreciate Savio's constant attention to technical development and upgrades. Savio is also very cooperative, and they respond to our queries quickly and support us promptly. We are very glad to associate with Savio, as our experience has always been very pleasant.

Q.: What were the deciding factors for you to select Savio EcoPulsarS PLUS winder?
Ans.: The winder model EcoPulsarS PLUS is built on a different platform from regular automatic winders and features individual suction, which is a key highlight of the machine. The higher production and reduced hard waste are other advantages. Further, manual doffing is made easier in EcoPulsarS PLUS, thanks to the cradle with the touch sensor.

Q.: Having used it, what features do you like the best in Savio EcoPulsarS PLUS?
Ans.: We are happy with the EcoPulsarS' advanced technology which enables efficient winding. The individual suction system for each spindle uses energy only during bobbin changes and splicing. This enables huge energy saving as compared to the common suction model. This machine is also operator friendly. We have been able to realise in actual practise what we expected when we bought the machine.

Q.: Apart from technology, what is your feedback on after-sales support?
Ans.: The after-sales support from Savio is good. The after-sales support team is knowledgeable, supportive, and regularly visits us. They also suggest technical upgrades and developments to us.

Q.: Could you share your experience about working with A.T.E.?
Ans.: A.T.E. is a highly professional sales organisation with a knowledgeable sales team. We enjoy an excellent relationship with A.T.E. and are very pleased to work with them for all our projects.

Q.: What are your future expansion plans?
Ans.: At present we do not have any plans for expansion. A.T.E. is a multi-product company and is always helpful by suggesting us the upgrades required for the existing machines and processes. When we make our plans, we will be in touch with A.T.E.

Birla Cellulose wins Innovative & Sustainable Supply Chain Award by UN Global Compact Network India

Birla Cellulose, part of the Aditya Birla Group and one of the largest global manmade cellulosic fibre (MMCF) producer, has emerged as a winner in the first edition of the "National Innovative and Sustainable Supply Chain Awards" by UN Global Compact Network India.

The case study of Liva Reviva & Fully Traceable Circular Global Fashion Supply Chains – was awarded for innovation in recycled and circular fibre made with pre-consumer fabric waste and end-to-end 'live' supply chain transparency and traceability through its unique blockchain-based platform GreenTrack™.

This case study solves two unique challenges: mounting textile waste which is either incinerated or landfilled due to lack of recycling technologies, and lack of transparency / traceability in the scattered, complex and long fashion supply chains.

Mr Dilip Gaur, Business Director of Birla Cellulose and Managing Director, Grasim Industries said, "We are proud to be recognised for our innovative Next Generation solution for upcycling the textile waste, reducing the pressure on virgin materials and establishing transparency in complex fashion value chain. These efforts are aligned to our prioritized UN SDG goals and dedicated to building circular business models which are based on partnerships that add value to stakeholders, people and planet".

Ms Shabnam Siddiqui, Executive Director, UN Global Compact Network India said, "the first edition of the awards witnessed outstanding case studies from prestigious organizations with notable contributions to adoption and implementation of innovative and sustainable supply chain practices in their organizations. We congratulate Birla Cellulose for their pioneering work done in accelerating circularity and transparency in the supply chain in a short time, which are high priority UN Sustainable Development Goals".

Birla Cellulose has achieved a path breaking innovation in manufacturing viscose fibre "Liva Reviva" using 20% pre-consumer fabric waste following the principles of circular economy. This innovation has the distinction of Recycled Claim Standard (RCS) and portrays Birla Cellulose's commitment to developing NextGen solutions.

Through its pioneering platform GreenTrack™ based on blockchain technology, Birla Cellulose along with their value chain partners tracks material flow real time in the supply chain of fibre, from certified forests to the end consumers. Through simple scan of QR code end-to-end sustainability journey is visible to consumers and helps them make an informed purchase decision.

Since the launch in 2020, multiple global brands have added Liva Reviva to their sourcing basket as they take decisive steps towards circular economy. Our close-knit partnerships across the global value chains helped us to establish 'viable reverse logistics' and created higher value for textile waste for small scale waste recyclers.

Birla Cellulose is prioritizing the increased use of alternate feedstock like textile waste and is committed to accelerate innovations that are aligned with UN SDGs 2030.

For more details, please visit:

- Birla Cellulose - https://www.birlacellulose.com
- GCNI - https://www.globalcompact.in/

Lenzing's VEOCEL™ introduce carbon neutral lyocell fiber

- VEOCEL™ Lyocell fibers are certified CarbonNeutral® products with a net- zero carbon footprint according to The CarbonNeutral Protocol
- New carbon neutral offering enables Lenzing's VEOCEL™ brand to lead the transformation of the nonwovens industry towards decarbonization

A keen advocate to transform the nonwovens industry with greater transparency and sustainability measures, Lenzing's VEOCEL™ brand is marking a new milestone with the introduction of the industry's first carbon neutral VEOCEL™ branded fibers. The new offering for Lyocell fibers will enable the VEOCEL™ brand to support nonwoven industry partners and product brands to reduce climate impact through the use of fibers with a net-zero footprint.

As a brand that has been dedicated to offering products based on renewable material wood, derived from sustainably managed forests, VEOCEL™ is leading by example, making significant strides in achieving new certification standards and now also reinforcing Lenzing's commitments to carbon neutrality.

"At Lenzing, we are very proud of the progress we have been making to address climate change," said Robert van de Kerkhof, Member of the Board of Lenzing. "The new carbon neutral VEOCEL™ Lyocell fibers will play a big role in contributing to our goal to become a net-zero company by 2050. At Lenzing, we understand that caring for the environment isn't just good business, but good for the business. That is why we are becoming even more dedicated to effecting real change to the industry as we come out of the COVID-19 pandemic, and embrace climate protection through our zero carbon commitments and ongoing innovations."

Certified CarbonNeutral® product for climate protection

As of June 2021, VEOCEL™ Lyocell fibers are available as certified CarbonNeutral® products with a carbon footprint reduced to net-zero according to The CarbonNeutral Protocol. Achieving certified carbon neutrality was the result of Lenzing's ambitious carbon reduction efforts over the last years and the collaboration with Natural Capital Partners, a recognized global leader in the design, development and delivery of corporate climate action programmes. Together it

was possible to reduce carbon emissions to net-zero through a mix of higher production efficiencies, use of renewable energy sources, low-carbon materials and the dedicated support of an external nature-based carbon removal project. These VEOCEL™ branded fibers reinforce Lenzing's commitment to the Science Based Targets initiative around reduction of total global carbon emissions, a quest driven by the UN Paris Agreement.

"The first step in taking action, understands the problem at hand," said Jürgen Eizinger, Vice President of Global Management Nonwovens at Lenzing. "The VEOCEL™ brand is committed to making the shift to carbon neutrality an ongoing effort. Emission from raw materials is often the biggest part of a product or corporate footprint. To reduce these indirect emissions, a company can either avoid such a material or depends on its value chain to deliver new climate friendly solutions. With our new offer of carbon neutral VEOCEL™ Lyocell fibers, we can certainly help our partners and customers reduce their emission impact."

Partnering for Change

Consumers are holding their brands to higher standards when it comes to carbon neutrality and climate friendly products. As an ingredient brand, VEOCEL™ is committed to guiding and partnering with retailers, brands and the nonwoven industry toward improving the carbon footprint and environmental impact of raw materials and products. Materials and goods produced with VEOCEL™ Lyocell fibers certified as CarbonNeutral® products will benefit from a specially developed VEOCEL™ "climate care" logo. The VEOCEL™ "climate care" initiative signifies Lenzing's commitment to offer climate friendly solutions to limit global warming reduce its carbon footprint and engage with partners along the supply chain to provide more sustainable nonwovens solutions.

"With the newly minted VEOCEL™ 'climate care' logo, we hope to build a connection between brands and consumers. When consumers see products with the 'climate care' logo on the packaging, they will be able to recognize that the product is made of VEOCEL™ Lyocell fibers which have a neutral impact on our climate.

This will not only give them confidence about making more informed, eco-conscious purchase decisions, but also reassure that they are taking a proactive step to tackle climate change," added Eizinger.

The VEOCEL™ brand will be sharing more details around Lenzing decarbonization effort for the nonwovens industry and the path forward during the EDANA Outlook event.

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Mr. G. V. Aras retired at his inning of 40 years at A.T.E.

Shri G. V. Aras is B.Text. from V.J.T.I., Bombay University securing First rank with distinction in 1979, M.Text. by research from Bombay University in 1982, Post Graduate Diploma in "Marketing Management" from Bombay University in 1984 and Member of Institution of Engineers (M.I.E.).

After completing his M.Tex by research at Tata Mills, Mr. Aras joined A.T.E. group as Sales Engineer in October, 1981 and rose to the presently held position of "Director" for the Textile Engineering Group at A.T.E. He leads a team of nearly 200 people under the Textile Engineering Group.

Shri Aras travelled widely across the world and worked for bringing in representations from many leading European machinery manufacturers from Europe. He has presented many technical papers at International forums. Shri Aras was presently Director of A.T.E. Enterprises Pvt. Ltd. and also the Board Member on A.T.E. Enterprises Private Limited, A.T.E. Technologies (Bangladesh) Private Limited and Valence Electrons Private Limited. He retired on 31-03-2021 after serving for 40 years a long successful journey.

Shri Aras had his inspiring career and wonderful inning of last 40 years at A.T.E. which was indeed very accomplished one and he was real guide to the students and colleagues. Textile industry requires many more years of his energetic & knowledgeable services. His exemplary service and contribution to the industry and to the society will always be the lighthouse for the youngsters. He is a dynamic and result oriented professional in a leadership role as Whole Time Director at A.T.E. His richly experienced professional in both domestic as well as international markets, was handling various profiles of businesses from textile machinery to machine tools at leadership roles.

Shri Aras was a member of the various Professional Bodies like V.J.T.I. Board of Studies; State Task Force for Textile Sector of (CII); Task Force for the Textile Sector (FICCI); Indo-Vietnamese Chamber of Commerce; All India Management Association (AIMA); Textile Machinery Manufacturers Association (TMMA) and member of the committee of the "Bureau of Standards of India" for textile machinery and accessories

Shri Aras contribution to the various educational fields like VJTI, Examiner by Mumbai University for M.Text by thesis, NMIMS, Shirpur (Centre for textile function), textile owners from Solapur, Instrumental in designing a joint certification programme of DyStar and A.T.E. and conducting across India at different textile centres training more than 500 technicians from the processing sectors, On the forefront in designing another joint certification programme on textile dyes and printing technology with Pidilite Industries, Jointly

established with Karl Mayer, Germany a training academy in Surat and Amritsar to provide training on basic, advanced and entrepreneurial level on warp knitting technology.

Shri Aras has contribution in Organising Conferences/Seminars. He played an active role in the success of the conferences and seminars organized by TAI, Mumbai Unit, successfully organized 2 days international conference, on **"Textile 4.0",** Successfully organized **"INDIATEX 2013**" exhibition at Vapi, International Conference of **TechTextil** India organized by Messe Frankfurt.

Shri G. V. Aras has been awarded by TAI with Service Gold Medal for the recognition of his services to the Association during AITC on 15th December, 2018 at Coimbatore.

The Textile Association (India) - Central Office and TAI Mumbai Unit wish him a wonderful next new phase of life with good health. Wish him all the best and to stay blessed retired exciting life ahead.

Splicing Solutions from Savio

In the automatic winding process, splicing is the most important part. That is why Savio offers a wide range of splicing solutions that are optimised for different applications and requirements.

Mesdan (a Savio Group Company) is a world-class splicer manufacturer with years of experience in production of best quality splicers providing the shortest and strongest splice results. Savio uses only its own splicers or Mesdan-made splicers.

Mesdan manufactures the well-proven Air, Moist Air, Water and Heat splicers. Savio's own twin splicers are completely mechanical.

The new Air and Moist Air splicers (improved versions of the previous 690 – Air and 6901 – Moist) are available with duo air control i.e., with separation of air supply for tail preparation and splicing. Earlier versions featured a common air supply for tail preparation and splicing with adjustments. This new system provides allows technicians to play around with the settings for better results and control.

Air

895/845 AIR

Air splicer settings are completely centralised:

- Fast and simple change over
- Consistent uniformity of splice in each and every spindle

Main application range:

100% cotton and blends, cotton compact yarns, fancy yarns, core yarns, synthetic and artificial yarns, wool 100% and blends, silk.

Moist Air (optional)8951/8451

Moist Air is an innovative air splicer using a very small quantity of water (as a spray). It features a water valve with dosage setting to moisturise the splice. Moist Air is suitable for almost all kinds of short and long spun yarns with the exclusion of plied cotton, high twisted wool yarns and linen. The Moist Air splicer delivers superior performances on Tencel and fine counts.

Main application range:

High quality yarns of cotton, cotton with LYCRA® fibre, Polyester/Viscose/Lycra® fibre, TENCEL®, and Lyocell blends.

Water Splicer Duo Stage (optional)962

The splicing operation is performed under vacuum while the water is injected (Duo-Stage). All the splicer parts are located in a waterproof housing to avoid dangerous spray of water outside.

Main application range:

100% cotton coarse counts (flat and fancy yarns), 100% cotton compact yarns, mercerised/singed yarns, elastomeric yarns, two ply yarns, open end yarns, synthetic yarns, linen yarns.

Heat Splicer (optional)6982

With the use of the heat, this splicer air technology guarantees a final joint with excellent appearance, high and consistent strength even with difficult yarn structures, different blended materials, and high twisted yarns.

Main application range:

Carded wool coarse counts, mule spun yarn, high twist yarns, 100% wool and blends.

Twin Splicer (optional)

Twin splicer is ranked at the top among all splicers for its superior quality. The splicer strength is always above 95% keeping the appearance the same as the parent yarn.

The splice on compact yarns, besides the strength, needs an extremely good appearance so that visible defects are not created on the finest fabrics. The Twin splicer for core yarns preserves the elastomeric filament entirely inside the joints.

Main application range:

Cotton 100%, cotton 100% effect yarns, compact yarns, elastomeric yarns, cotton and blends.

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SUBJECT INDEX

FORTHCOMING EVENTS

ITMA ASIA + CITME
Date : 12th to 16th June, 2021
Venue : National Exhibition and Convention Center, Shanghai, China
Website : http://www.itmaasia.com

ITM 2021
Date : 22nd to 26th June, 2021
Venue : Tuyap Fair Convention and Congress Centre, Beylikduzu, Istanbul
Website : www.itmexhibition.com

Yarnex – India International Yarn Exhibition
Date : 01st & 03rd July, 2021
Venue : Pragati Maidan, Delhi
Contact : S.S. Textile Media Pvt. Ltd.
826, 9th cross, 10th Main Rd, 2nd Stage, Indiranagar, Bengaluru - 560 038 Karnataka
Tel. : +91-80-25214711, 41151841
Mob. : +91-9845446570
E-mail : sstm@textilefaiarsindia.com
Website : www.textilefairsindia.com

FILTECH 2021
Date : 23rd to 25th August, 2021
Venue : Cologne, Germany
Website : https://filtech.de

Shanghaitex – 20th International Exhibition on Textile Industry
Date : 23rd to 26th November, 2021
Venue : SNIEC, Shanghai (Pudong)

ITME India Exhibition 2021
Date : 08th to 13th December, 2021
Venue : IEML, Greater Noida
Contact : India ITME Society,
1210, Dalamal Tower, A Wing, 12th Floor,
211, Nariman Point, Mumbai – 400 021
Tel. : +91-22-4972 4603 / 2202 0032 / 2285 1579
Mob. : +91-9820507570
E-mail : itme@india-itme.com
Website : https://itme2021.india-itme.com/

Every effort is made to ensure that the information given is correct. You are however, advised to re-check the dates with the organizers.

FORM IV (See Rule 8)
Statement about Ownership and other Particulars about Newspaper
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I, J. B. Soma, hereby declare that the particulars given are true to the best of my knowledge and belief.

Mumbai
1st APRIL 2021

(Sd/-)
J.B. SOMA
Hon. Asso. Editor & Publisher

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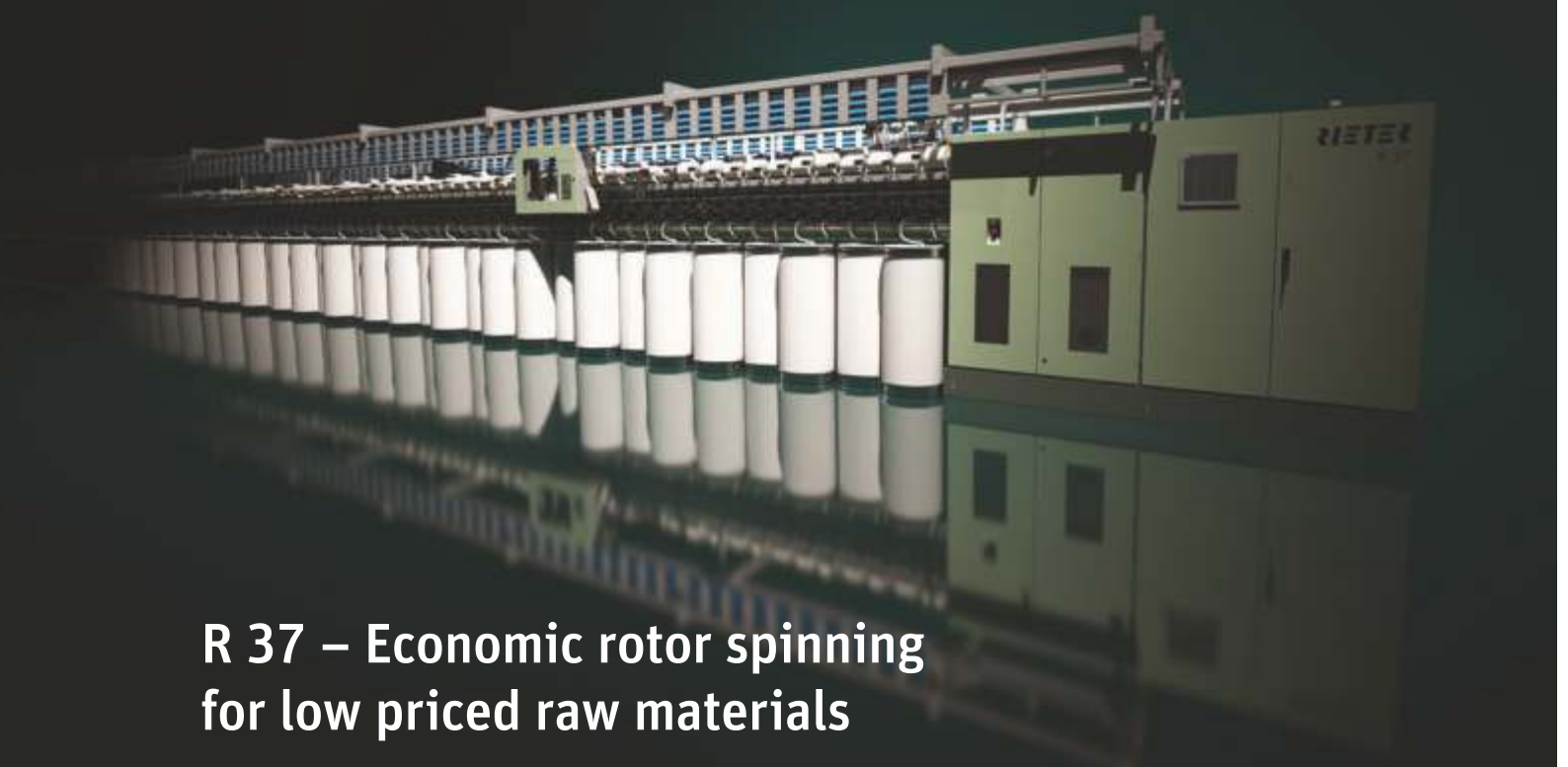

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