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ISSN 0368-4636
e- ISSN 2347-2537

Journal of the TEXTILE Association

VOL. 75 NO. 1 MAY - JUNE 2014

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ISSN 0368-4636

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Printed at :
Sundaram Art Printing Press, Mumbai

Published by PAVITRA PUBLISHER
Mr. J. B. SOMA (Publisher)
7A/203, New Dindoshi Giridarshan CHS.,
Near N.N.P. No. 1 & 2, New Dindoshi,
Goregaon (E), Mumbai - 400 065.
M.: 9819801922
E-mail : pavitra1941@gmail.com / jb.soma@gmail.com

JTA is a BImonthly Publication of
THE TEXTILE ASSOCIATION (INDIA)
Pathare House, 2nd Floor, Next to State Bank of India,
67, Ranade Road, Dadar (W), Mumbai - 400 028.
Phone : (91-22) 2446 1145 • Fax (91-22) 2447 4971
E-mail : taicnt@gmail.com
www.textileassociationindia.org

JTA is Abstracted By :
Chemical Abstracts, USA | Indian Science Abstrats, India
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Journal of the
TEXTILE Association
TEXTILE SCIENCE | TECHNOLOGY | ENGINEERING | MANAGEMENT

ISSN 0368-4636
e-ISSN 2347-2537

May - June 2014
Volume 75 No. 1

Contents

Editorial

Celebration time for both JTA and ICT!

We feel glad and honoured to share a prestigious moment of JTA through this issue. We are proud to present this first issue of JTA of 'Platinum Jubilee' Volume. Our team feels obliged to you all our readers and well wishers for this success.

JTA has successfully completed 75 years of contributing knowledge and new advancements in the field of textiles. During this journey, JTA has achieved a tag of being a 'Peer Reviewed' Journal just two years ago. This has encouraged not only to Indian contributors but many foreign authors also to get their research work published in our journal. It has always been a practice that JTA does not keep its articles confined to only one field; we try to make a point that we include articles covering varied area. Budding authors from various branches of textiles are being encouraged to come forward and send their research and review articles. This issue also consists of articles from diverse fields such as fibres, processing, testing and technical textiles, which will definitely add to your knowledge. This issue also marks the ending to series of biotechnology under 'Texnotes'. The coming issues will have some new and interesting topics under 'Texnotes'.

Before we move forward with another celebrative moment, we apologize for delay of this issue of JTA. We are and will persistently work on ways to make each succeeding issue of JTA more pertinent of International Standards and applicable to the global textile market in time.

Another milestone which I witnessed was by ICT where I work. On 24th July 2014 was signing of Twinning arrangement between ICT and Ethiopian Textile Industry Development Institute (ETIDI). This was a notable moment not only for ICT but for all those professionals concerned with textiles. The evening was highlighted by the presence of His Excellency, Mr. Tadesse Haile, State Minster to Ministry of Industry of Ethiopia, Mr. Seleshi Lemma, Director General of Ethiopian Textile Industry Development Institute (ETIDI), Mr. Fiker Tesfu, Director for Finishing Technology Directorate, Ato Yitbarek Tilahun, Director for Spinning Technology Directorate, ETIDI and Members from the Ethiopian Consulate in India. ICT will help in building a sound technical and managerial knowhow by providing handholding support to their staff by appointing our own faculty and other textile professionals from industry. You can read the details of this MoU and agreement signed further ahead in this issue.

Last but not the least; we thank all our readers for their never ending support through all these years of successful journey so far. We look forward to your support for achieving next milestone in years to come.

Prof. (Dr.) R. V. Adivarekar,
JTA, Editor

Journal of the TEXTILE Association

A Journey Towards The Platinum Jubilee Volume

A Reminiscence

A House Magazine:

Textile Digest

Within a year of foundation of Textile Association of India (TAI), the members of the Textile Association (India) thought it proper to give wider publicity to the activities and a technical magazine was born in 1940 named "TEXTILE DIGEST". The inaugural issue was published in 1940 for which Shri G.N. Vaidya accepted the responsibility of editing quarterly periodical and Shri N.V. Ullal looked after the publication formalities. A magazine Sub-Committee was formed with Shri T.G. Choudhari, Shri P.V.S. Iyengar and the principal of VJTI, Shri P.N. Joshi as members. In the early years of its publication, the Textile Digest served as a medium for communication and information rather than having technological and research orientation. Happenings in the industry were given more prominence. Research work was not in vogue and hence investigative types of articles were relatively scarce. "United We Stand" was the main message and the information about the membership, their names, personal notes, employment opportunities, readers' page, open forum, summary of articles, wartime innovations were some of the features. As the name of the magazine suggests, it was a kind of digest - a kind of window for the outstation members to get a glimpse of the advancement in the textile technology and information about the progress and activities of the Association.

Textile Digest was then registered with Registrar of Newspaper under R.N. 113886 in 1957.

Following are the list of persons who shouldered the responsibility of the Honorary Editorship of the Textile Digest.

Late G.N. Vaidya
Late Nandulal Shah
Late N.V. Ullal
Late S.D. Oke
Late K. Parameshwar
Late S.Y. Nanal
Shri Srinagabhushana
Dr. U. Bhattacharya
Dr. S.V. Bhende
Shri A.R. Garde

The Journal of the Textile Association (JTA)

Shri A.R. Garde, however continued to be the Hon. Editor when the house magazine "Textile Digest" changed to "Journal of the Textile Association" (JTA) from January 1972 and he was at the helm of the Hon. Editorship till April 2008 for 36 years. During his time the name of the house magazine was changed to the JTA to indicate the change in the nature of the articles published, the emphasis being shifted to publish articles giving more technically oriented research and investigative type of information and knowledge. Due to coming up of a number of educational institutes in textiles and co-operative research associations (CRAS) like ATIRA, BTRA, SITRA, NITRA etc., since 1949, technicians and academicians started writing articles based on their research and investigations carried out at the shop-floor-of the mills, with scientific reasoning. Shri Ashok Garde himself was associated with one of the oldest CRAS viz. ATIRA. Though the JTA was a quarterly journal till 1977, it became bimonthly from January 1978.

In addition to the Honorary Editor, Prof. V.R. Wadekar was appointed as an Editor since January 1974 to assist Shri Garde. There was an Editorial Board also, instead of the earlier Magazine Sub-Committee and since March 1978, a practice which has been followed that one of the members of the Editorial Board, including the Editor and Hon. Editor, would contribute to the editorial write-up with his identity in each issue of the JTA.

Various editors have tried their best to make the house magazine a popular one. A feature "Notes and News" giving information about the activities of the TAI Units and the general information about the

Indian and Foreign Textile Industry was started in 1941. It was continued till 1981 when the features "Textile Kaleidoscope" written by Prof. Wadekar giving the important textile events occurring in the national and international scene was introduced and the other feature "TAI ACTIVITIES" was started. 'In the World of Textiles' feature was replaced by the feature 'Current Literature' which was further replaced by 'This May Interest You'. The contributors of this feature from ATIRA collect gleanings from the textile periodicals and published under sub-headings of 'Spinning', 'Weaving' and 'Chemical Processing'. For some time a feature 'Employment Bureau' giving information, about vacancies was seen in the earlier issues of the Textile Digest.

Prof. S.Y. Nanal started a regular feature of interesting "Interviews" with important personalities from the fields of industry, research, education and machinery manufacturers when he was the editor during 1966-67. He was also responsible for starting "Refresher Courses" in 1966, the reports of which can be seen in the issues of Textile Digest of 1966-67. In the earlier days the detailed reports giving the speeches delivered in the All India Textile Conferences of the Textile association (India) were published as a special conference issue of the Textile digest. Afterwards only a few pages giving a report, mainly of the inaugural function and the technical sessions were published in the JTA. Since the Haryana Conference of 1980, a book of papers on the theme of the conference was separately published. The pioneering credit of this publication culture goes to Dr. M.L. Gulrajani of IIT, Delhi, who himself has edited seven such books of Technical Papers. One such book of papers of conferences were edited by Dr. H.T. Lokhande and Dr. M. D. teli also.

Besides the regular features of Editorial, 'This may Interest You', 'Textile Kaleidoscope', 'TAI Activities' occasionally 'Book Reviews', 'On the Shop-floor', 'Letter to the Editor', 'Question Box' features were published. In addition about two to three technical articles were included in each issue of the JTA, but the vast membership of the Association has a varied interest and many times displeasure is openly expressed in the meetings of the technicians that they do not get what they want through this journal. The Textile Digest or the JTA facing financial difficulties is also a common feature.

Since the beginning, issues of Textile Digest and Journal of the Textile Association were printed by the India Printing Works, Bombay for the 67 years till 2007. Except two years 1973 to 1975, JTA was printed by Vidhya Press, Bombay and then Colour Publication Pvt. Ltd. was the Publisher. There after, for two years in 2007 & 2008, JTA were printed by Om Graphics, Mumbai. Mr. S.K. Modi was an Editor for 1 year in 2007. Now since 2009, JTA issues are being printed by Sundaram Art Printing, Mumbai.

Mr. A.R. Garde was a Chairman of Editorial Board of JTA till 2007 and there after, from 2008 onward till date Dr. M.D. Teli is a Chairman of Editorial Board and Dr. R.V. Adivarekar is Editor of JTA. After the sudden demise of Publisher, Late P.S. Pawar, Mr. J.B. Soma took the charge as Publisher of JTA.

The Textile Association (India) is constantly working on ways to make each successive journal more relevant of International Standard and applicable to textile business. We have made an effort that JTA does not incur into paid news (commercial news). We have tried to present the news as they are to avoid misguidance to the readers. Our main priority is that our readers must get to know the truth so that they can be aware of the recent activities going on around them.

JTA team tries to bring something new and interesting for the readers, for that matter we have included jokes and quotes column; which otherwise are not seen in most of the Technical Journals. One major leap was that JTA becoming a Peer Reviewed journal. Now JTA is made available on TAI website as e-journal with e-ISSN number.

We have broadened the areas of publication, now including bio-technology, management, HR, non-wovens, technical textiles also. Through this we can get variety of readers and articles for publications too.

We have always tried to improve ourselves through our articles, news, designs and quality. There is always a scope for upgradation, thus we are always open for new developments and suggestions. We always strive for giving what is best for our readers and will continue to do so. We thank our readers wholeheartedly for their love and affection and look for the same in the coming years.

Chemical Modification of Polyethylene Terephthalate (PET) Fibres for Better Performance: A Review Article

Al-Balakocy N.G.*
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Abstract
This review deals with chemical modification of polyethylene terephthalate (PET) fibers, appearing in order of their commercial importance to the textile industry. Various approaches which were used in modification of polyester fibers, modifying agents, and application of the modified products based on the properties obtained have been highlighted. The information on the various modifications is classified primarily based on the functional properties acquired by the fibers after modification. Particular emphasis has been given to the modified polyesters. The modifications for improved dyeability, pilling, antibacterial properties, reduced flammability, high water absorbency and modified mechanical properties have been discussed for the PET fibers. Several modifications influence combination of properties and hence although they have been discussed under a particular functional property, should be viewed in totality.

Key words
PET fiber, functional properties, modified polyester, mechanical properties

1. Introduction

The creation of fibers with new service properties, which will meet the requirements of modern engineering and of the producers of consumer goods, is one of the urgent technical and scientific tasks confronting the man-made fiber industry. The recent literatures show that the problem will not be resolved by the creation of basically new fiber-forming polymers but rather by the modification of the structure and chemical composition of polymers and fibers already in production on an industrial scale.

The methods of modifying the properties of PET fibers can be divided into three groups, physical, chemical and combined physical and chemical methods, all of which are characterized by the fact that by means of them, the structure of the fiber or film is rearranged in some measure and their properties are changed accordingly. Regardless of the method (chemical or physical) by which another polymer is added to the base polymer, the resulting mixed polymer systems are not only chemically but also structurally nonhomogeneous. This has been demonstrated with graft co-polymers as example and is a fact which must be stated with special emphasis because the synthesis of a graft polymer results in the formation of a second microphase in the condensed system of polymers. The presence of one or even several chemical bonds between the graft polymer and the matrix on hundreds or thousands of graft-molecule units cannot produce a radical change in the difference in the thermodynamic nature of the two mixture components and consequently cannot prevent them from forming their own individual structure.

The physical methods of fiber modification are reasonably simple with respect to the process design and are therefore inextensively used in the man-made fiber industry but the scope for producing radical changes in fiber properties by these methods is very limited.

The tensile strength and some of the textile properties of the fiber can be improved by varying the molecular and supramolecular fiber structure in orientation stretching or by varying the spinning conditions and introducing artificial structure-forming nuclei. The degree of polymerization has a large influence on the fiber structure and properties i.e. the tenacity and elastic properties of fibers can be improved by increasing the degree of polymerization.

Changes induced in the molecular structure have resulted in the creation of new fiber types known as high-modulus fibers (polynosic etc.) and having a high elastic modulus and improved strength.

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Orientation stretching is one of the factors, which influences the fiber structure. The conditions of stretching determine whether the fiber will be amorphous or partly crystalline. The mechanical fiber properties are improved when stretching is carried out under specific optimal conditions. In the case of PET monofilament, for example, it was found that a correctly organized oriented structure is produced under the conditions existing in two-stage stretching.

The chemical methods of fiber modification are based on the principle of changing the chemical composition and the structure of the macromolecules of the base polymer as a result of chemical conversion. There are several methods by which PET and its derivatives can be converted chemically resulting in the chemical modification of the properties of PET fibers. One of these consists of the substitution of the functional groups, more particularly of the hydroxyl and carboxyl groups, of the base polymer. The Substitution reactions can be carried out either in the parent polymer before spinning or in the finished fiber, film or fabric.

1.1 Need of modification of PET

The modified polyester are prepared to develop the production processes, creating materials for special applications and to overcome some of the drawbacks such as low moisture regain, static electricity and soiling problems.

These three drawbacks are interrelated and associated with hydrophobicity of the polyester. By making hydrophilic, these drawbacks can be overcome. Thus, a hydrophilic fiber will have a higher moisture regain. The garments made up of hydrophilic fiber will absorb perspiration and will be comfortable.

Another drawback is pilling problem and difficulty in dyeing. The low pilling fibers are required to retain the elegant appearance of polyester garments for a long time. These low pilling fibers have lower tenacity than normal polyester fibers. Thus, although pills are formed in these fabrics, these pills are removed by simple brushing or washing. Extensive research has therefore, been carried out on PET to overcome the above mentioned drawbacks. Such changes (physical and chemical) have led the manufacture of modified polyester fibers.

Modification of normal polyester has been accomplished by following routes:

- Change in the chemical composition of the PET molecule by introducing a third and /or fourth component into the polymer chain during polymerization (copolymerization).
- Use of certain additives (particulate fillers, pigments of polymers) in the melt phase prior to extrusion.
- Modification during melt spinning such as hollow varied profile and micro-denier fibers for specific applications.
- Surface modification of normal polyester fiber for producing specific effects.

2. Chemical modification by using copolymerization

2.1. Modification for improved dyeability

During dyeing, the dyestuffs diffuse into the fiber and are absorbed primarily by the amorphous regions. The thermal coefficient of the molecular mobility, responsible for the dye diffusion depends largely on the Tg; which increases with increase in crystallinity and the degree of orientation of the fiber. It has been demonstrated that drawing and heat setting causes a significant reduction in the rate of dye absorption, which, however, can be improved by introducing certain hydrophilic comonomers in the PET molecule [1]. The extent to which this can be accomplished without fundamentally changing the nature of the polymer in its definition or other properties is debatable. Some basic criteria must be met in order for the material to be satisfactory.

The comonomer must be stable during polymerization and extrusion and not lead to a polymer with markedly inferior mechanical properties. In general, the use of a comonomer as opposed to an additive in the melt results in reduced leaching tendency in later use. This may be an advantage or disadvantage. Related to the use of a comonomer is the inclusion of some agent that affects the degree of polymerization (DP) or linearity of the polymer.

2.1.1. Deep dyeable PET (DD-PET)

Modification of the polymer to reduce the glass transition temperature (Tg) is helpful in increasing the dyeing rate. The most effective comonomers are aliphatic in character. Replacing a small proportion, usually 5-10 mo1% of terephthaloyl units with an aliphatic dicarboxylic acid such as glutaric or adipic acid produces fibers that will dye at boil without carriers. Aromatic units, derived for instance, from isophthalic acid, act primarily through reducing crystallinity, are less effective. Since to a first approximation, the depression of melting temperature on copolymerization is proportional to the molar percentage of the modifier, a flexible comonomeric unit of high molecular weight is particularly useful.

Block copolymers made from PET and polyalkylene glycols, i.e. polyethylene or polypropylene glycols having 1000-3000 molecular wt. showed good dyeability with disperse dyes. Deep shades can be obtained in a boiling bath without carriers. Block copolyesters containing PET and polyethylene oxide [PEO] segments synthesized in the presence of lead oxide and Mn, Sb, Sn or Mg based catalysts have been reported. Poly (ester-b-ether) by incorporating ether blocks (PEG-1000) in the PET back bone. Polyester copolymer fibers made form a mixture of ethylene glycol, diethylene glycol and dimethylterephthalate showed improved dyeability and are found useful as binder fibers in fiberfill battings for sleeping bags and sky jackets [2].

]E. M. Aizenshtein selected aliphatic and aromatic acids or their derivatives in form of dimethyl esters or containing an ion-active functional group as comonomers, subsequently used for production of copolyester fibers including comonomeric units i.e ethylene adipate, ethylene sebacate, ethylene iso- and ortho- phthalate, ethylene sulfoisophthalate. A 2-10% weight content of these units gave the required thermal shrinkage level and dyeability by disperse and cationic dyes [3].

Features of deep dyeing PET,

Better dyeability (for disperse dyestuffs)
Shorter dyeing time
Spinning throughput increased by as much as 5%
Higher water take-up (0.8% against 0.4% in unmodified PET)
Agreeable hand and soft feel of fabrics.

2.1.2. Carrier free dyeable PET (CF-PET)

Carrier free dyeable polyesters are defined as those polyesters, whose dyeability at boil without the use of carriers is similar to that of polyester fibers dyed under high temperature - high pressure (HT-HP) conditions, or at boil in the presence of carriers. There are two approaches for producing CF-PET.

The dyeing properties of polyester are strongly influenced by many of the processing conditions to which it may be subjected during manufacturing or during subsequent textile processing. Efforts have been made to improve the dyeability of polyester, to produce CF-PET by making certain changes in melt spinning, drawing and heat setting operations. Air texturing and filament mixing have also been used to produce a whole variety of products. But the most important technique at hand is the draw texturing of partially oriented yarn (POY).

Chemically modified CF-PET is produced by adding certain additives - polyethylene glycol (PEG), adipic, azillic acids which forms block copolymers with polyester. Several properties are claimed for the fiber, including good dyeability at 100°C, physical properties and tensile strength are comparable with the normal polyester. The glass transition temperature of all these fibers is about 10°C, lower than of normal polyester, leading to higher segmental mobility. This in turn increases the rate of dye diffusion into fibers at a lower temperature and can be dyed with deep shades at boil even in the absence of carriers. These fibers offer the following advantages over normal polyester.

Better exhaustion under atmospheric conditions,
A higher color yield,
Shorter dyeing cycle
Reduction in dyeing costs,
Elimination of the carrier cost,
Energy saving,
Environment protection, i.e., ecological advantages,
Possibilities of the dyeing of PES/wool of PES/acrylic blends, and
Reduction of the oligomer problem during dyeing.

The simplest and most common method of manufacturing modified polyester is by incorporating a modifying agent, during trans-esterification, polycondensation or during melt blending.

In considering the nature of the block to be introduced into the molecule, the following criteria could be adopted:

The block should contain chemical groups of a hydrophilic nature to assist the swelling of the fiber in aqueous solution.

The fiber intermediate forming the block must have some reactive end groups like carboxyl or hydroxyl, capable of undergoing poly condensation.

It must be thermally stable at 275-280 °C in order to withstand polymer melt spinning conditions.
It must be chemically stable under these conditions.

The above conditions limit the choice of modifying component, but of the few available, polyesters are the most interesting. Thus, the most popular modifiers today are a range of polyethylene glycols of the general formula $H(OCH_2CH_2)nOH$. Polyethylene glycols fulfill all the four conditions stated above and also exhibit very little scatter in the molecular weight.

2.1.3. Cationic dyeable PET (CD-PET)

In normal dyeable polyester, there are no sites for ionic dyes. So, it can only dyed by disperse dyes. Compared to ionic dyes, disperse dyes have smaller molecular extinction coefficients and lower build up property. So these dyes cannot give bright and deep colors. Moreover, fastness to sublimation and wet treatments of disperse dyes are relatively poor compared to other classes of dyes. In order to avoid these problems, cationic dyeable polyester was developed.

Copolymerization of an isophthalic acid component containing a sulfonic acid group makes it possible to use cationic dyestuffs for polyester staple fibers and filaments. Generally, the sodium salt of 5-sulfoisophthalic acid (Na-SIPA) is used as CD co monomer. A cationic or basic dyestuff contains amines or ammonium groups or quaternary nitrogen-heterocyclic. Dyeing CD-PET is an ion exchange process. The sodium cations (Na+) from CD-PET are substituted by the bigger dye cations, whereas the sodium ions enter into the dye bath. Thus, PET is chemically modified in a manner that cationic dyestuffs can form a chemical complex with the fiber that is as shown in the Figure 2.1

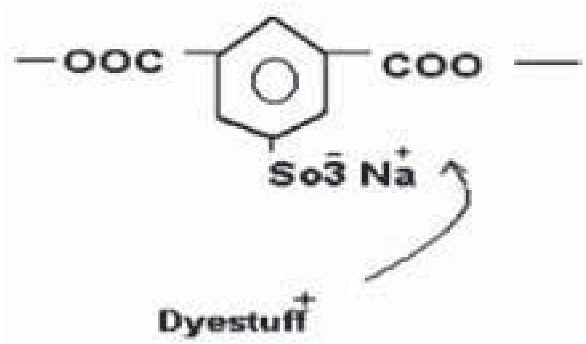

Figure 2.1: Cationic dyestuffs reacting with modified PET fibre (CD PET)

Thus, for example, challenges in dyeing polyester have been answered in part by the development and commercialization of PET that includes a proportion of 5-sulfoisophthalic acid as a co-monomer, the resulting sulfonic acid groups provide "sites" for dyeing with cationic (basic) dyes [4].

The chemistry of producing CD-PET is complicated. The reason for difficulty is the acidic character of Na-SIPA, especially in connection with hydrolytic or glycolytic conversion. Therefore, after direct addition of this salt into the PET esterification stage, the diethylene glycol (DEG) would reach a high level because ether formation is acid-catalyzed. Additionally, the acidic character enhances the TiO2 agglomeration. The result is difficulty in the spinning process, and an excessively low melting point of CD-PET.

1.2.4 Low pilling PET

Pilling is a serious problem which is associated with all the synthetic fibers. In order to reduce the pilling, polyester fibers having lower than usual strength has been prepared. Although such fibers form pills due to friction, these pills can be removed by simple brushing since the fibers has lower strength. The polyester fiber having pilling tendency can be obtained by incorporation in the polymerizing mass, certain substances such as terepthalate of barium, calcium or zinc or organic compound of antimony, chromium or iron .

Normally the pilling resistance has been achieved by reducing the abrasion resistance so that the fiber breaks off before the formation of large pills.

Polyester fiber based on poly (ethylene terephthalate) modified by addition of 3 % (on basis of weight) sulfoisophthalic acid Na salt dimethyl ester, has high resistance to the pilling effect and elevated dyeability with disperse dyes. Sorption of the dye by the modified fiber at 100ºC is several times higher (and in the case of a disperse dye, more than one order of magnitude higher) than sorption of dyes by mass-produced polyester fiber. The fastness of dyeing the modified and mass-produced fibres in different kinds of treatment is almost the same. The high sorption capacity of the modified fiber not only allows dyeing it with disperse dyes at normal pressure in a wide range of deep and medium shades, but also reducing the amount of unused dye in the baths and thus decreasing the effect on the environment [5].

Thus, the inclusion of a depolymerization agent in the melt produces a PET with a lower MW (narrower weight distribution) that pills less, and the addition of 6-16% (by weight) of polyethylene glycol together with ca. 0.1% pentaerythritol branching agent increases the wetting and wicking behavior of the polyester fiber [6].

2.1.5 Flame retardance (FR) PET

Fire accidents generally results in considerable loss of life and property. The majority of fire accidents occur due to burning of textile fibers. Polyester fiber is flammable and can cause considerable injuries due to melting. The blends of polyester with cotton are highly flammable. All the fireproofing compounds must satisfy of general requirements like, they must be non-toxic and not emit toxic products when burned, they must have sufficient light fastness and must relatively available and inexpensive, high thermal stability, resistance to UV radiation, and good compatibility with polymer.

For flame retardance, bromine-containing co-monomers have been developed, such as 2, 5 dibromophthalic acid. More recently, phosphorus-based comonomers have been examined.

Bis 4-carboxyphenyl phenyl phosphine oxide (BCPPO) was prepared by oxidation of the corresponding dimethyl compound bis (4-methylphenyl) phenyl phosphine sulfide (prepared from the reaction of toluene with dichloro-phenyl phosphine sulfide). Flame resistant PET was prepared with BCPPO as a co-monomer. The resulting copolymers exhibit good fiber-forming properties, improved flame retarding behaviour, high glass transition temperatures and improved thermal stability. The flame resistant PET product studied in this work was prepared through the direct esterification and polycondensation route of ethylene glycol (EG) and terephthalic acid (TPA) with BCPPO as a co-monomer. The obtained copolymers exhibit good fiber-forming properties, improved flame retarding behavior and high glass transition temperatures. Such a fame retardant polymer has no halogen and therefore no toxic properties [7].

2.1.6 Biodegradable PET

Hydrolytically degradable PET/PEG block copolymer was synthesized by macromolecular transesterification. When hydrophilic PEG was incorporated into the PET chain, water absorption increased. With the increase in PEG concentration, the degradation rate increased accordingly [8].

3. Additives to the PET melt before extrusion

Additives to the melt get embedded in the fiber structure after extrusion and drawing. The additive must be stable to the temperature of the melt, i.e., up to about $300^{0}C$. The additive must be readily miscible with the melt and not significantly change its rheological properties. It must also not degrade the polymer at the high temperatures. The resulting polyester should not have markedly worse physical properties. Subsequent use should also not remove the additive, unless leaching is a required property. The prime example in this case is the routine inclusion of titanium dioxide as a delustrant.

3.1. Hydrophilic additives

A large number of additives are suggested for making polyester fiber hydrophilic [4]. ICI have suggested the addition of 5-10% by weight of sodium sulphate as slurry in glycol during polymerization. The particle size of sodium sulphate should be less than 3 microns. Polyester filament having a moisture absorption capacity of at least 1% at 65% R.H. and 21ºC and a water retention capacity of at least 15% is developed by adding a water soluble aliphatic polyamide to the polyester, spinning the mixture and washing out the added amide with water. The soil resistance property of polyester fibers can be enhanced by the addition of polyethylene glycol or tetraethyl ammonium perfluoro octane sulfonate to the melt before melt spinning.

3.2. Antistatic additives

Static may be controlled by incorporating carbon into the fiber matrix, and the improved compatibility of polyester with a carbon bicomponent has been described [9]. When a surface effect is required, this method, like copolymerization, is of limited value, since the bulk nature of the fiber is being altered. It is thus not usually used to affect the hydrophilicity (hence soil release or moisture transport properties) of the fiber.

3.3. Anti-Pilling additives

Sharova, L.P. [10] has found that, additional use organic acids such as isophthalic, adipic, sebacic, 4-acetooxybenzoic acids during synthesis increase the pilling resistance and enhances the dyeability with disperse dye.

3.4. Flame retardant (FR) additives

Previously, components containing halogen, and above all bromine, were used. The effect of these substances was based on the halogen radicals interrupting the combustion chain reaction. However, as halogen enables the formation of highly toxic dioxins, the compounds used today contain phosphorus [11]. Bromine compounds are efficient, flame retardant additives but their fastness to light is not always satisfactory. Chlorinated arylalkyl hydrocarbons and bis (2,4,6-trichlorophenyl) phthalate have been suggested.

A number of FR polyester fibers commercially available include: Dacron 900F, Heim (Toyobo Co.) Tetoran Exter (Teijin), Trevia CS and Trevira FR, Toyobo GH etc. A number of flame retardant additives used during the trans-esterification reaction in the PET or sometimes mixed with PET chips prior to extraction. The important ones are; triphenlyphosphineoxide, 3,5-dibromo-terephthalate, decabromodiphenyl ether, tribromodiphenyl, phosphinic acid derivative etc [4].

3.5. Antimicrobial additives

Comfort and protection are two very important aspects of textiles today. The increase in the health concern of the consumer has prompted a need for fabrics that can inhibit the growth of bacteria and other micro-organisms which can cause offensive odors, skin irritation, visual spoilage and disfiguring stains making garments unusable with regards to hygiene and aesthetics. Certain allergens can cause allergic reactions and asthma in humans. These microorganisms may develop from the spills of body fluids or medical liquids.

Antibacterial protection (additives) inhibits the growth of such bacteria and allergens at the same time, providing an antibacterial protection which must not alter fiber spinnability, main properties of the fibers as dye uptake, wear and abrasion resistance and other mechanical properties.

It is a common practice to give antibacterial properties to synthetic fibers, by adding organic additives combined with fibers in several ways. However, employing organic agents to provide antibacterial activity is to some extent unsatisfactory. This is because of their toxicity, lack of durability and poor resistance to heat. Organic compounds also pose problems in fiber production and present problems when worm next to skin, so inorganic supports such as special zeolites or ceramic substrates containing Ag or Zn ions have been proposed [4].

Features of the antibacterial fibers,

- Prevents development of micro-organisms which are responsible for bacterial contamination and unpleasant odors.
- Should maintain a high level of effectiveness throughout the life of the products.
- No reduction of antibacterial activity when subjected to dyeing and finishing process.
- Greater amount of active material exposed on the surface.
- Compatibility in blends.
- Withstand robust handling and abrasion without impaired performance.

4. Surface modifications

4.1. Surface modification for making PET hydrophilic

Various processes for making polyester fibers hydrophilic include treatment with aqueous solutions of metal salts [12-13], alkaline solutions [14], cationic surfactants [15-16], non-circular cross-section, multilayered structure [17], and coating [18]. Very recent and important modification approaches are discussed below.

4.2. Enzymatic finishing of the PET fibers

Enzymatic treatment of the surface have the advantage of a reaction limited to the polymer surface only, and milder treatment conditions leading to less damage of the fibers. It may save energy and avoids the use of strong chemicals, which can become a problem when discharged with the process effluent. Oxidative enzymes or mediator-triggered enzymes can be able to introduce functional groups in an easily predictable way compared to plasma treatment. Enzymes considered for application in textile industry include mainly hydrolytic enzymes and oxidative enzymes. Recent promising results on enzymes for textile polymer surface treatment are reviewed and their application for polyester fiber surface treatment is discussed.

4.2.1. Hydrolytic enzymes modifying PET

PET is known to be very hydrophobic and insoluble in water as well as in most organic solvents, which makes an enzymatic reaction at the surface of the polymer rather unlikely. Nevertheless, several enzymes have been found to carry out hydrolysis reactions at the PET surface [19-20]. Hydrolysis leads to an increase of free hydroxyl- and carboxylate end groups changing the surface properties of the treated material. This introduction of charged and functional groups directly leads to an increased hydrophilicity, which can be measured by determining water retention, rising height, or contact angles [21]. Furthermore, the increased amount of carboxylate and hydroxyl end groups facilitates the attachment of cationic dyes and could allow furthermore a reduction of coupling agents in special textile applications (e.g., PVC coating) [22-23].

Lipases and esterases may potentially hydrolyze the ester bond of PET. Besides these hydrolases used in many industrial applications such as in detergents the potential of cutinases for PET modification has recently been assessed. Cutinases are enzymes that hydrolyze the plant cutin, which is the main component (between 40 and 80%) of the plant's cutical layer. Its monomers are oxygenated C16 hydroxyacids (e.g., 16-hydroxyhexadecanoic acid) and C18 hydroxyacids (e.g., 18-hydroxy-9, 10-epoxyoctadecanoic acid) that forma polymeric network by ester linkages [24]. Cutinases belong to the family of serine hydrolases and they are specific for the hydrolysis of primary alcohol esters. Their substrate specificity is very broad, which can be seen from the wide range of chemical substances that can be hydrolyzed or synthesized [25]. Given the fact that cutinases act on insoluble esters of primary alcohols, it can be assumed that PET is a potential substrate. Hydrolysis of PET with cutinases and other esterases has been proven as an increase of hydroxyl end groups of the polymer powder as well as on fabrics. A 48-h fabric treatment with an esterase increased the amount of hydroxyl end groups from 62 to 138 mmol/kg fabric [26]. Cutinases and so called polyesterases, which may be lipases or esterases, have been reported to reduce the pilling properties of PET. A pre-pilled PET fabric has been treated with a polyesterase from Genencor resulting in the removal of nearly all pills. A weight loss of about 4% correlates with the depilling effect [27]. Hsieh and Cram have tested the ability of lipases to hydrolyze the PET surface and achieved a decrease in water contact angle from 78^0C (untreated fabric) to $40\text{-}60^0$C depending on the lipase used. These results correlated with a change in water retention, which was found to be increased from 0.2 mL/mg fabric (untreated fabric) to 1.0 mL/mg fabric, showing strongly increased hydrophilicity [28]. Furthermore, PET hydrolyzing enzymes have been shown to improve color clarity in fabrics [29].

4.1.3. Oxidative enzymes modifying PET

Laccases are unspecific oxidoreductases that catalyze the removal of a hydrogen atom from the hydroxyl group of ortho- and para-substituted mono- and polyphenolic substrates and from aromatic amines by one-electron abstraction. The substrate range of laccases can even be expanded by the use of electron mediators. Laccases have been reported to strongly enhance the hydrophilicity of a PET knitted fabric measured by determining the water contact angle and the rising height. Depending on the treatment time, the laccase activity in the assay and the mediator used, rising heights of 5.8 cm (laccase activity: 1000 nkat/g, treatment time: 300 s), 7 cm (laccase activity: 1000 nkat/g, mediator: violuric acid, treatment time: 300s), and 7.3 cm (laccase activity: 1000 nkat/g, mediator: 2,2,6,6-tetramethylpiperidin-1-yloxy, treatment time: 300 s) compared to 0.2 cm for the untreated fabric have been observed [30]. However, the mechanism of these investigations has not been elucidated until now.

4.2. Antimicrobial finishing of the PET fibers

PET fiber materials can be exposed to contamination with microbes (bacteria, fungi, algae) during production, usage or storage. The microbial attack of textiles leads to quality losses due to changes of colour and appearance or to reduction in strength and can result in unpleasant odour formation. Moreover, since microbes absorb to textiles there is a risk of contamination and infection.

This knowledge led to the development of antimicrobial finishing agents for textiles, in particular for textiles with special usage, e.g. socks, underwear, sports wear, medical textiles, technical textiles, geo-textiles or other materials. In hygienic fictionalization of textiles, different concepts exist. Textiles are either finished with antimicrobial substances or those substances are introduced into the fiber bulk during fiber production, the latter in the case of synthetic fibers. Among others active substances from the cosmetic sector, metal ion-containing compounds like zinc-pyrithion, and metal or metal ions like silver are used. In this section, a survey on the recent methods for existing antimicrobial agents and finishing procedures is given.

The basic requirement for antibacterial fibers are absence of systemic toxic, allergenic, and irritating effects on human skin, resistance to light and temperature, ability to retain bactericidal action over a perhaps long period of use, including repeated laundering and cleaning [31].

Polymeric materials are non-volatile, chemically stable and do not permeate through the skin of man or animal (non-released material). T. N Yudanova, et. al [32-33] obtained on cellulose and PET fiber materials with a long lasting biological acting containing a polymeric antimicrobial of the cationic type polyethyleneimine and polyhexamethyleneguanidine hydrochloride fixed with glutaraldehyde

Antimicrobial properties are often related to the introduction of functions like quaternary ammonium.

An effective two-stage method has been developed for imparting antimicrobial properties to regular polyethylene terephthalate (R-PET), polyethylene glycol modified polyethylene terephthalate (PEG-M-PET), R-PET/Cotton blend (R-PET/C) and PEG-M-PET/Cotton blend (PEG-M-PET/C) fabrics. The method consists of partial hydrolysis of the fabrics to create carboxylic groups in PET macromolecules followed by subsequent reaction with dimethylalkylbenzyl ammonium chloride (DMABAC) under alkaline conditions. All the modified PET fabrics showed excellent antibacterial activity towards Gram-positive (*Bacillus mycoides*), Gram-negative (*Escherichia coli*), and nonfilamentous fungus (*Candida albicans*). The achieved antimicrobial functions on the PET fabrics are durable in repeated laundering processes. Even after laundering 10 times the fabrics could still provide more than 85% of its antimicrobial activity against B. mycoides, E. coli, and C. albicans [34].

Radical grafting of biocidal precursor monomer 3-allyl-5,5-dimethylhydantoin (ADMH) onto poly (ethylene terephthalate) (PET) fabric After being converted to N-chloramide structure, the poly(ADMH)-g-PET fabric demonstrates total kill of 105-106 CFU/mL *Escherichia coli* at a contact time of 2 h [35-36].

Jadwiga Buchenska, et al [37] prepared PET yarn with antimicrobial properties by incorporation of carboxylic groups into fibres by poly (acrylic acid) grafting polymerization followed by impregnation of the fibres with an antibiotic which belongs to the cephalosporins. In vitro studies revealed that the drug- loaded fibres were bioactive against Gram-positive (*Staphlococcus aureus*), Gram-negative (*Escherichia coli*) and (*Pseudomonas aeruginosa*).

Chitosan-based polymers are known to provide some antimicrobial effectiveness to textiles, in particular if the naturally occurring chitosan is modified with quaternary ammonium groups. These polymers can be obtained by polymerization of monomer bearing such function or by grafting them on pre-made polymer [38-39].

4.3 Silk like finishing of the PET fibers

For centuries silk fabrics are considered to be most elegant and gorgeous textile materials. However the production of silk fiber could not keep pace with increase in human population, and hence the price of silk is now beyond the reach of most of the people. When synthetic fibers were first developed it was thought that these fibers will be able to substitute silk. However, soon it was realized that these fibers have metallic luster, papery feel and poor aesthetic value. Substantial amount of research work was carried out to make silk like synthetic fibers which has resulted in the development of silk like polyester fabrics [14].
The following factors should be considered in the production of silk like polyester,

Fiber cross section to obtain the desired luster
Fine denier filament to obtain the desired feel

4.3.1 Role of cross-section of the PET fibers

Modification of cross-section of the fiber allows engineering of surface properties in yarn and fabric. Many cross-section shapes are available; circular, trilobal, pentalobal, octalobal, hollow, hexagonal, and other irregular shapes. For silk like polyester fiber circular, trilobal, tetralobal, C shape, V shape, and hollow cross-sections have been used. The most popular cross-section for silk like polyester is trilobal, which gives adequate luster resembling that of silk [17].

4.3.2 Role of average denier of PET yarn

It plays a primary role in determining the stiffness of the yarn. It is easy to visualize its effect by an analogy, where a thin glass capillary is stiff and brittle but when it is made in the form of the filament it is pliable. Silk fibers are "very fine" in the range 1.2 to 1.3 dtex and hence necessarily the synthetic fiber used to be in the same range or finer to obtain a feel closer to silk. Finer the single filament in the yarn, softer is the hand of the resultant fabric. The larger the number of fine filaments in yarn of identical over all titer, the fabric hand is bulkier and denser.

5. Supercritical phase of carbon dioxide treated PET fibers

Polymerization reactions in supercritical carbon dioxide have been under extensive research in the recent years. The motivation has been to eliminate the emissions of volatile organic compounds. The first example of a $scCO_2$-solvent based industrial polymerization process is the Dupont's fluoropolymer plant opened year 2002. Supercritical phase of carbon dioxide appears above the critical pressure and temperature (+31^{0}C, 73.8 bar). In supercritical state the physical properties of the fluid are between the gaseous and the liquid phases. Moreover, the "solvent power" the fluid can be adjusted by changing the pressure and temperature. Supercritical carbon dioxide can be used instead of common organic solvents to swell the structure of the fiber and open the way for the monomer to penetrate into the polymer i.e. to impregnate the fiber. The polymerization reaction can be take place in the supercritical phase if the polymerization reagents (oxidants, dopants) are made soluble in CO_2 or in a separate process step utilizing e.g. simple aqueous reagent paths for monomer impregnated fibers. Conducting PET and polyamide fiber and fabrics were prepared by chemical oxidative polymerization using super critical fluid assisted process [40].

6. Plasma Treatment of the PET fibers

The pre-treatment and finishing of textiles by non-thermal plasma technologies becomes more and more popular as a surface modification technique. It offers numerous advantages over the conventional chemical processes. Plasma surface modification does not require the use of water and chemicals, resulting in a more economical and ecological process. The enormous advantage of plasma processes concerns the drastic reduction in pollutants and a corresponding cost reduction for effluent treatment, so it can be considered as an environmentally benign technology. A non-thermal (or cold or low temperature) plasma is a partially ionized gas with electron temperatures much higher than ion temperatures. The high-energy electrons and low-energy molecular species can initiate reactions in the plasma volume without excessive heat causing substrate degradation. Non-thermal plasmas are particularly suited to apply to textile processing because most textile materials are heat sensitive polymers. In addition, it is a versatile technique, where a large variety of chemically active functional groups can be incorporated into the textile surface. The possible aims of this are improved wettability, adhesion of coatings, printability, induced hydro- and/or oleophobic properties, changing physical and/or electrical properties, cleaning or disinfection of fiber surfaces etc [41].

6.1. Plasma treatment effects on PET

6.1.1. Increasing the hydrophilic character

Wettability of polyester has been increased by using oxygen or nitrogen plasma. Plasma- produced polar groups increase the surface free energy of the fiber and decreases the contact angle. The contact angle for water was found to decrease for PET after plasma treatment in oxygen and nitrogen, while the contact angle for cellophane increased. Such low temperature, low pressure plasma treatment is effective in inducing the high consumption of chemical wetting agents normally required chemical processing of textiles.

Negulescu et al. treated a PET fabric in low pressure $SiCl_4$ plasma [42]. The SiClX groups implanted at the PET fiber surface spontaneously hydrolyze by reaction with atmospheric humidity, creating hydrophilic Si-OH groups in addition to the plasma created carbonyl groups. Thus, a hydrophilic fiber surface is created. The water contact angle was reduced from an original 86^0 for the untreated surface to 60^0 after a 30 s treatment and to 46° after a 10 min plasma treatment.

PET fabric was treated by plasma initiated in various gases (N_2, O_2, air, CO_2 and NH_3) by Wróbel et al. [43]. Evaluation of the wettability was done by the wetting time, i.e. the time required for a drop of distilled water, placed on the treated fabric surface, to lose its reflective power. The wetting time of the plasma-treated fabric considerably drops in comparison to the untreated fabric and the best results were obtained after treatment in oxygen, nitrogen and air plasma. F. Ferrero et al. also studied the effects of gas composition on the wettability of PET fabrics [44]. C. W. Kan et al. reported on an improved wettability of keratin fibres with water vapour plasma [45]..

Borcia et al. studied an 80 kHz dielectric barrier discharge (DBD) in air, nitrogen or argon for the treatment of natural, synthetic and mixed fabrics [46]. The enhanced wettability and wickability appeared to be strongly increased within the first 0.1-0.2 s of treatment. Any subsequent surface modification following longer treatment (N1.0s) was less important. The increased wettability could be attributed to the increased level of oxidation where supplementary polar functionalities are created on the fabric fiber surface, as observed by X-ray photoelectron spectroscopy (XPS) - also known as electron spectroscopy for chemical analysis (ESCA).

Cheng et al. developed a new plasma jet system and obtained similar results of increased wettability and O/C ratio for PP and PET fibers [47]. Figure 6.1 shows the change in contact angle for PP and PET as a function of plasma treatment time, while Figure 6.2 shows the ageing behaviour of PP and PET samples treated for different times.

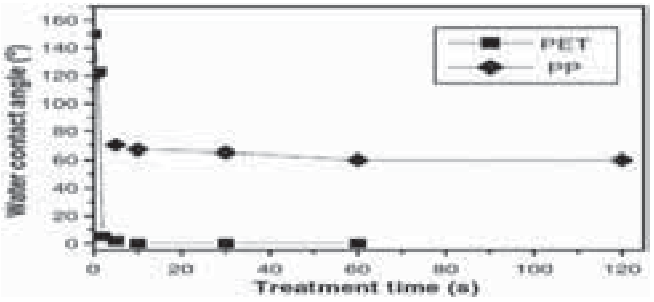

Figure 6.1: Water contact angle of PP and PET fibres Vs plasma treatment time

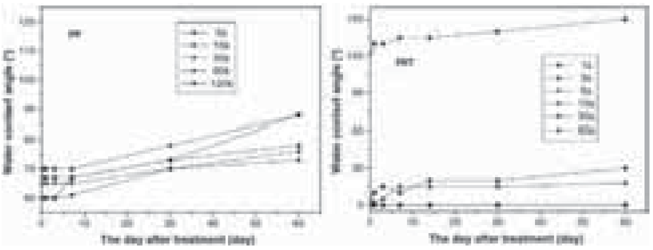

Figure 6.2:Water contact angle of different time plasma-treated PP (left) and PET (right) fibers versus storage time at ambient temperature

6.1.2. Combination with coupling agents

Krump et al. [48] described the improvement of the adhesion of PET fibers to different rubber types by plasma treatment in air and nitrogen. After the plasma treatment the textile structures are impregnated in a bath containing a resorcin-formaldehyde-vinylpyridin latex. A 60s nitrogen plasma treatment increased the adhesive forces of fabrics to a polar rubber by a factor of 2.75 (8 N/cm to 22 N/cm), which is still not enough for most intended applications. The adhesive force to high polarity rubber however increased from 15 N/cm to 70-90 N/cm (a factor of 4.7-6). From an adhesive force of 70-90 N/cm onwards the adhesive failure is not situated at the fiber-rubber interface but in the rubber bulk itself. Treatments in argon, carbon dioxide or hydrogen plasmas were far less efficient than treatments in air or nitrogen.

Janca et al. reported on a plasma surface treatment of PET fabrics for the reinforcement of car tires [49]. Oiling of the original synthetic cord fibers is the main technological problem. The fibers were treated to increase the adhesion of the PET fibers with the rubber matrix and the best results were obtained with nitrogen plasma at atmospheric pressure. The authors suggest that a small addition of ammonia enhanced the adhesion even more. Addition of other gases containing fluorine and chlorine were labeled as not useful due to their toxicity and ecological unacceptability in industry.

An atmospheric pressure nitrogen plasma was used to render a 0.1 mm thick PET non-woven hydrophilic and facilitate absorption of a palladium catalyst in order to provide a catalytic surface for the deposition of electroless nickel plating [50]. While PET-nickel adhesion was inexistent for untreated samples, an optimal adhesion was obtained after 1 s of plasma treatment. The standard industrial peel test (ASTM D 3359-78 Method B) removed fibers from the (loosely structured) non-woven before removing nickel from the fiber surface. A similar study on electrolysis nickel plating of a polyester fabric was recently done by Yuen et al. [51].

6.1.3. Improving dyeing and printing properties

Ferrero et al. tested the dyeability of PET, polyamide (PA) and PP woven fabrics after plasma polymerization of acrylic acid [52]. The overall colour strength was significantly increased. However, while the wash fastness was acceptable on PA, it was unsatisfactory on PET and PP fabrics, probably due to the lack of penetration of the acrylic acid monomer in the fiber. SEM and Fourier transform infrared spectroscopy (FTIR) confirmed that grafting of polyacrylic acid had taken place only on the surface of PET and PP, but in the case of PA the interior of the fiber was also modified. Similar experiments on nylon-6, with plasma pretreatment and a subsequent acrylic acid or 2-hydroxyethyl methacrylate grafting process were also reported by Liao et al. [53].

Raffaele-Addamo et al. applied RF plasma in air or argon to PET fibers and showed an increased colour depth upon dyeing [54]. Figure 6.3 shows the increase and saturation of colour depth as a function of dyeing time for a PET fabric.

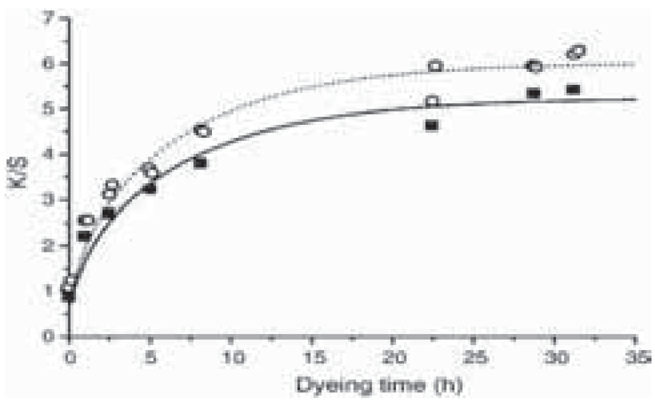

Figure 6.3: Increase of colour depth at 371 K as a function of time on an untreated ( ) and an air plasma-treated (0) PET fabric

6.1.4. Hydrophobicity and oleophobicity

By using a corona discharge, hydrogen silicone fluid was grafted on polyester fabric [55]. Contact angles varied with initiator concentration and treatment duration. The untreated PET showed a contact angle of 71° and obtained the highest angle of 127° after a 30 s treatment. Reduction of contact angles after long corona treatments is probably due to the oxidation of the silicone, with the introduction of hydrophilic functional groups.

6.1.5. Surface cleaning: desizing, removal of impurities

When using a plasma treatment for surface cleaning, selectivity of the plasma for the material to be removed from the fiber surface is required, since the fiber structure itself should not be damaged. The use of plasmas for desizing of cotton and polyester-cotton was first described as early as 1973. The technique was presented as a novel approach to the environmental problems of desizing in the textile finishing industry. Cotton, polyester and cotton-polyester fabrics containing 8.4% weight of fiber (w.o.f) polyvinyl alcohol (PVA) size were treated in a RF plasma afterglow in O_2, N_2 and air at low pressure, and in an atmospheric pressure corona discharge. The oxygen plasma treatment was the most efficient one, while the N_2 plasma was not effective at all and air plasma caused intermediate results. Corona treatments of identical fabrics failed to show weight loss, even after long treatment times (20 min). The developed plasma desizing process finally consisted of two steps: an oxygen plasma treatment during which the PVA polymer is degraded into gaseous compounds, and a subsequent aqueous washing step which removes the size which was not removed during the plasma treatment. After a 10 min plasma treatment almost 60% of the size was removed; a subsequent cold rinse removes another 35%. A cold rinse without a previous plasma treatment removed only 11% of the size, while a conventional hydrogen peroxide desizing method removed 82%. Loss of fiber mass, which should be minimized, is less than 4% in plasma conditions were 60% of PVA is removed. This is somewhat logical because the layer of PVA must be removed from the yarn before the fiber surface can be etched away. No significant loss in fabric strength was noted.

A comparative study between plasma and wet chemical cleaning of synthetic fibers was done by Keller et al. [56]. In this work, different cleaning methods were compared in order to remove sizes on PET multifilament fibers, namely chemical cleaning by Soxhlet extraction and by cleaning in a lab-built bath, as well as etching in atmospheric and low pressure microwave plasma, and in RF plasma. Figure 6.4 shows the effect of microwave plasma cleaning process with different gas mixtures and varying pressure. It was found that both parameters were key factors for desizing. The best result was obtained with a 1:1 gas mixture of argon and nitrogen at a pressure of 0.53 kPa (Power = 18 W). Different criteria, such as efficiency, flexibility, ecology and industrial applicability were evaluated. In terms of these criteria, the authors claimed that the RF plasma showed the best performance. The continuous fiber treatment in a low pressure He/O_2 RF discharge enabled the complete removal of 4.4 wt. % size at a velocity of 10 m/min. Although atmospheric and low pressure microwave discharges showed higher efficiencies, their application was limited due to the high heat loads yielding degradation of the PET fibers before cleaning was completed.

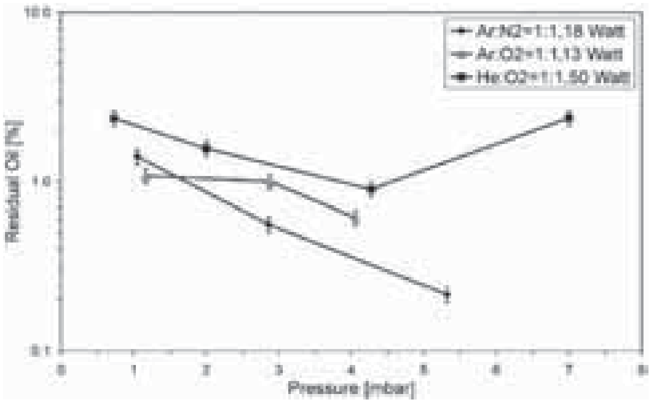

Figure 6.4: Effect of microwave plasma cleaning with different gas mixtures and varying pressure

6.1.6. Influencing physical properties of fibers

6.1.6.1. Optical properties

The treatment requires efficient physical removal of fiber surface polymers for the creation of microscopic pits. Treatments have been specifically done to decrease light reflection at the fiber surface, so that a dyed treated textile acquires a deeper shade. The decrease in reflection after a plasma treatment is caused by the creation of ripples and microcraters. The created surface roughness causes the incident light to be scattered rather than specularly reflected. For optimum colour deepening the size of microcraters should be between 0.1 and 1 mm, i.e. around the visible wavelength range (0.4-0.7 mm). The influence of plasma current frequency on the resulting fiber surface topography was shown by Wróbel et al. [43]. For a 4 min low pressure treatment in nitrogen plasma the mean size of created pores decreased with increasing frequency (50 Hz, 5 kHz or 100 kHz).

To improve the deep colouring effect of PET fabrics, Lee et al. deposited anti-reflective coatings on the PET surface with two different organo-silicon compounds (HMDS, TTMSVS) using an atmospheric pressure microwave plasma [57]. They analyzed the quality of their polymerized thin film with SEM and FTIR. Spectrophotometry was used to measure the reflectance to confirm the deep colouring effect. It was observed that the minimum reflective value was obtained at a film thickness of 150-200 nm on PET when using HMDS and TTMSVS monomers. An addition of O2 promoted the decomposition of organic monomers and contributed to the enhancement of the colour intensity on the PET surface.

Lehocky and Mracek treated PET fibers with low pressure RF air plasma [58]. Due to the plasma treatment they were able to use a new dye bath composition without any use of sodium sulphate resulting in a coloured fiber with the same reflectance as obtained with traditional dyeing processes without plasma treatment, but with sodium sulphate. In this way, they showed the power of plasma treatment from both ecological and economical view.

6.1.6.2. Mechanical properties

The treatment of PET fabrics in SiCl4 plasma has been done to improve their comfort-related mechanical and surface properties [42]. The primary effect of the plasma treatment was on the surface roughness, in good accordance with atomic force microscopy (AFM) roughness data. A similar AFM study was done by Poletti et al. [59] to quantify the effect of gas composition on the surface roughness. Figure 6.5 shows AFM images of the untreated and the 1 min and 2 min air plasma treated PET samples. The surface of the untreated PET textile appeared to be flatter compared to the treated samples. The treated samples showed that the air plasma treatment induced pits and micropores whose density, depth and size increased as a function of exposure time.

Textsmile

My old aunts used to come up to me at weddings, poking me in the ribs and cackling, "You're next!" After a while, I figured out how to stop them. I started doing the same thing to them at funerals!

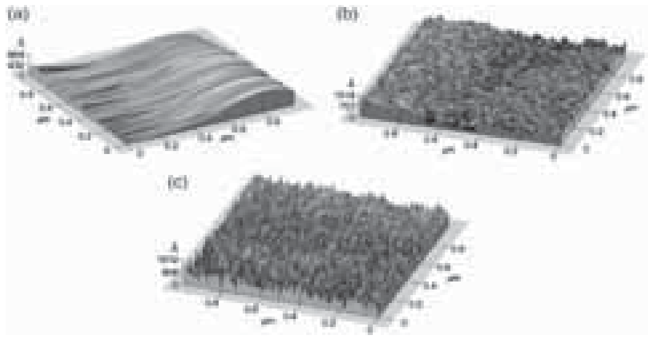

Figure 6.5: 3D views of AFM images of PET textile surface. (a)Untreated surface; (b) 60 s treated surface; (c) 120 s treated surface

Titov et al. reported in a series of papers about the fundamental study on etching of PET fabrics in different conditions [60-63]. Among others, the effects of texture, specific surface area, gas composition, afterglow and temperature were investigated by rate of mass loss and evolution of gaseous products. In different papers [64-65], Sun and Stylios studied a low temperature plasma treatment of cotton and wool. Next to a changing wettability depending on gas composition, they observed a slight loss in elasticity after plasma treatment. The tensile strength increased after plasma treatment, while the stretch of the material was reduced.

6.1.6.3. Electrical properties

Bhat and Benjamin treated cotton and polyester fabrics at different power levels in a 13.56 MHz air plasma for durations between 10 and 60s [66]. Following this air plasma treatment the fabrics were grafted in acrylonitrile plasma or in an aqueous acrylamide solution of different concentrations. The surface resistivity at 70% RH was considerably reduced for the grafted polyester fabrics. This reduction was linked to the increased moisture content of the treated fabrics.

Aubrecht et al. [67] treated PET fabric with low pressure O_2/CF_4 13.56 MHz plasma and surface resistance was significantly reduced from 10^{14} W to 10^{8} W. One week after treatment the original surface resistance was reached again.

6.1.7. Improving the efficiency of wet finishing processes

The treatment effect has to optimize the interaction between fiber surface and the finishing product that is added to a bath or foam. The effect can be advantageous on two levels: (a) due to improved wetting properties of the textile product, less or no chemical wetting agent is needed, and (b) because of an improved interaction between finishing product and fiber surface, less finishing product is needed for identical properties (better bath exhaustion). The properties of a plasma-treated and finished textile can also be improved as compared to a merely finished textile to which the same amount of finishing product is added.

6.1.8. Formation of radicals

The working gas and the treatment conditions must be optimized towards maximum production of surface radicals. Wakida et al. [68] did a virtually identical study on the creation and stabilization of free radicals for a range of fiber types treated in different plasma gases. Electron Spin Resonance (ESR) spectra were used to assess the relative amount of radicals remaining in the fiber polymer structure after 24 h of ageing in dessicator conditions. The ESR signal increased with treatment duration and also depended on the plasma treatment pressure, for which an optimum exists. Following order was found for the fibres (relative intensity for a 180 s treatment):

Cotton ; linen > mercerized cotton > polynosic fiber > viscose > wool > silk > polyamide 6 > PET;

after a CF_4 plasma values range from 2.9 to 4.9 for cotton and linen, to 0.0 to 0.2 for PET, showing the large influence of fiber type on free radical stabilization. Within cellulosic fibers, free radicals recombine more easily when the fiber structure is loose, such as is the case with mercerized cotton as compared to native cotton. The type of gas also had a profound influence on free radical creation:

CF_4 > CO > H_2 > Ar > CH_4 > N_2 ; O_2

For cotton fibers, values range from 2.9 to 4.9 after a CF_4 plasma, to 0.3 to 0.5 after an O_2 plasma.

6.1.9. Antimicrobial activity

Much attention paid in recent years to PET fabrics grafted after being activated by plasma, which is one of the environmentally friendly ways to make fabrics antimicrobial [69-70].Yu. B. Chang et al evaluated the properties of PET fabrics grafted with chitosan oligomers / polymers after being activated by atmospheric pressure plasma for 60 to 120 s. The PET grafted fabric showed also high hydrophilicity and good biocompatibility.

7. Miscellaneous modification methods

7.1. PET fibers dyed with natural dyes

Chemical modification of a natural dye is the most promising way to give it the ability to dye textile materials made of chemical fibers (polyester and polyamide) without using a mordant - heavy metal salts is thus possible [71]. The dyes isolated from natural raw material (Hypericum perforatum L) were modified with an Azo coupling reaction where the extract isolated contains organic derivatives with a phenol structure. Samples of PET and polyamide fibres were dyed with the compounds obtained by the periodic method with disperse dye-dyeing technology [72].

7.2. Laser Treatment of the PET fibers

Modifications of textile properties of polyester due to laser irradiation were studied by C. W. Kan [73]. Properties included fiber weight and diameter, tensile strength and elongation, yarn abrasion, bending, surface luster, wetting, air permeability as well as crystallinity. Generally speaking, laser irradiation could not affect the bulk property due to its low penetration depth, and hence, the effect on the bulk and structural properties was limited.

7.3. Ion exchange PET fibers

L. Ducoroy et al [74] described a chemical method to prepare ion exchange textiles from finishing of PET nonwoven fabrics based on the use of cyclodextrins (CDs) and citric acid (CTR) as finishing chemicals for the modification of polyester fibers (PET). It was observed that the reaction between these reactants yielded a cross-linked polymer, by formation of ester functions between the polyol (CD) and the polycarboxylic acid (CTR). This polymer (called polCTR-CD) permanently coated the PET fibers. The chemical structure of poly CTR-CD consisted of CD moieties and unreacted carboxylate groups. These groups resulted from the partial reaction of CTR and yielded ion exchange property to the fibers. The finished fabrics were applied in decontamination of water solutions containing Pb^{2+}, Ni^{2+}, Cd^{2+}. It was observed that 0.3 mmol of each cation were adsorbed per gram of fabrics.

7.4. Removing oligomers from the PET fibers

A new direction in finishing of polyester materials based on the use of low-concentration aqueous solutions of ammonia in textile processes has been successfully developed in recent years [75]. The systematic study of the reaction of polyester with aqueous solutions of ammonia with a concentration of 0.01-0.05 M at 25-130^{0}C for 1-60 min showed that no changes occurred in the average molecular weight of the polymer under the effect of the ammonia. Based on the above, we can conclude that dilute aqueous solutions of ammonia do not cause hydrolysis of polyethylene terephthalate (PET) macromolecules even at temperatures above 100^{0}C. However, the total concentration of oligomers in the polymer in these conditions decreases significantly under the effect of heated aqueous solutions of ammonia: the oligomers in the inner regions of the polyester migrate to its surface and then pass into the solution. This is accompanied by hydrolysis of the oligomers with formation of terephthalic acid (TPA). The rate of migration of the oligomers increases at temperatures above 80^{0}C.

In the study of the effect of low-concentration aqueous solutions of ammonia on polyester fibers conducted, positive technological effects were found in dyeing and finishing of polyester textile materials, and one was decreasing their surface electrical resistance without the use of antistatic agents. The method of giving polyester fiber materials antistatic properties consists of treating them with an aqueous solution of ammonia in the concentration of 0.02-0.03 M for 10 min at 130^{0}C. The specific surface electrical resistance p of polyester fiber treated with the new method is almost 1000 times lower than the p of fiber with OS-20 nonionogenic antistatic agent applied on it [76].

N. P. Prorokova [77] showed that, modification of PET using equimolar amounts of ammonium nitrate and sodium hydroxide with 0.25 and 0.5M can be used for removing oligomers from polyesters to increase the dyeability of the polymer materials.

Recently, the study of the effect of solutions ammonium salts of low concentrations on PET fiber material showed that, modification of the PET with the ammonia formed by thermal hydrolysis of ammonium salts differs from modification with ammonia obtained by the reaction of equimolar quantities of ammonium nitrate and sodium hydroxide and is similar to the process that takes place when ammonia is added to the working solution. Of the salts examined, ammonium fluoride in the concentration of 0.02-0.035 M at 130°C and 30 min is the most active modifying agent. In this conditions, ammonium fluoride and the products of its high -temperature hydrolysis - hydrogen fluoride and ammonia- have the strongest catalytic effect on hydrolysis of cyclic oligomers with formation of their linear form. On the whole, ammonium fluoride has a stronger modifying effect on polyester material than aqueous ammonia [78].

8. Summary

The fundamental topics which are being addressed more and more frequently in literature may be briefly set forth as follows:

- Development of industrial Fibers with high physico-chemical and mechanical properties on the basis of the classical fiber forming polymers;
- Development of fine, very fine and superfine - microfibers;
- Modification of polymers and fibers by additives;
- Exploitation a new enzymes and genetic engineering towards highly functional polymers and fibers based materials, e.g. with high value applications;
- The mechanistic understanding on (enzyme , plasma, laser, supercritical carbon dioxide) / polymer interactions, combined with advances in chemical and genetic engineering, will also lead to implementation of environmentally friendly technologies in processing of fiber materials; and
- Great challenge to develop non-expensive and simple technologies to be applicable in textile industry.

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Printing of Cotton with Natural Dyes using Pre and Meta Mordanting Techniques

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Abstract
Printing with natural dyes is still in its infancy due to the problems associated with natural dyes like difficulty in extraction of the dye, requirement of a mordant, uneven prints, fastness properties, etc. In this study an attempt was made to get even prints with bright shades using the direct style of printing by both the premordanting and metamordanting techniques. Alum 20% (owf) was used as a mordant. Extracted dye solutions of madder, sappanwood and onion peels was used in the print paste with different concentrations (10%, 20% and 30%) and guar gum was used as the thickener in screen printing. The K/S and L*, a* and b* values of the printed material were studied. The wash, light and rubbing fastness along with the bending length of the printed fabric was also evaluated. The K/S values obtained for metamordanting were more than those obtained using premordanting technique. The metamordanting technique was also easier and the prints obtained were more even. The fastness properties were not affected by the technique used.

Keywords
Premordanting, Metamordanting, Natural dyes, printing

1. Introduction

Textile material (natural and synthetic) is coloured for value addition, aesthetic look and desire of the customers. Anciently, this purpose of colouring textile was initiated using colours of natural source until synthetic dyes were invented and commercialized. Due to the ready availability of pure synthetic dyes of different types and its cost advantages, most of textile dyers/ manufacturers shifted towards use of synthetic colourants. However, almost all the synthetic colourants are synthesized from petrochemical sources through hazardous chemical processes and some of them pose a threat to human safety and environment. Hence, there is a growing consciousness worldwide about the eco-friendly products which has generated renewed interest of consumers towards use of textiles (preferably natural fibre products) dyed with eco-friendly natural dyes.

The word 'natural dye' covers all the dyes derived from the natural sources like plants, animal and minerals. Natural dyes are mostly non-substantive and must be applied on textiles by the help of mordants, usually a metallic salt, having an affinity for both the colouring matter and the fibre. Transition metal ions usually have strong coordinating power and/or capable of forming weak to medium interaction forces and thus can act as bridging material to create substantivity of natural dyes with the textile material. The textile fabric is thus impregnated with such metallic salt (i.e. mordanted) and then it is subjected to dyeing or printing with different natural dyes. The presence of metallic mordant facilitates the fixation of such dye/colourant. These metallic mordants after combining with the dye in the fibre form an insoluble precipitate or lake and thus both the dye and mordant get fixed within the fabric matrix and exhibit fastness to a reasonable level [1].
Natural dyes have the ability to produce wide range of tints and shades, with the same dye material [2]. India is richly endowed with vast variety of natural flora. It is estimated that, in India there are some 500 varieties of plants that can yield natural colours [3, 4]. The art and craft of producing natural dyed and printed textile is being practiced in many villages by expert craftsmen in the country. Natural dyes, when used by them have many limitations of fastness and brilliancy of shade. However, when used along with metallic mordants they produce bright and fast colours.

Rubia tinctorum, the common madder, is a plant species in the genus *Rubia*. The plant's roots contain several polyphenolic compounds like 1,3-

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Dihydroxyanthraquinone (purpuroxanthin), 1,4-Dihydroxyanthraquinone (quinizarin),1,2,4-Trihydroxyanthraquinone (purpurin) and 1,2-dihydroxyanthraquinone (alizarin). This alizarin gives its red colour to a textile dye known as Rose madder. It has been used since ancient times as a vegetable red dye for leather, wool, cotton and silk. For dye production, the roots are harvested in the first year. The outer brown layer gives the common variety of the dye, the lower yellow layer the refined variety. The dye is fixed to the cloth with help of a mordant, most commonly alum. Madder can be fermented for dyeing as well.

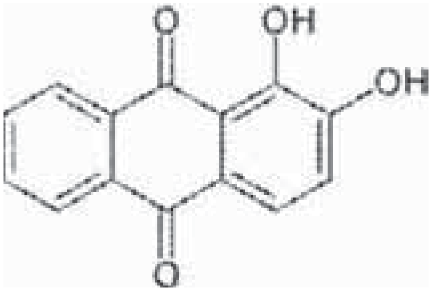

Figure 1.1: Alizarin, the colouring matter in Madder

Caesalpinia sappan is a species of flowering tree in the legume family, *Fabaceae,* that is native to Southeast Asia and the Malay archipelago. In India it is found along the Western Ghats and in Bihar. This plant has many uses. It possesses medicinal abilities as an antibacterial and for its anticoagulant properties. It also produces a valued type of reddish dye called brazilin, used for dyeing fabric as well as making red paints and inks. The coloring matter of sappanwood has been attributed to brazilin which is oxidized to brazilein to give a red colour. Brazilein is a red pigment and is also known as Natural Red 24. Besides brazilin, additional constituents include gallic and tannic acids.

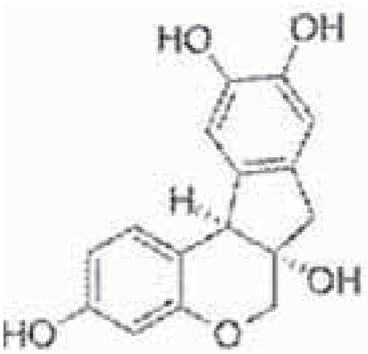

Figure 1.2: Brazilein, the colouring component in Sappanwood

Allium cepa L. that is Onions contain phenolics and flavonoids that have potential anti- cholesterol, anticancer and antioxidant properties. Besides the flavonoid quercetol, onion peels are also rich in tannins which parts good affinity to onion even without using a mordant. The pungent juice of onions has been used as a moth repellent and can be rubbed on the skin to prevent insect bites. Onion skins create a golden range of earthy colors. With a concentrated dye bath and enough time for the fibers to soak, the colors achieved are a combination of red and yellow, usually resting in the middle as an orange [4].

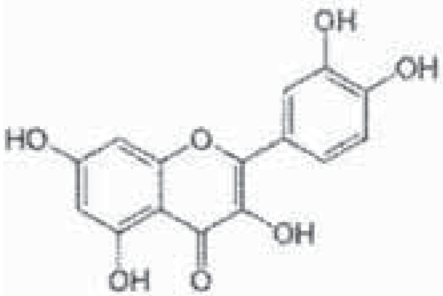

Figure 1.3: Quercetol, the colouring matter in Onion peels

2. Materials and Methods

2.1. Materials

Madder and Sappanwood were provided by Adiv pure natural in powder form. Onion peels were purchased from the local market. Cotton (120 GSM) was used as the substrate. Alum was used as the mordant and was of laboratory grade purchased from S.D Fine Chemicals Ltd.

2.2. Methods

2.2.1. Preparation of Mordant

A stock solution of alum (5%) was made by dissolving 5g of alum powder in 100ml solution.

2.2.2. Extraction of Dye

Madder and sappanwood stock solution (40%) of the dye was prepared by taking 80 g of dry dye powder in 200 ml water. This was boiled for 1hr. The extract was filtered, made up to 200ml and used by diluting to required concentration.

The onion peels were dried at 50^0C overnight. This was then grounded in a mixer to a fine powder. A stock solution (40%) was made by taking 80g of the dry powder in 200ml water. This was boiled for an hour. The extract was filtered, made up to 200ml and used.

2.2.3. Direct Style of Printing by Premordanting of fabric

The fabric was premordanted using 20% (owf) Alum. A stock solution of 5% was made by taking 5g alum

powder in 100ml solution. The mordanting of cotton fabric was carried out in rota dyer (Rota Dyer machine, Rossari® Labtech, Mumbai) keeping the liquor to material ratio of 30:1.The fabrics were introduced into the mordant solution at room temperature and slowly the temperature was raised to 80^{0}C. The mordanting was continued at this temperature for 60 min. After mordanting the fabric was squeezed and air dried.
A 40% dye stock solution was made. Required amount of dye solution was taken from the stock solution to get 100ml of 10% solution. To this solution 2g of guar gum was added slowly with constant stirring with the help of a stirrer to get coloured viscous paste. Fabric was then printed using this print paste and dried at 80°C for 5 mins followed by steaming at 100°C-105°C for 5 to 10 mins.

Similar steps for printing of 20% and 30% shade were also carried out.

2.2.4. Direct Style of Printing by Metamordanting of fabric
A 40% dye stock solution was made. Required amount of dye solution was taken from the stock solution to get 100ml of 10% solution. To this was added 20% (owf) alum powder. This was followed by addition of 2g guar gum slowly with constant stirring with the help of a stirrer. The print paste so prepared was used to print the fabric. The printed fabric was dried at 80^{0}C for 5 mins and steamed at 100°C-105°C for 5 to 10 mins.

Similarly, printing of 20% and 30% shade, was carried out.

3. Testing and Analysis

3.1. Colour value by reflectance method

The dyed samples were evaluated for the depth of colour by reflectance method using 10 degree observer. The absorbance of the dyed samples was measured on Rayscan Spectrascan 5100+ equipped with reflectance accessories. The K/S values were determined using expression;

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$

Where, R is the reflectance at complete opacity

K is the Absorption coefficient &
S is the Scattering coefficient

Dyed fabrics were simultaneously evaluated in terms of CIELAB colour space (L*, a* and b*) values using the Rayscan Spectrascan 5100+. In general, the higher the K/S value, the higher the depth of the colour on the fabric. L* corresponding to the brightness (100= white, 0= black), a* to the red-green coordinate (+ve= red, -ve =green) and b* to the yellow-blue coordinate (+ve =yellow, -ve =blue). As a whole, a combination of these entire enables one to understand the tonal variations.

3.2. Evaluation of Light Fastness

Printed fabric was tested for colour fastness to light according to ISO 105/B02. The light fastness was determined using artificial illumination with Xenon arc light source, Q-Sun Xenon Testing Chamber with black standard temperature =65^{0}C with relative humidity of the air in the testing chamber as 40% and daylight filter, wavelength, k= 420 nm. The samples were compared with the standard scale of blue wool reading (Ratings, 1-8, where 1 - poor, 2 - fair, 3 -moderate, 4 - good, 5 - better, 6 - very good, 7 - best and 8 - excellent).

3.3. Evaluation of Wash Fastness

Colour Fastness to washing of the printed samples was evaluated using ISO II method. A solution containing 5 g/L soap solution was used as the washing liquor. The samples were treated for 60 min at 50^{0}C using liquor to material ratio of 50:1 in rota machine. After rinsing and drying, the change in colour of the samples were evaluated on the respective standard scales (rating 1-5, where 1 - poor, 2 - fair, 3 - good, 4 - very good and 5 - excellent).

3.4. Evaluation of Rubbing Fastness

The printed fabric was tested for color fastness to dry and wet rubbing according to ISO 105-X12. Rubbing fastness was tested by using the Crock meter with 10 strokes of the finger. Standard temperature= 20^{0}C and relative humidity= 65%. The samples were then compared with grey scale for staining. (Rating 1-5, where 1 - poor, 2 - fair, 3 - good, 4 - very good and 5 - excellent).

3.5. Evaluation of Bending Length

Evaluation of stiffness of the printed fabric due to residual gum was evaluated according ASTM D1388-08(2012). The bending length was determined by using the Shirley Stiffness Tester at 20^{0}C with relative humidity= 65%.

4. Results and Discussion

In order to compare the effect of premordanting and metamordanting techniques, the cotton fabric was printed with natural dye extracts from madder, sappanwood and onion peels. The K/S values and L*, a* and b* values and their corresponding fastness properties were evaluated and they are summarized in Table 4.1. From Table 4.1 it can be seen that the K/S values increased with increase in dye concentration in the printing paste and they were maximum for 30% shade for all the dyes using both the techniques. This may be attributed to increase in dye concentration in the print paste which may be causing higher transfer of dye from the print paste to the fabric giving an increase in K/S.

While comparing the K/S values of the printed sample with two different techniques it was found that K/S of metamordanted samples was higher as compared to those obtained for premordanted sample for all the dyes. The K/S values will depend upon final fixation of colours on the printed fabric. Lower values in premordanted fabric may be due to lesser extent of dye mordant complex formation, since the dye was only in the printing paste. The extent this dye transfers from print to the interior of the fabric which contains mordant, dye will get fixed and this kind of mechanism will have limitation in formation of dye mordant complex, whereas in case of metamordanting, both dye and mordant are in the paste to form that complex and the whole complex is transferred during steaming.

Higher L* values relate to increase in brightness. Since the L* values were closer to 100 the brightness of the

Table 4.1: Direct Style of Printing on cotton by Premordanting and metamordanting technique.

Sr. No.	Shade (%)	K/S	L	a*	b*	Fastness Properties				Bending Length
						Light	Wash	Dry Rub	Wet Rub	
Madder										
1.	10	0.25 (0.41)	82.51 (78.31)	7.04 (10.99)	9.25 (12.82)	5 (5)	5 (5)	4 (4)	4 (4)	2.7 (2.4)
2.	20	0.61 (0.76)	83.36 (78.64)	10.05 (12.91)	11.41 (13.25)	5 (5)	4 (5)	4 (4)	4 (4)	2.8 (2.6)
3.	30	0.83 (1.22)	83.51 (78.10)	10.04 (15.33)	11.72 (12.90)	6 (4)	5 (4)	4 (5)	3 (4)	2.8 (2.5)
Sappanwood										
4.	10	0.45 (0.77)	75.04 (70.30)	17.80 (17.43)	5.09 (10.21)	2 (3)	5 (3)	3 (3)	2 (3)	3.1 (2.4)
5.	20	0.59 (1.36)	74.36 (70.73)	17.94 (20.94)	7.44 (8.75)	2 (3)	4 (3)	2 (3)	2 (2)	3.1 (2.5)
6.	30	1.62 (2.07)	75.84 (71.29)	22.87 (22.76)	5.87 (9.18)	3 (3)	3 (3)	2 (3)	2 (2)	3.2 (2.4)
Onion peels										
7.	10	1.64 (1.94)	78.17 (71.16)	-1.72 (-2.90)	33.61 (21.23)	7 (7)	4 (3)	4 (5)	4 (4)	2.7 (2.7)
8.	20	4.27 (5.09)	81.38 (80.08)	-2.87 (-1.64)	36.51 (35.27)	7 (7)	5 (4)	4 (5)	4 (4)	2.8 (2.8)
9.	30	4.59 (6.58)	81.00 (81.23)	-2.51 (-1.57)	36.26 (35.15)	7 (7)	4 (4)	4 (4)	3 (3)	3.1 (2.7)

* Values in () indicate for fabric printed with metamordanting technique
Bending length of controlled sample is =2.1

shades was very good. The a* values indicate redness or greenness and the b* value indicates yellowness or blueness. From Figure 4.4 for madder it can be seen that both the a* and b* values were positive indicating reddish-yellow shades using premordanting and metamordanting techniques. From Figure 4.5 for sappanwood both the a* and b* values were also positive indicating pinkish-yellow shades. From Figure 4.6 for Onion peels, however, the a* values are negative and the b* values are positive indicating greenish-yellow shades for the prints.

The light fastness properties of madder and onion are good to excellent which shows that the dyes are stable to photo degradation when alum was used as the mordant. Sappanwood gave poor light fastness properties indicating that the dye-mordant complex is photo degraded very easily. Madder and onion showed very good to excellent wash fastness to non-ionic soap with alum as the mordant. This shows that the dye-mordant fibre interaction is good. Sappanwood showed satisfactory wash fastness to non ionic soap. This shows that the dye fibre interaction is good. Madder and onion gave good wet and dry rubbing fastness when alum is used as the mordent. The dry rubbing fastness was slightly better than the wet rubbing fastness. This shows that majority of the dye is fixed well on the fibres and surface residual dye is minimal. Sappanwood gave poor wet and dry rubbing fastness when alum is used as the mordant. The wet rubbing fastness was poorer than the dry rubbing fastness. This shows that there was a residual dye. The printed samples showed slight increase in the bending length which shows that there was residual gum to a certain extent in the printed portion. But it is also seen that the bending length obtained by metamordanting was lesser than that of prints obtained using premordanting technique. It can be said that the fastness properties were dependent on the dye- mordant combination and not on the technique of printing used.

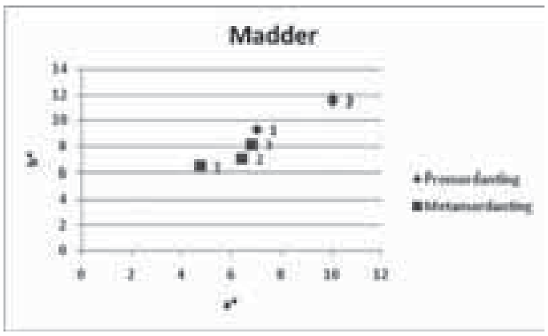

Figure 4.4: a* v/s b* plots for madder dye printed on cotton using Premordanting and Metamordanting technique.

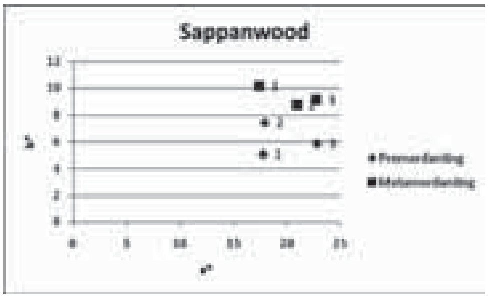

Figure 4.5: a* v/s b* plots for Sappanwood dye printed on cotton using Premordanting and Metamordanting technique

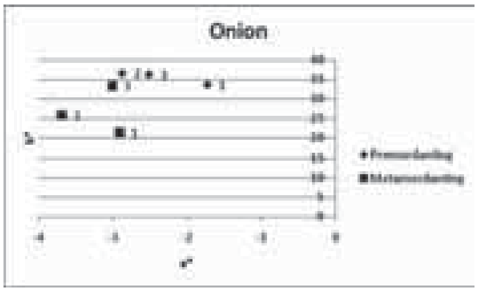

Figure 4.6: a* v/s b* plots for Onion Peels dye printed on cotton using Premordanting and Metamordanting technique

5. Conclusion

The processes of extraction of dye and printing are not very stringent and thus K/S values of the prints were found to increase with increase in dye concentration in the printing paste. The K/S values obtained by metamordanting were higher than those obtained by premordanting for all the three dyes studied. Also, the metamordanting technique gave more even prints than the premordanting technique. The fastness properties of the prints were not affected by the technique used and are dependent on the dye-mordant combination. Hence, the industrial implementation of natural dye printing using the direct style of printing is very much possible, giving all-round performance properties.

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Properties of Nettle-Acrylic Blended Yarn

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Abstract
Effect of blending nettle fiber (N) with acrylic fiber (A) on properties of yarn has been reported in this article. Nettle and acrylic fibres were blended in three different ratios viz., 70N/30A, 50N/50A and 30N/70A. For each blend ratio, yarns of two counts (16 Ne and 24 Ne) were prepared on ring spinning system inserting Z twist. The yarns were tested for various properties. Blending of nettle fiber with acrylic fibre made the processing easier on ring spinning system, improved yarn evenness, yarn strength, and reduced yarn hairiness.

Keywords
Blend ratio, Yarn evenness, Yarn hairiness, Yarn strength

1. Introduction

Stinging Nettle (*Urtica dioica*), locally known as Bichhu ghass, is a perennial plant found in temperate and tropical wasteland areas in Himalayan foot hills. People living in northern Himalayan foothills have used fiber from the wild-growing, stinging nettle plant to make garments, sacks, ropes and other utility items. They separate the fiber from the bark using primitive and inefficient methods that yield coarse, strong fiber. Village women then spin the fiber to yarn using hand spindles and weave cloth on back-strap looms. The end products are rough and rustic [1].

Special features of nettle fiber are eco-friendliness and sustainability, unique natural feel, thermal properties and excellent strength [2]. There is need to explore full potential of this fiber. Literature survey revealed that not much research work has been reported on nettle fiber. An attempt has been made in this study to utilize the nettle in blend with acrylic fibre. The present study was undertaken to find out effect of blending these two fibres of different origin on performance of yarns and fabric.

2. Materials and methods

2.1 Material

Nettle fibre was purchased in lap form from Uttarakhand Fiber and Bamboo Board, Uttarakhand. Acrylic fibre was purchased from Indian Acrylic Pvt. Ltd., Ludhiana.

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2.2 Method

Physical properties viz. fiber fineness (ASTM D-1577), diameter (IS: 744-1977), strength (ASTM D: 3822), length (IS: 10014) and crimp (ASTM D: 3937) of the fibres were tested. Table 2.1 shows properties of both the fibers.

Table 2.1: Properties of Nettle and Acrylic Fibers

Sr. No	Parameters	Nettle		Acrylic	
		Mean Values	C V (%)	Mean Values	C V (%)
1.	Fineness(denier)	16.25	43.28	1.81	22.08
2.	Diameter (microns)	68.57	38.20	15.58	26.60
3.	Tenacity (g/denier)	3.81	48.93	2.87	11.36
4.	Elongation at Break (%)	2.93	41.32	27.41	9.27
5.	Crimp (arcs/cm)	0.8	-	5.5	-
6.	Length(cm)	65.97	56.16	51.41	2.5

Blending and spinning of fibers was done at NITRA's Pilot Plant on ring spinning system. Nettle and acrylic fibers were blended in three different ratios viz.70/30,50/50,30/70 of nettle/acrylic. Yarns of two counts (16 Ne and 24 Ne) were prepared. 100% acrylic yarn was also prepared for base reference. Blend of 70N/30A in 24 Ne could not be produced because of lots of breakage in nettle fiber. Similarly pure nettle yarn could not be produced in 16Ne and 24Ne because of its stiffness and low pliability. Thus total eight yarn samples were prepared inserting Z twist. Various properties of yarns such as single yarn strength and elongation (IS: 1670), yarn evenness and hairiness (ASTM D- 1425) were measured.

3. Results and discussion

3.1 Yarn Strength

Table 3.1 shows that among 16 Ne yarns, tenacity of 70N/30A is lowest. As the percentage of acrylic fibre is increased from 30 to 70, tenacity of yarns also increases. A similar trend is observed in case of 24 Ne yarns.

Table 3.1: Strength characteristics of blended yarns

S. No.	Blend Ratio of Yarns	Parameters					
		Breaking Force (kg)	CV (%)	Elongation at Break (mm)	CV (%)	Tenacity (g/tex)	CV (%)
	16 Ne						
1.	70N /30A	245.6	17.9	4.37	28.9	7.35	17.9
2.	50N /50A	427.9	15.4	11.82	30.9	11.04	15.4
3.	30N/70A	505.7	8.1	17.13	10.8	11.68	8.1
4.	100 A	693.2	6.9	22.63	5.7	16.32	6.9
	24 Ne						
5.	50N /50A	230.2	26.5	10.62	26.5	9.61	26.5
6.	30N/70A	290.7	17.5	14.11	21.9	10.52	17.5
7.	100 A	735.9	7.7	23.41	6.2	14.69	7.7

100 % acrylic yarn exhibits highest strength with lowest coefficient of variation percent. On increasing the ratio of nettle fibre in blended yarn, coefficient of variation increases in 16 Ne as well as 24 Ne yarns. This indicates that the blended yarns are more variable.

It can be observed from Table 3.1 that maximum elongation is observed in 100 % acrylic yarn. Elongation at break decreases with increase in ratio of nettle fibre in blended yarns. This trend is found in both 16 Ne and 24 Ne yarns.

Results of yarn strength clearly indicates that elongation and tenacity values decrease with the increase in nettle fibre component in blends in spite of the fact that the strength of nettle fibre is more than acrylic fibre. This may be attributed to the fact that when two fibres are blended, the resultant strength is not the algebraic sum or average strength of the two component fibres. Low strength of blended yarn is mainly due to the difference in breaking elongation of constituent fibres [3]. Breaking elongation of nettle fibre is 2.87 % as compared to 23.41 % for acrylic fibre. When fibres having different elongation are blended together, the resulting yarn may be weaker than 100 % yarn of either fibre and have respectively less elongation as a result of unequal loading of the component fibres [4]. In blends fibres strength are additive only to the extent of the stress absorbed up to the limit of stretch of the lower elongation component.

Lower strength of blended yarns with more percentage of nettle is also affected by other factors. One factor is brittle nature of nettle fibre. Due to brittleness of fibre, 100 % 16 Ne and 24 Ne nettle yarns could not be procured. Another reason is that yarns with high percentage of nettle fibre are more uneven; higher number of imperfection also affected strength negatively. Thin places, whether in slivers, roving, or yarns, are weak places. The more irregular a strand is, the greater is the chance of a breakage [5].

It is also observed that 16 Ne yarns are stronger than 24 Ne yarns for each blend ratio. It may be attributed to the coarser count of 16 Ne yarns. 16 Ne yarns are coarser than 24 Ne yarns so there are more number of fibres in the cross section contributing towards higher strength in case of 16 Ne yarns. This may be supported by the statement of Klein that additional fibres in the cross section of a yarn of given thickness provide not only additional strength but also a better distribution in the yarn. Also 16 Ne yarns are more even than 24 Ne yarns. On the basis of results it can be said that blending of acrylic fibres enhances strength of nettle yarns [6].

ANOVA was applied to find out the effect of blend ratios and count on yarn strength. Effect of blend ratios on yarn strength was found to be significant at one percent level of significance. Effect of yarn count on yarn strength was also significant at 1 % level. Interaction between different counts and different blend ratio was found significant. Thus both the factors significantly affect the strength of yarn.

3.2 Yarn Unevenness and Imperfection

It is inferred from Table 3.2 that among 16 Ne yarns, maximum unevenness is recorded in 70N/30A blended yarn followed by the 50N/50A and 30N/70A yarns respectively in comparison to 100 % acrylic yarn. Imperfections have been measured in the form of thick places, thin places and neps. Maximum number of thick and thin places and neps per km are observed in 70N/30A yarn sample in comparison to the minimum number of imperfection observed in 100 % acrylic yarn. Higher percentage of unevenness in the yarn samples having more percentage of nettle fibers may be attributed to the higher number of imperfection found in these yarns. This is due to high variation in fineness and length of nettle fibre, a natural fibre.

Similar trend was observed in all the yarns of 24 count. High percentage of nettle fibre in blended yarns results in higher unevenness. Yarn of 50N/50A exhibits maximum unevenness with maximum number of thick places, thin places and neps as compared to minimum values in 100 % acrylic yarn.

Table 3.2: Unevenness and imperfections in blended yarns

Sr. No.	Blend Ratio	Unevenness (%)	Thick Places (+50 %)	Thin Places (- 50 %)	Neps (+ 200 %)
	16 Ne				
1.	70 N /30 A	18.17	595.0/km	630.5/km	2026/km
2.	50 N /50 A	14.72	224.0/km	250.0/km	728/km
3.	30 N /70 A	11.24	107.5/km	95.7/km	320/km
4.	100 A	9.26	10/km	2.5/km	28.0/km
	24 Ne				
5.	50 N /50 A	18.32	763.0/km	415.0/km	2094/km
6.	30 N /70 A	13.40	223/km	15.0/km	831/km
7.	100 A	10.03	7/km	1.5/km	25.0/km

As the percentage of acrylic fibres increases in the blends, yarn unevenness decreases. The main advantage of manmade fibres is the uniformity of length and fineness. This results in improved drafting, as the fibre movement is under better control [7]. As acrylic fibre content is increased in nettle/acrylic blend, the yarn irregularity goes down. The improvement in yarn evenness due to addition of manmade fibres is generally accompanied by a lower level of imperfections like neps, thick and thin places.

It is also evident that the yarns of 24 count exhibit higher percentage of unevenness for each blend ratio and more number of imperfections as compared to the yarns of 16 count. It may be attributed to the reason that when the count gets finer, yarn thickness decreases and small variations become more prominent.

There is almost unlimited source of variables which may contribute to the evenness of a textile yarn. The causes of yarn irregularity are properties of raw materials, inherent shortcomings in yarn making process and external causes due to working conditions and inefficient operation. With spun yarns a certain amount of irregularity is inevitable and the fabric produced from them will possess irregularity in appearance [8]. There was significant variation in unevenness percent of yarns of different blend ratios at 1% level of significance. Effect of yarn count on unevenness was also significant at 5% level of significance. Interaction between these two factors (yarn count and blend ratio) was found significant.

Table 3.3: Hairiness value of blended yarns

Sr. No.	Blend Ratio	Hairiness Value	CV (%)
	16 Ne		
1.	70 N /30 A	24.41	1.2
2.	50 N /50 A	15.49	0.9
3.	30 N /70 A	13.65	1.5
4.	100 A	11.0	0.5
	24 Ne		
5.	50 N /50 A	11.25	3.0
6.	30 N /70 A	10.62	1.4
7.	100 A	9.04	0.5

3.3 Yarn Hairiness

Table 3.3 shows that among 16 Ne blended yarns, maximum hairiness is observed in 70N/30A blended yarn sample and minimum in 30N/70A. Maximum coefficient of variation exists in 30N/70A yarn sample. In case of 24 Ne blended yarns, maximum hairiness is observed in 50N/50A yarn and minimum value is observed in the yarn sample of 30N/70A. Maximum coefficient of variation exists in 30N/70A yarn sample. Similar trend was found for this blend ratio in 16 Ne yarns.

100 % acrylic yarns of 16 and 24 count give lowest value of hairiness and coefficient of variation.

It can be said on the basis of results that hairiness value increases with the increasing percentage of nettle fibre in the blend ratios. It may be because of the reason that nettle fibres were coarse and in blended yarns coarser fibres migrate towards the periphery and fine fibres remain in the core. Long, fine fibres tend to move to the centre of a yarn, while coarse, shorter fibres migrate to the periphery of yarn [9].

For each blend ratio hairiness value is more for the yarn samples of 16 counts. It may be attributed to more number of fibres in the yarn cross section in 16 Ne yarns. With more fibres in yarn cross section there is tendency for the outward movement of the fibres during drafting at ring frame because of less control over fibres.

The hairiness is dependent upon the number of fibres present in cross- section. Coarser yarns have more hair as compared to finer yarns. It is generally accepted that the greater the number of fibres in the cross section for a given yarn count, the greater is the hairiness [10].

Another reason for more hairiness in 16 Ne yarns may be less number of turns per inch in these yarns as compared to 24 Ne yarns. The yarn hairiness is most strongly influenced by twist. Twist binds the constituent fibres together to make the yarn more compact. Hence more number of turn per inch may reduce the hairiness [11].

Effect of blend ratios and yarn count was found significant at one percent level on yarn hairiness in the blended yarn samples of 16 Ne and 24 Ne. Interaction between different counts and different blend ratio was found significant at five percent level. Both the factors significantly affected the yarn hairiness.

4. Conclusion

On the basis of the results, it can be concluded that blending of acrylic fiber with nettle significantly adds to the value of yarn. Acrylic fibre can be blended with nettle fiber to improve performance of yarn. Blended yarn can be used to prepare fabric for apparel items.

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Role of Textiles during Wound Healing

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Abstract
Wound healing is a natural biological process in the human body which is achieved through four highly systematic phases: inflammatory, migratory, proliferative and remodeling. For a wound to heal successfully, all four phases must occur in the proper sequence in proper time. Some factors can interfere with one or more stages of this process, thus causing improper or impaired wound healing. In the present study, an attempt has been made to summarize the various types of textile based wound dressings which are highly helpful during wound healing. A strong knowledge on these factors and type of wound dressings on repair may lead to improve wound healing.

Keywords
Inflammation, migration, proliferation, remodeling, wound dressings

1. Introduction

The wound-healing process consists of four phases like inflammatory, migratory, proliferative and remodeling. The functions of these stages must occur in the proper order, at right time, and continue for a specific duration at an optimal intensity (Figure 1.1). There are many factors that can affect wound healing which interfere with one or more phases in this process, thus causing improper or impaired tissue repair.

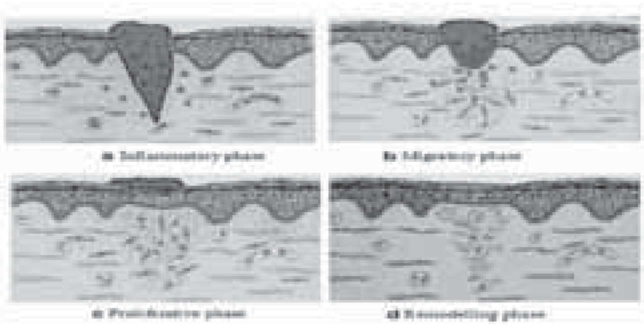

Figure 1.1: Normal Wound Healing Process [2]

1.1 The wound healing process

In adult humans, optimal wound healing involves the following events: (1) rapid hemostasis; (2) appropriate inflammation; (3) mesenchymal cell differentiation, proliferation, and migration to the wound site; (4) suitable angiogenesis; (5) prompt re-epithelialization (re-growth of epithelial tissue over the wound surface); and (6) proper synthesis, cross-linking, and alignment of collagen to provide strength to the healing tissue [1]. The first phase of hemostasis begins immediately after wounding, with vascular constriction and fibrin clot formation. The clot and surrounding wound tissue release pro-inflammatory cytokines and growth factors such as transforming growth factor (TGF)-, platelet-derived growth factor (PDGF), fibroblast growth factor (FGF), and epidermal growth factor (EGF). Once bleeding is controlled, inflammatory cells migrate into the wound (chemotaxis) and promote the inflammatory phase, which is characterized by the sequential infiltration of neutrophils, macrophages, and lymphocytes [2, 3]. A critical function of neutrophils is the clearance of invading microbes and cellular debris in the wound area, although these cells also produce substances such as proteases and reactive oxygen species (ROS), which cause some additional bystander damage.

The proliferative phase generally follows and overlaps with the inflammatory phase, and is characterized by epithelial proliferation and migration over the provisional matrix within the wound (re-epithelialization). In the reparative dermis, fibroblasts and endothelial cells are the most prominent cell types present and support capillary growth, collagen formation, and the formation of granulation tissue at the site of injury. Within the wound bed, fibroblasts produce collagen as well as glycosaminoglycans and proteoglycans, which are major components of the extracellular matrix (ECM). Following robust proliferation and ECM synthesis, wound healing enters the final remodeling phase, which can

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last for years. In this phase, regression of many of the newly formed capillaries occurs, so that vascular density of the wound returns to normal. One critical feature of the remodeling phase is ECM remodeling to an architecture that approaches that of the normal tissue. The wound also undergoes physical contraction throughout the entire wound-healing process, which is believed to be mediated by contractile fibroblasts (myofibroblasts) that appear in the wound [1, 3].

1.2 Factors affecting wound healing

Multiple factors can lead to impaired wound healing. In general terms, the factors that influence repair can be categorized into local and systemic. Local factors are those that directly influence the characteristics of the wound itself, while systemic factors are the overall health or disease state of the individual that affect his or her ability to heal. Many of these factors are related, and the systemic factors act through the local effects affecting wound healing.

2 Textile based wound dressings

The use of textiles in medicine has a long tradition. An important field of application is wound care and prevention of chronic wounds, in particular pressure sores. Among the long list of textile materials, bandages and wound dressings gained great popularity. The use of textile materials was supported by availability, prices and re-usability. Woven textiles are mostly used. Despite the fact that traditional textiles fulfilled primary quality approaches like biocompatibility, flexibility, strength, etc. there is an increasing need for specified functions. Along with the technological development of functional textiles, their use in wound healing and prevention of chronic wounds has reached a new quality of interactivity between biological tissues and textiles [4].

2.1 Application of spacer fabrics for wound healing

Spacer fabrics are interesting textile technological solutions for a medical condition. The basic principle is a combination of textile sheets with distance fibres. An overview of fibres used is given in Table 2.1 and Figure 2.1.

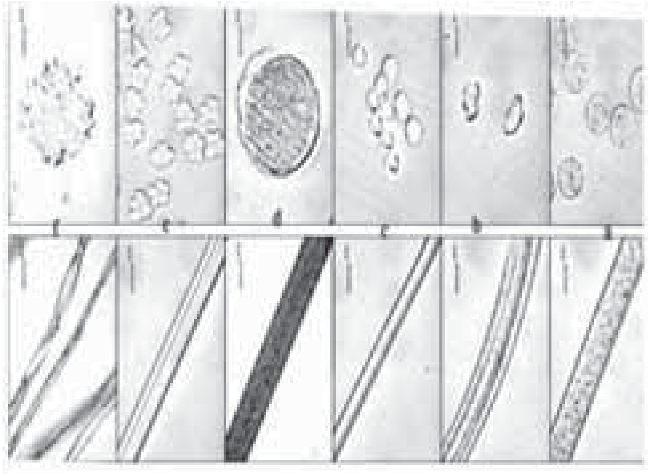

Figure 2.1: Microscopy of synthetic and cellulosic fibre both interms of longitudinal and cross section: a) PA multifil, b) cool max, c) PES multifil, d) PES monofil, e) viscose, f) cotton [5].

Monofilar polyester fibres have a marked stiffness providing a higher pressure resistance of the spacer fabric. Monofils, however, are not suitable to encourage a directed fluid transport in contrast to capillary fibres composed of single fibres and fixed by heat. The higher the fixation temperature, the higher the crystallinity of filaments is. Surface modification as in profiled Coolmax® fibres supports the fluid transport. By optimization of materials and technologies a directed transport of fluids and heat becomes possible. Constructions of synthetic fibres with cellulosic fibres, combinations of synthetic fibres and different densities of fibre con-

Table 2.1: Some property of natural and synthetic fibres used for spacer [5]

Fibre	Fibre type	Density (g/cm3)	Elasticity % Dry/wet	Specific electric resistance, W /cm	Melting point, ^{0}C	Water sorption (mass percentage)	Water holding, %
Polyamide 6	Filaments	1.14	20-45/105-125	109-1011	215-220	3.5-4.5	10-15
Polyamide 6,6	Filaments	1.14	20-40/105-125	109-1011	255-260	3.5-4.5	10-15
Polyester	Filaments	1.36-1.41	20-30/100-105	1011-1014	250-260	0.2-0.5	3-5
Viscose	Filaments	1.52	10-30/100-130	106-107	---------	12-14	85-120
Cotton	Fibres	1.52-1.55	20-50/100-120	Low	---------	7-18	42-53

nections with the textile sheets have been used to ensure a directed fluid transport [5] (Figure 2.1). Another important property of spacer fabrics is pressure resistance which is dependent on pol-fibre material, pol-fibre angle and stitch density. The mechanical and microclimatological qualities (Table 2.1) ensure their use for medical textiles such as compression bandages, supports for beds and the operation theater to ensure decubitus prophylaxis [6,7]. Spacer fabrics based bandages have been used in a clinical trial for patients with lymphedema of the leg. In primary lymphedema the mean microlymphatic pressure is raised from 7.9 mm Hg (healthy controls) to 15.0 mm Hg. Thereby the microlymphatic pressure reaches the range of the interstitial pressure. The lymphatic flux becomes inhibited [8]. An analogous mechanism develops in secondary lymphedema, e.g. in combination with chronic venous insufficiency or after lymph node dissection and/or radiation. Physical treatment with lymphatic massage and special compression bandaging is a cornerstone of modern therapy. Spacer fabric-based compression bandages have been shown to be as effective as classical bandaging but much more comfortable, since there is the need of only one layer bandaging. By microclimatic quality of spacer fabrics, sweating and overheating of skin is prevented [9]. The same principle can be used to decrease pressure peaks in bed coverings, for shoes, textiles for the operation table or wheel chairs [10]. Spacer fabrics have also been employed in biosurgery as carriers of living maggots used for wound debridement and stimulation of healing.

2.2 Embroidery Technology for wound care application

Advanced composite materials are reinforced by textile performs for primary structural applications. The close control over fibre architecture offered by embroidery is of potential interest for highly loaded structures, enabling fibres to be placed in the position and with orientations necessary to optimize strength and stiffness locally. Hernia patches, implants for inter vertebral disc repair and a graft stent for the repair of aortic aneurysm have been designed [11]. Karamuk et al. [12] developed a textile wound dressing based upon this technique. The embroidered textile has a three-dimensional architecture that combines different kinds of pores and holes for directed angiogenesis with stiff elements for a local mechanical stimulation of the wound bed. First clinical trials focused on the treatment of pressure sores and venous leg ulcers.

2.3 Absorbing textile material for wound management

Incontinence is a major problem in small children and elderly people. The avoidance of skin irritation by enzymes in feces and urine is mandatory in pressure sore and napkin dermatitis prophylaxis [13, 14]. The fluid-handling capacity of incontinence devices is realized by introduction of super absorber. The textile surface of these devices, however, is also of importance for comfort and prevention of mechanical irritation. A smooth surface is better to avoid irritation. Technically the most important compound for the production of super absorbers is acrylic acid. The monomer acrylic acid is

Table 2.2: Microclimate parameters of spacer fabrics [6]

Parameters	Spacer fabric with liquid transporting system (Polyester filament with one sided cotton sheath)	Spacer fabric without liquid transporting system (100% synthetic fibre)
Water steam diffusion resistance, m^2. Pa/W	8.0-10.2	11.2-12.1
Fluid sorption %	197.5-292	0.4-64.2
Buffer effect from the steam phase (Buffer score Feuchteausgleichskennzahl Fd')	0.36-0.47	0.25-0.36
Buffer effect from the liquid phase (Buffer score Pufferkennzahl Kf')	0.89-0.99	0.73-0.75
Liquid permeability, g/m^2. h mbar	16.3-17.8	10.7-13.5
Water sorption, µg/$(mm)^3$	7.0-8.9	5.6-7.1
Heat Capacity, (W/S)/ (m^2.K^b)	40-50	34-37

polymerized with the support of compounds like triallylamine. Co-polymerization allows the coating of cellulosic fibres like viscose or lyocell [15]. Such products are used for napkins and other hygienic devices. For both fields of application voluminous nonwovens are a significant supplement and a functional improvement (Figure. 2.2). By application of the compound methods, multilayer products can be produced in which several layers fulfill different functions. The monolayers were created by several techniques, such as stitch bonding and needle punching (Kunit, Malivlies, needlevlies). The assembly of the monolayers was realized by multiknit or Kunit layer compound procedures (KSB) [16, 17]. Soaking pads of modified nonwoven voluminous material with knitted fibres have been developed and used successfully for acute (split skin donor sites) and chronic (leg ulcers) wounds. In the field of pressure, sore prophylaxis special devices such as covers are under investigation.

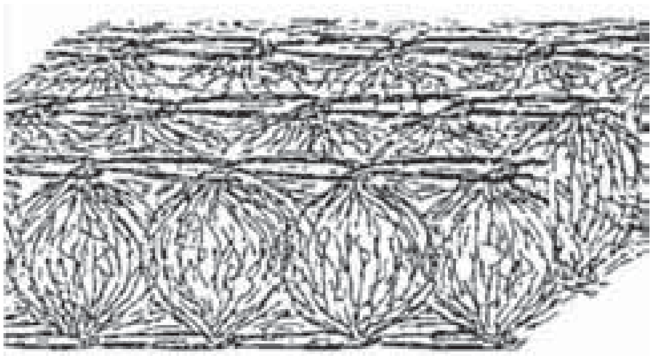

Figure 2.2: Modified nonwoven with mixed knitted fibres for absorbing pads [16]

2.4 Antibacterial textiles for wound healing

Textiles are carriers of bacteria and fungi. Controlling bacterial or fungal growth on fabric can be achieved by (a) finishing using resins to fix the antibacterial/ antifungal agents to the textile surface or (b) grafting antimicrobials/ antifungal agents on the cellulosic chain, i.e. viscose, lyocell etc. Antibacterial activity is closely related to soil-repellent and soil-release qualities of textiles. Recently, Kawoll®, a homogenous mixture of kapok hollow fibres and wool fibres, has been applied for bed covers. It has a positive effect on microclimate by moisture-absorbing capacity and an unusually high content of air. The kapok fibre also shows antimicrobial activity [18]. The most important criteria for the selection of additives are (a) their extremely low solubility in water, alkali and acid, (b) their chemical stability against strong acids, bases, and oxidants, and (c) their thermal stability. Additives should have no negative influences on the spinning process and fibre properties. They must have a migration capability from the fibre interior to its surface and should have excellent toxicological and environmental properties. Antibacterial activity of small ions like silver, zinc, copper and quaternary ammonium compounds is well documented. Silver impregnated textiles are used as wound dressings for infected wounds or wounds at high risk of infection. Whereas linkages between biocidal moieties and cellulose are covalently formed on reactive hydroxyl groups, polyamides, polypropylene and polyester lack such reactive sites. Quaternary ammonium salts have a positively charged nitrogen ion that can interact with the negatively charged groups of anionic dyes. These intermolecular interactions inside fibres serve as binding forces to enhance the durability of the biocidal agents once attached. Dye molecules can be used as bridges to bind functional antimicrobial groups to chemically stable synthetic polymers. Quantitative antimicrobial evaluations of treated fabrics reveal that there are significant reductions in bacterial load on surface contact [19].

Ofloxacin, penicillin and other antibiotics have been applied to polyester grafts. A collagen coating was used for binding chloramphenicol and rifampicin. A fibrin sealant was employed to bind gentamycin. More recently, ciprofloxacin and ofloxacin were used unmodified as dyes for polyester fibres. Pad heating was employed as well. The best results were obtained with pad heating of a mixture of both antibiotics [20]. Another technique is the use of antibacterial agents in the spinning process of viscose fibres. Modal fibres are obtained by adding the antibacterial agent to the spinning dope. The viscose is pressed through the holes of the spinnerets into the generation bath where filaments are formed and drawn off at high speed. By the incorporation technique a homogenous distribution of the additive within the cellulose matrix of the fibre can be achieved. The hydrophilic and porous structure of the fibre enhances the diffusion of the agent onto the surface. This is also supported by a humid environment (i.e. due to sweating) [21]. The use of small molecules to prepare textiles is of hygienic interest, i.e. impregnation of towels, bed covers, underwear, etc. [22, 23]. In addition, antimicrobial activity can also reduce odor, which is of interest for wound dressing in the treatment of chronic wounds as well as for clothes [24]. Halamine-modified cotton has been used for protection textiles in workers exposed to pesticides. Halamine-modified cotton is also capable of suppressing a great variety of microorganisms including *Staphylococcus* *aureus*, a leading cause of infections in hospitals, or Salmonella species. Since body odors largely depend on the skin flora, halamine modified cotton may also be used for odor control [25].

2.5 Barrier Textile Materials

Barrier textiles are necessary in cases of high risk of contamination by infectious or toxic material. They are widely used in the operation theatre not only to protect the staff but the patient as well. Barrier textiles are of major importance in the hygienic regimen of surgical procedures and to prevent infections in the hospital. Table 2.3 provides a summary of basic properties of barrier textiles.

Table 2.3: Basic textile properties for barrier materials [26]

Parameters	Influence	Parameters	Influence
Abrasion resistance	Good	Trapezoidal tear resistance	Good
Blocking resistance	Good	Resistance to permeation by liquids	Good
Flex cracking resistance	Good	Resistance to penetration by particles	Good
Puncture resistance	Excellent	Resistace to ignition	Excellent
Tensile strength	Excellent	Seam strength	Excellent
Burst resistance	Excellent	suit	Excellent

The protective function is obtained by the construction of fabric and product which shield the user from fine particulate matter or liquids. A basic quality of these textiles is the filtration of medically relevant media, like blood, sweat, urine, etc. Medical laminates are used for such purposes, which are composed of porous membranes, tissues and absorber. The fluid exchange is limited by capillary flow. Microfibre textiles were found suitable for re-usable protecting clothes [26, 27]. A critical structure is the seam area. Lapped seams provide a better barrier function, but other techniques such as polyurethane adhesives provide improved qualities. For medical applications like surgical gowns, sheets or mattress covers, polyurethane adhesives or hot melts have been used in different laminated materials. Chemical resistance, resistance against body fluids, laundry and sterilization are some of the demands for adhesives in this field [28]. Encasings are a special application of barrier systems for mattress and pillow covers. The barrier must be equally effective for airborne particles as well as mechanically transported particles. Again the seam areas and the fastening parts are critical in this respect. Since barrier retention capacity and particle transport are determined by the electrostatic behavior of the complex system 'bed', the electrostatic properties of the encasings and their wash-dependent variability have to be taken into account when considering barrier effects [29]. The most protective materials are the nonporous membranes. However, in practice a compromise has to be made between barrier function and comfort [30]. Another problem of conventional textiles in the operation theatre is the particle release, especially in the case of re-usable woven textiles for abdominal surgery. Knitted cotton dramatically diminishes particle release even after repeated washing-drying and disinfection cycles [31].

2.6 Textile-based smart wound dressings

Wound dressings can have number of purposes, depending on the type, severity and position of wound. But all the purposes are focused towards promoting recovery and preventing further harm from the wound. Latest developed dressings include gauzes, films, gels, foams, hydrocolloids, alginates, hydrogels and polysaccharide pastes, granules and beads. Textile materials includes fibres, filaments, yarns, woven, knitted, nonwoven materials and something made from natural and man-made materials as well as products developed from such materials [32]. In spite of known natural and man-made fibres, some fibres manufactured from naturally available polymers like alginate, proteins, polyglycolic acid, regenerated cellulose, chitin, chitosan, hyaluronan etc. Some non fibrous materials like carbon and metals such as silver are also used [32]. A number of dressings like hydrocolloids, alginates and hydrogels along with supporting textile materials are now available in the market [33]. These coated textile materials have been engineered to have specific properties like good strength, flexibility and air as well as moisture permeability for their use as smart wound dressings [33].

2.6.1 Hydrocolloids

Hydrocolloids form a set of dressings, which heals the wound by providing occlusion. It is usually a multilayered structure, which consists of an outer layer to provide protection and a supporting material, which may be present in the form of film, foam or fibre. The typical supporting materials used in hydrocolloid dressings are nonwoven polyester fibres and semi permeable polyurethane films while the hydrophilic component of the adhesive may contain several components such as synthetic polymers including polyurethane gels, gelatin protein and cellulose derivative polysaccharides. These hydrocolloid dressings physically interact with the wound exudates and forms hydrated gel over the wound surface and the gel gets separated during dressing removal avoiding damage to the newly formed skin [33, 34].

2.6.2 Alginates

Alginates are block copolymers of two hexuronic acid residues with exclusively glycosidic linkages [34]. These alginate based wound dressings are tremendously gaining attention as wound management aids. These are capable of forming gels. The calcium alginate fibre of the dressings when comes in contact with the fluid, it gets partially converted to water soluble sodium alginate that swells to form calcium-sodium alginate gel around the wound. This helps in keeping the wound moist, which ultimately leads to better healing of the wound [34, 35].

2.6.3 Hydrogels

It has been reported that, [35, 36] crosslinked 2-hydroxyethyl methacrylate (HEMA) hydrogels which has hydrophilic character and potential to be biocompatible has been of great interest towards biomaterial applications [37, 38]. Hydrogels are defined as two component systems, where one of the components is a hydrophilic polymer, insoluble in water because of three dimensional network, and the second one is water. These systems may swell in water up to an equilibrium state and retain their original shape, thus provide a moist environment needed for an ideal dressing [38, 39].

2.7 Chitosan Coated Textiles as Wound Dressings

Chitin (one type of chitosan) is a valuable natural polymer indicating excellent bioactive properties [32]. Chitin products are anti-bacterial, anti-viral, anti-fungal, non-toxic and non-allergic. Three dimensional chitin fibre products with qualities such as soft handle, breathability, absorbency, smoothness and nonchemical additives are found to be the ideal dressings with wound healing properties [40]. Along with above properties, chitosan have many useful and advantageous biological properties in the applications as a wound dressing, such as biocompatibility, biodegradability, hemostatic activity, anti-infectional activity and property to accelerate wound healing [40, 41].

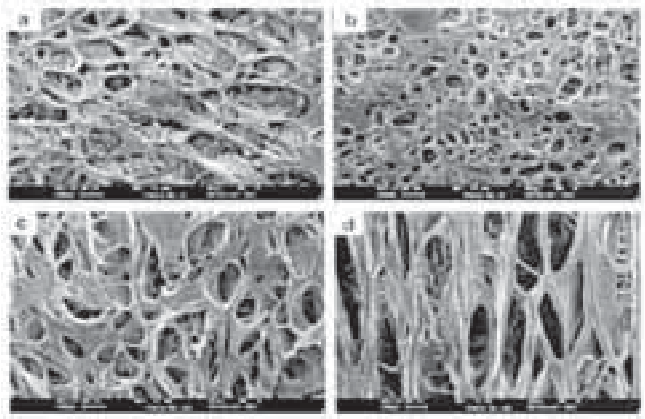

Figure 2.3: SEM image of chitosan coated cotton fabric at various chitosan thickness a) 0.25 mm, b) 0.5 mm, c) 0.75 mm and d) 1.00mm. (magnification X 80) [40]

In one of the studies, cotton fabric was coated with chitosan and polyethylene glycol. The scanning electron microscopy (SEM) (Figure 2.3) of the coated fabric revealed a porous structure. The porosity of the material was 54-70 % and the pore size was in the range of 75-120 μm [40, 42].

3. Conclusion

Wound healing is a complex biological process that consists of hemostasis, inflammation, proliferation, and remodeling. Large numbers of cell types-including neutrophils, macrophages, lymphocytes, keratinocytes, fibroblasts, and endothelial cells-are involved in this process. Multiple factors can cause impaired wound healing by affecting one or more phases of the process and are categorized into local and systemic factors. The influences of these factors are not mutually exclusive. Single or multiple factors may play a role in any one or more individual phases, contributing to the overall outcome of the healing process. Textile materials and biomaterials for the last few decades have been found to generate considerable interest in the biomedical textile field covering the area of wound dressings. Biopolymers along with textile materials are versatile candidates in the area of wound dressings. These provide all the specifications required for an ideal wound dressings.

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Influence of Properties of Back-Up Fabrics on Properties of Synthetic Leather

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Abstract
There has been a large use of leather from footwear, clothing, leather bags to articles of warfare since very olden times. Primitively natural leather i.e. the skin of the animals was used which is now replaced by artificial leather due to various reasons like cost effectiveness, durability, etc. Artificial leather is a man-made fabric that looks and feels like real leather and is also known as synthetic leather. It is less expensive as compared to real leather. In this study we have used different varieties of fabrics such as 100% cotton (C), 100% polyester (P), 100% nylon, 100% polypropylene, polyester-viscose (PV) blend, 100% viscose (V), PC blend, and different types of non-woven such as spun bonded, spun laced etc. as back up cloths to produce cost effective leather without affecting the quality. The samples produced are of different GSM, different reed/pick, different warp and weft count, which will help us to differentiate between properties of uncoated and coated fabrics. The effect of polyurethane and DMF on different varieties of fabrics has also been studied. On comparing coated woven and coated nonwoven fabrics, polypropylene fabrics appear to be the best one, both aesthetically (samples were rated on the basis of their resemblance to natural leather as one of the important parameter) as well as on the basis of physical properties.

Keywords
Natural Leather, Synthetic Leather, Back up cloths, Coated fabrics, Cost effective.

1. Introduction

Natural leather is nothing but the skin of the animals such as kangaroo, deer, ostrich, crocodile, snake, dog, alligator, etc.

Natural leather is not cheap, it costs anywhere from $250-$500 per hide. Because of its tiny pores, it breathes, making it cooler to sit on than on polymeric leather. It ages beautifully but scratches and stains easily and it is tricky to clean. It cannot withstand extensive heat. It is not available easily as it needs an animal hide, the tanning of which is prohibited in certain countries.

Therefore people have moved on to manufacture artificial leather which is a man-made fabric that looks and feels like real leather. Also it is less expensive as compared to real leather [1]. It can be dyed to a variety of colours, is durable, stain resistant and can be created to look like any type of leather desired. But good quality leather costs high.

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Synthetic leather is often found as a covering material on massage chairs, car seats, and handbags. Synthetic leather is not the plastic looking, tacky material that it was in the past. Today's synthetic leather is made much better than the early versions. Synthetic leather is realistic and used in many different products that once used only real leather. Robotic massage chairs are a popular item that uses synthetic leather since the properties of synthetic leather actually enhance the performance of the chair. Many products, just not massage chairs, are now offered in synthetic leather and consumers love this new trend.

There are a range of different types of synthetic leather. The type of synthetic leather is usually defined by what materials the leather is made of [2]. The most common type of synthetic leather is pleather. Pleather or plastic leather, is made from plastic. It is very light weight, comes in a range of styles and textures and is easy to clean. Many of the pleather materials on the market are soft and have the feel of real leather.
Poromeric imitation leather is usually a polyester base covered in a plastic coating that is made to resemble leather. It is very durable and easy to clean. It is often criticized for being too stiff, though, and today in mainly used in the making of shoes. Leatherette is made using a cloth base with a PVC cover layer. It is used in

many different products. It is almost maintenance free and will never crack or fade. Some other common types of artificial leather include those made of plant materials, such as vegan leather, blended materials made of acrylic and fiber blends and vinyl or PVC artificial leather.

Most upholstery leather is tanned using the chrome tanning method. The hides are rotated for eight hours in a drum of trivalent chrome. Then, the chrome is locked into the leather by adding bicarbonate. This "tanned" leather is now wrung out, split into sheets of varying thickness, and then put through a shaving machine. They go back into those drums to be dyed and are then treated with a combination of synthetic fatty type chemicals and natural fat, to make them soft.

Pleather is made by taking the same components that are found in PVC pipes, stretching them very thin, and then applying a strong woven backing to the sheets. It is stain resistant, strong and with the new innovations coming out every year, has shed its reputation as a poor substitute for leather. It is substantially cheaper to buy, running from $35-$100 a yard.

After studying the above mentioned background, we had carried out a project in which different varieties of fabrics such as 100% cotton, 100% polyester, 100% nylon, 100% polypropylene, PV blend, 100% viscose, PC blend were used. Also, different types of non-woven such as spun bonded, spun laced etc. had been used to produce cost effective leather without affecting the quality.

All the samples were of different GSM, different reed/pick, different warp and weft count. This had helped us to differentiate between properties of uncoated and coated fabrics. The effect of polyurethane and DMF on different varieties of fabrics has also been studied.

2 Materials and methods

2.1 Recipe for Coating

PU chips

The ratio of polyurethane chips and DMF solution used is 1:3. The recipe is prepared by w/w.

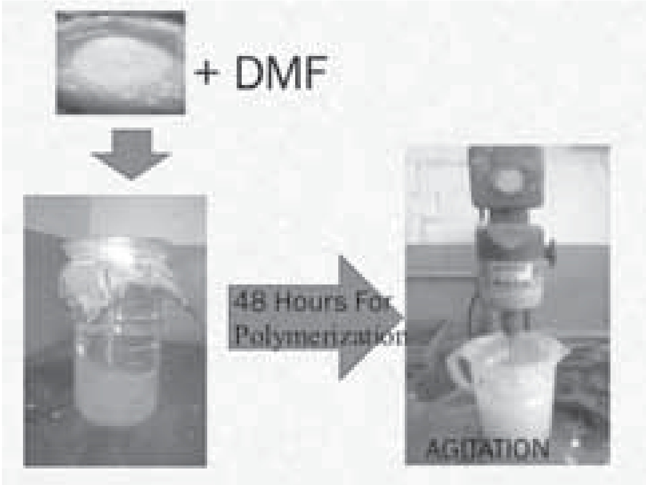


Figure 2.2: Preparation the Coating Material

The solution is prepared in an air tight glass container and kept for 48 hours for polymerization at room temperature. After 48 hours, the mixture is thoroughly ted with the help of grinder till required viscosity is obtained.

Epoxy based coating

Raw material: paint based polyurethane and hardener

Coating solution is not prepared at less than 27^0C

Drying time at 30^0C: 1) Touch dry = 15-25 minutes.

2) Hard dry = 24 hours.

3) Full care = 7 days.

Shelf life: 6 months (individual component) in sealed condition.

Mixing ratio: By volume = Base : hardener

3 : 1

Application method: Brush/Spray.

Compatibility: it can be top coated on Epoxy primers.

2.2 Manufacturing of Synthetic Leather

In this process, a PU sheet is formed and then laminated onto the base cloth. This is done by coating release paper with a layer of a mixture containing MEK, EA solvents and PU resin. The paper is dried in an oven at 100?. It is then recoated with the same substance and again dried in an oven at 110-140?. This sheet of PU is then laminated onto the base cloth. At this point the paper on which the PU was formed is released. The release paper may be used up to 10 times. It should none the less be inspected for scratches each time it is used. This product is highly valued in the garment, shoe and luggage industries since the feel and even the smell are much closer to genuine leather.

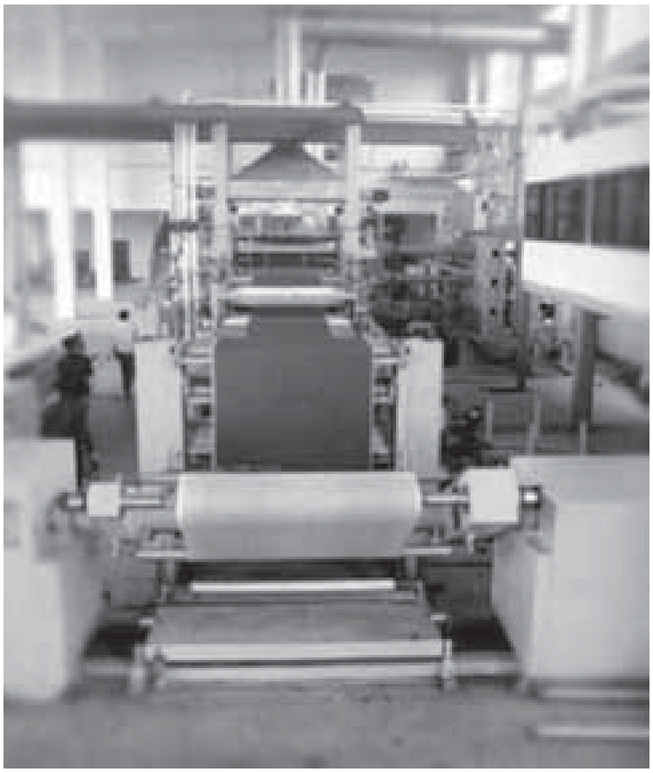


Figure 2.1: Coating Process

2.3 Varieties of Back-Up Fabrics Used

A coated fabric combines the benefits of the base fabric with those of the polymer with which it is coated. The resulting coated fabric will have many properties which cannot be offered by either component individually, and careful consideration is necessary to select both base fabric and coating polymer. The base fabric provides the mechanical strength of the composite material and supports the layer of coating applied to it. For good quality coated fabrics, quality base fabrics are essential. This point is made because newcomers to the industry sometimes believe that the coating can cover fabric defects, and so second quality fabrics may be sent for coating. In fact, the defect is frequently made more prominent and the cost of rejected coated fabric, with the added value of coating, will be significantly higher than that of the base fabric alone. The fabrics that have been used as back-up fabrics in the manufacturing of synthetic leather are shown below:

1) Woven Fabrics
   - a) Natural- cotton
   - b) Regenerated- viscose
   - c) Synthetic- polyester, nylon
   - d) Blends- P/C blend, P/V blend
2) Non-woven Fabrics
   - a) Regenerated- viscose
   - b) Synthetic- polypropylene

2.4 Coating Process

A dry, smooth fabric is fed over the flat bed under a knife. The coating material is poured in front of the knife by a trough over the entire width of the fabric. As the knife is transported over the fabric, the forward motion of the knife and the knife barrier gives the viscous mass of the material a rotary motion. Special care is taken that the material has adequate viscosity so that it does not strike through the fabric. The coated fabric then put in drying oven. The rate of evaporation of the solvent determines the rate of transport of the fabric, and thus, the coating rate. The coating thickness is mainly controlled by the gap between the knife and the fabric.

For imparting a good and even coat onto the fabric following points are to be followed,

- Use of oil free, wax free and desized fabric is recommended. This will improve the process of coating.
- Proper technique of heat setting should be used when highly flammable solvent is used.
- Fabric should always be kept in floating condition during coating process to avoid sticking.
- Viscosity of coating material depends on ratio of the solvent and polyurethane used. In case, viscosity of solution needs to be decreased, it should be done after polymerization which takes place after 48 hours.
- In case if luster is required, thermal heating should be given to the coated fabrics.

3. Results and Discussion

Table 3.1: Details of Woven Fabrics

Sample code	Type of fabric
S1	100% Cotton
S2	100% Cotton
S3	100% Cotton
S4	Bleached 100% Cotton
S5	Bleached 100% Cotton
S6	PC Blend (67/33)
S7	100% Polyester
S8	100% Polyester
S9	100% Nylon
S10	100% Nylon
S11	PC (67/33)
S12	PC (67/33)
S13	Polypropylene
S14	100% Nylon
S15	100% Polyester
S16	100% Viscose
S17	100% Viscose
S18	100% Viscose
S19	PV Blend
S20	PV Blend
S21	PV Blend

Table 3.2: Details of Nonwoven Fabrics

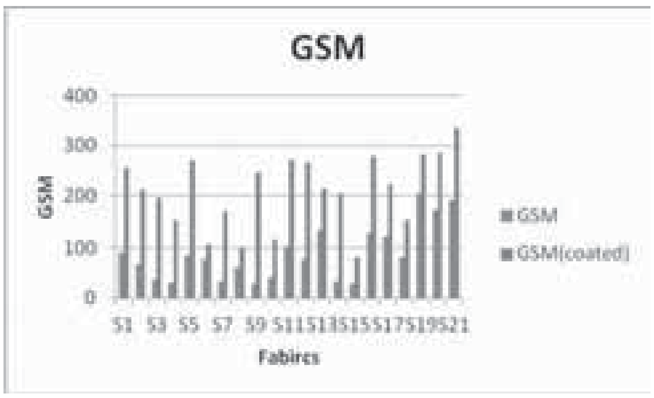
S22	PV Blend
S23	PV Blend
S24	Polypropylene
S25	Polypropylene
S26	Polypropylene
S27	Polypropylene
S28	Polypropylene
S29	100% Polyester
S30	100% Viscose
S31	100% Viscose

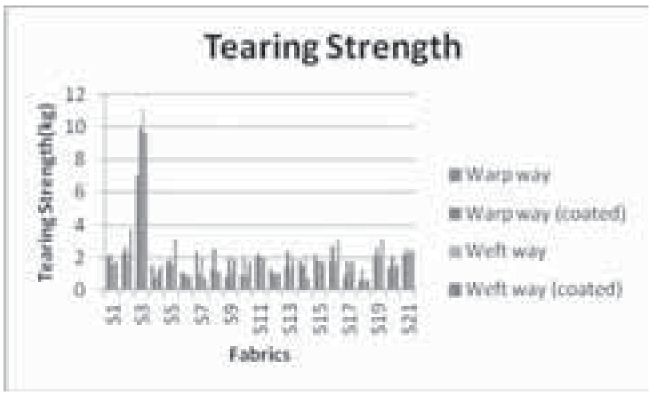
Table 3.3: Properties of Woven Fabrics

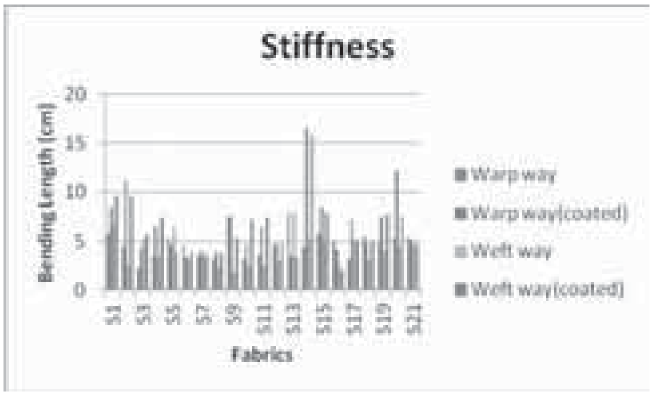
Test Fabrics	GSM	Warp count (Ne)	Weft count (Ne)	Drape Coefficient	Stiffness Bending length(cm)		Tearing strength (kgf)		Tensile strength (kgf)	
					Warp way	Weft way	Warp way	Weft way	Warp way	Weft way
S1	91.28	15	18	0.34	5.8	6.7	2.08	1.6	157.3	112.7
S2	67.63	28	28	0.54	4.5	2.6	2.2	2.3	119.2	12.38
S3	37.55	36	28	0.32	2.3	5.2	7.04	11.2	81.22	74.06
S4	30	40	32	0.44	3.5	3.4	1.52	1.12	104.4	89.1
S5	84.98	30	20	0.66	5.4	6.5	1.76	1.63	148.8	120.7
S6	76.06	46	40	0.40	4.5	3.2	1.12	0.89	195.5	181.8
S7	31.60	55	60	0.38	3.5	3.3	2.43	2.04	24.8	18.6
S8	61.49	76	60	0.19	3.2	2.3	1.28	1.15	27.83	27
S9	28	21	70	0.88	7.5	1.85	0.89	1.08	20.5	24.4
S10	40	100	132	0.33	3.2	2.5	0.91	0.95	21.0	20
S11	102.1	24	20	0.24	3.6	2.6	1.98	1.98	256	176
S12	77.63	46	44	0.40	4.6	3	1.31	0.96	43.33	24
S13	136	28	28	0.33	8	8	1.44	1.40	152	150
S14	32	81.76	265.7	1	4.4	5.3	1.85	2.24	14.5	35.83
S15	28	120.7	100.2	0.041	5.8	4.8	2.24	1.78	16.67	14
S16	129	64	60	0.30	5.1	2.8	1.79	1.79	45.5	46
S17	123	40	40	0.30	3.2	5.3	0.86	1.12	38.16	40.33
S18	80.29	60	60	0.15	5.5	3.1	0.64	0.64	26.33	23.17
S19	203.6	20	20	0.33	4.9	4.0	2.08	2.08	114.6	96
S20	176	32	32	0.46	5.4	4.4	1.44	1.40	130.6	97
S21	191	20	20	0.38	5.4	4.5	2.24	2.30	112	69

Table 3.4: Properties of Coated Woven Fabrics (Synthetic Leather)

Test Fabrics	GSM	Stiffness Bending length (cm)		Tearing strength (kgf)		Tensile strength (kgf)	
		Warp way	Weft way	Warp way	Weft way	Warp way	Weft way
S1	256	8.45	9.6	2.24	1.78	40	39
S2	211	11.2	9.65	2.68	3.79	40	37.5
S3	195	4.35	5.7	9.92	9.6	30	25.6
S4	156	6.5	7.45	0.8	1.44	40	38.2
S5	270	4.6	3.9	1.92	3.13	42.1	36.9
S6	108	3.4	3.96	0.96	0.89	63	55.6
S7	174	4.05	3.75	0.96	0.76	34	33
S8	102	3.9	3.75	2.56	1.12	51.5	45.5
S9	246	7.5	5.35	1.98	1.92	24	20.6
S10	117	4.75	7.2	2.06	1.76	64	55
S11	272	6.55	7.45	2.30	1.98	74	68.3
S12	267	4.75	4.9	1.05	1.02	55.9	49
S13	213	3.5	3.4	2.40	2.01	138	128.5
S14	206	16.6	15.8	1.56	0.76	49	24
S15	81	8.5	8.0	1.85	1.76	24	22.3
S16	278	4.1	2.1	2.7	3.1	57	65
S17	224	7.25	5	1.79	1.82	22.5	20
S18	155	4.85	5.1	1.28	0.64	32	31
S19	283	7.55	7.75	2.62	3.07	120	115
S20	286	12.25	7.5	2.11	1.56	94	96
S21	335	5.18	4.92	2.59	2.46	108	106







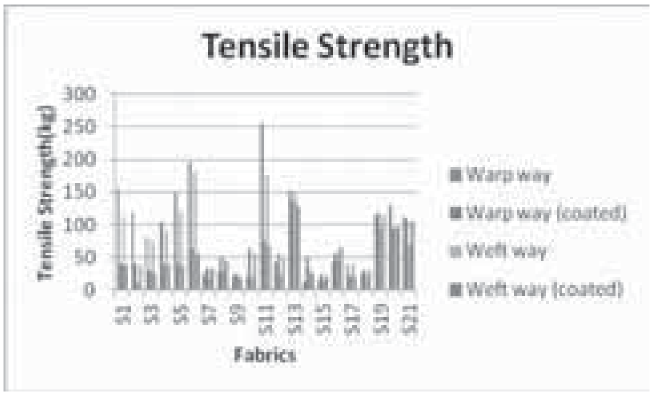


Figure 3.1: Comparison of properties of woven & coated woven fabric (Synthetic Leather)

GSM

As usual, it increases with coating of samples. The highest value of 335 was observed in case of sample number S21 made of PV Blend. It increases drastically which can increase the cost of leather.

Stiffness

Warp-way stiffness of majority of samples was found to increase with coating. The highest value of 16.6 cm was observed in case of sample number S14 made of 100 % Nylon.

Same was the trend observed in case of weft-way stiffness. The highest value of 15.8 cm was observed in case of sample number S14 made of 100 % Nylon. The increase in stiffness of majority of samples might be because of usage of coating materials which had resulted into the higher stiffness values.

Tearing Strength

Warp-way tearing strength of majority of samples was found to increase with coating. The highest value of 9.92 kgf was observed in case of sample number S3 made of 100 % Cotton.

Same was the trend observed in case of weft-way tearing strength. The highest value of 9.6 kgf was observed in case of sample number S3 made of 100 % Cotton.

We can say that coating increases the tearing strength of the fabric.

Tensile Strength

Warp-way tensile strength of majority of samples is seen to decrease with coating. The highest value of decrease in tensile strength from 256 kgf to 74 kgf was observed in case of sample number S11 made of PC Blend (67 : 33).

Same was the trend observed in case of weft-way tensile strength. The highest value of decrease in tensile strength from 181.8 kgf to 63 kgf was observed in case of sample number S6 made of PC Blend (67 : 33).

The decrease in tensile strength of majority of samples might be because of influence of coating materials which had resulted into such decrease in the final values. More specifically, the decrease in tensile strength values was observed in case of 100 % cotton, PC and PV blended fabrics while in case of 100 % synthetic fabrics, the trend was opposite, i.e. there was an increase in the values of tensile strength. This might be due to the differences in quality of coating, resulted mainly because of differences in affinity of different fabrics to coating materials.

Table 3.5: Properties of Nonwoven Fabrics

Test Fabrics	GSM	Stiffness Bending length (cm)	Tearing strength (kgf)	Tensile strength (kgf)
S22	80	2.6	0.46	0.25
S23	45	3.3	0.39	0.36
S24	50	3.9	1.60	0.89
S25	60	5.6	1.85	0.97
S26	81.3	6.3	2.05	1.09
S27	100	11.3	2.57	1.27
S28	35	4.2	0.85	0.83
S29	42	4.8	0.38	0.65
S30	42	4.0	0.20	0.45
S31	52	7.74	0.64	0.15

Table 3.6: Properties of Coated Nonwoven Fabrics (Synthetic Leather)

Test Fabrics	GSM	Stiffness Bending length (cm)	Tearing strength (kgf)	Tensile strength (kgf)
S22	235	7.95	0.6	26
S23	178	14.25	1.15	39
S24	92	6.25	2.11	23
S25	156	14.15	0.99	33
S26	143	11.4	0.83	28
S27	163	8.0	1.18	30
S28	113	8.55	0.96	20
S29	118	7.2	0.67	37
S30	234	10.7	2.43	23
S31	161	7.15	1.69	24

GSM

As usual, it increases with coating of samples. The highest value of 235 was observed in case of sample number S22 made of PV Blend. There is no significant increase in GSM, thus reducing down the cost of leather.

Stiffness

Stiffness of majority of samples increases with coating. The highest value of 14.25 cm was observed in case of sample number S23 made of PV Blend.

Tearing Strength

Tearing strength of majority of samples increases with coating. The highest value of 2.43 kgf was observed in case of sample number S3 made of 100 % Cotton. Same was the trend observed in case of weft-way tearing strength. The highest value of 9.6 kgf was observed in case of sample number S30 made of 100 % Viscose.

Tensile Strength

Tensile strength of majority of samples was found to increase drastically with coating. The highest value of 39 kgf was observed in case of sample number S23 made of PV Blend (67 : 33). Spun bond non woven sample has better strength and less elongation than spun lace non woven.

In case of nonwoven samples, the trend of increase in values of all the properties was observed in almost all the samples after coating. In other words, the materials used for coating had the direct influence on the properties of majority of the samples.

Table 3.7: Rating on the basis of aesthetic appearance

Synthetic leather samples	Rating
Nylon (woven)	1
Polypropylene (woven)	2
Polypropylene (non-woven)	3
Viscose (woven)	4
Cotton (woven)	5

Rating of samples of synthetic leather has been done on the basis of aesthetic appearance on comparing with the natural leather as well as physical properties. Rating is done in the range of 1-5, such that the sample which is similar to natural leather is rated 1 and which is least similar is rated 5. All the samples produced during the project were shown to technocrats from the industries and those from the areas of sales and marketing, a few samples are found to be similar in appearance as well as in properties to natural leather, the ratings can be seen from Table 3.7

During the experimental work, some other parameters were also observed which are highlighted as follows,

- Nylon gives good luster but strength is poor while all other fabrics does not give any luster.
- Density of fabric also affects the appearance and strength of leather, for example, Sample No. 3 has lowest density (threads/inch) which results in pore like appearance. In this case, fabric should be coated twice.
- Weaves of fabrics results in texture of leather. For example, plain weave, twill weave (Sample no 21) etc. Embossed nonwoven gives good texture than needle punched.
- Nylon, P/V blend and viscose gives good feel and smoothness and hence can be used as seat covers. Stiff leathers can be used in carpets.
- Based on the cost, nylon is better for manufacturing of synthetic leather. P/V blend, Spunlace polyester and viscose gives good appearance, hence can be used as air bags, car accessories.
- P/V blend costs higher than other fabrics, hence it is not preferable for the manufacturing of synthetic leather. Nylon and polyester can be used because their properties differ marginally.
- Cost of polyester is less than that of Nylon hence it can be used widely. Thus cost of synthetic

leather is comparable with that of natural leather. With the growing demand for leather in the market, it can be concluded that polyester fabric synthetic leather can carve a niche.

4. Conclusion

On the basis of the Results & Discussions, we can conclude that:

Among woven fabrics, polypropylene gives best results after coating and has been given highest rating.

Among nonwoven fabrics, P/V blend gives best results after coating.

On overall comparison of coated woven fabrics with those of coated nonwoven fabrics, the fabrics made of polypropylene were found to be the best both aesthetically as well as on the basis of physical properties.

5 Acknowledgement

Both the authors wish to mention the names of Ms. Ankita Kaushik, Ms. Karan Patel and Ms. Kruti Patel for their active involvement in this research work.

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Bleach Clean-up

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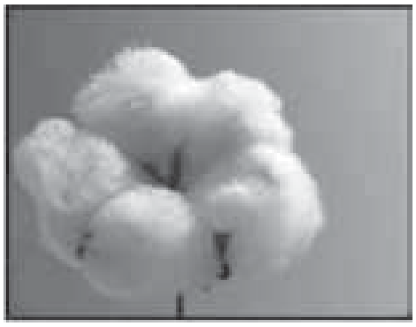
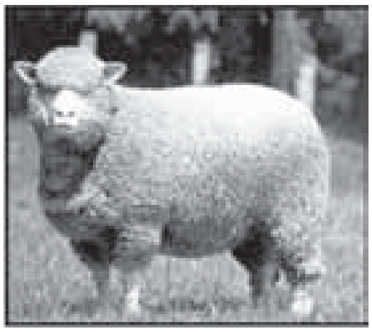
Bleaching is an important and essential step in pretreatment of Textiles. It helps 'whiten' the textile material by removing undesired inherent coloring components. Generally, the natural fibres and their blends comprise about 50 % of total textile substrates and are invariably bleached, while the regenerated and synthetic goods are given this treatment considering the specific requirement. Depending on the substrate, a number of chemicals and application methods are employed to achieve optimum bleaching effect, however, it is also imperative to remove and get rid of the excess and leftover bleaching agent from the textile goods before subsequent wet processing. In this article an attempt is made to review various bleaching chemicals used in textile industry and the methods of their removal and cleaning.

Inherent colorants in textile

Natural vegetable fibers like cotton, linen, jute, etc. contain varying extent of pigments like Chlorophyll, Xanthophyll and Carotene. This imparts off-white, yellowish brown hue and depends on the area of cultivation, climatic conditions and varies from crop to crop. Similarly, the animal fibers like wool and silk too contain non protein impurities which impart characteristic color.



Cotton



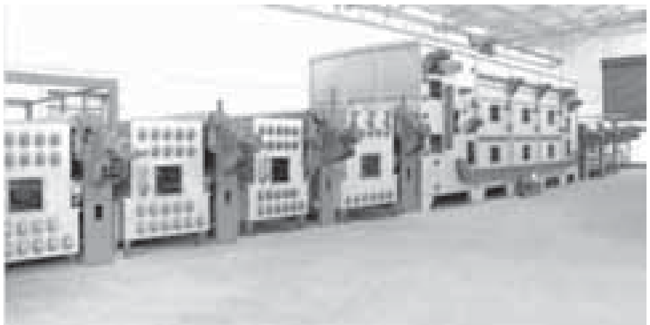
Merino Sheep - wool

Need of Bleaching

Bleaching is the process of decolorization of raw textile material by removing inherent and or acquired coloring components from the fiber. It provides base whiteness to the textile material which could be further whitened with the help of optical brighteners or dyed | printed depending on the desired end use. Even in case of regenerated and synthetic fibers, bleaching step is incorporated for achieving full white or extra bright shades. Though, in case of material to be dyed with dark and dull shades bleaching step could be omitted.

Bleaching can be carried out at various stages of conversion of fiber to garment i.e. from fiber, yarn, hank, woven, knit, towel, sewn up garments, etc. on various types of machines by simple hand processing to sophisticated bleaching ranges and by different application processes from exhaust to continuous.

Jigger



Continuous Bleaching Range

Bleaching chemicals

Though bleaching is an age old process, the major commercial chemicals were developed in the last few centuries. The modern bleaches resulted from the work of 18th century scientists Claude Berthollet, who developed bleaching with sodium hypochlorite, later Louis Thénard produced hydrogen peroxide which gained wide commercial acceptance.

Basically, two type of chemical processes are employed - oxidative and reductive, and are employed depending on the substrate to be bleached and the nature of inherent coloring impurities.

The organic compounds containing conjugated double bonds are considered to be the color producing agents in natural fibers. Their decoloration can occur by breaking up the chromophore, most likely by destroying one or more of the double bonds within the conjugated system and by breaking up the resonance.

An oxidative bleach works by breaking the chemical bonds that make up the chromophore and changes the molecule into a different substance that does not absorb visible light

A reductive bleaching works by converting double bonds in the chromophore into single bonds by the addition of one mole of hydrogen which eliminates its ability to absorb visible light

In case of oxidative bleaching, Chlorine is the basis for commonly used bleaching agents like sodium hypochlorite, bleaching powder and sodium chlorite. While, the non chlorine containing oxidative chemicals are hydrogen peroxide, sodium persulphate, sodium percarbonate, sodium perborate and peracetic acid. Some times peroxide bleaches are also used along with catalysts and activators like tetra acetyl ethylene diamine (TAED) and sodium nonanoyloxy benzene sulfonate (SNOBS). The reducing agent based bleaching agents comprise of sodium dithionite or sodium hydrosulfite, sodium thiosulphate and sulfinic acid derivatives.

The commonly used application methods are :

Batch or discontinuous - Kier, Jigger, Winch, package, softflow, jet
Semi continuous - pad batch or pad roll
Continuous - J-box, pad steam

The oxidative chemicals are widely used for bleaching of natural fibers like cotton, linen, jute, wool, while reductive method is used for Polyamide and Polyacrylates. The chlorine based bleaches though economical and easy to apply have lost importance due to health and environmental issues but still find use in some areas.

The selection of bleaching agent depends on the fiber and machinery in use, the method of application, the extent of whiteness expected without adversely impacting fiber strength and meeting the desired cost economics.

Hydrogen peroxide is the most common and universally used bleaching agent and is applied under specified conditions of time, temp, pH and stabilizers for optimum efficacy. The generally considered advantages in its use are:

Less weight loss than that with hypochlorite bleaching
Bleached goods are more absorbent than hypochlorite bleached goods.
Less yellowing of post bleached white goods
Suitable for bleaching of cotton, wool and silk
Suitable for combined and continuous scouring and bleaching

Need for bleach clean up

Generally, the peroxide bleaching process is set in such a way that it retains about 10-15% of the initial peroxide amount at the end. This is achieved by optimising the process parameters and incorporating suitable stabilisers. The basic purpose is to avoid uncontrolled and rapid decomposition of strong oxidising agent which is detrimental to the tensile strength of cellulosic textiles. Similarly, in case of other bleaching agents, in order to achieve optimum results, slight excess is used at the start which is carried forward as residue at the end.

When the textile material is to be dyed after bleaching, it becomes imperative that the left over | residual bleaching agent is effectively removed, as the bleaching agent affects coloring component |chromophore of dyestuff. Failure to do so can result in poor dyeability, batch-to-batch shade reproducibility as well as uneven dyeing. Therefore, in order to get rid of the remaining leftover bleaching agent a intermittent bleach clean-up process is incorporated before dyeing. It is also termed as peroxide killing or neutralisation in case of hydrogen peroxide and antichlor in case of chlorine based bleaching. This is specifically required in processes involving use of material in package or rope form, while in continuous process, owing to the open width form and continuous counter current water washing, generally bleach clean-up is not required.

Even in case of full bleach or full white process, where high concentration of bleaching agent is used it is considered advantageous to neutralise and clean-up to avoid subsequent yellowing during extended storage conditions.

The Direct and Reactive dyestuffs are generally sensitive to oxidizing agents and even small amount of post bleaching residual hydrogen peroxide may have a negative influence on subsequent dyeing resulting in loss of depth. The Vat and Sulphur dyes are relatively stable and unaffected by the residual bleaching chemical, however, it is still considered advisable to clean-up the strong oxidizing agent before start of dyeing in order to avoid neutralization of dye solubilising chemicals which could cause inadequate reduction |precipitation of this class of dyestuffs.

Given below is an illustration on dyeability and effect on color strength of select high exhaust bis-monochlorotriazine type Reactive dyes -with and without bleach clean-up.

Dyes	Bleach-Quench with RUCOLASE KAT-Dye	Bleach-Refill-Dye
PROCION Brill. Yellow H-E6G-1.00 %		
TULACTIV Yellow XLE-1.00 %		
TULACTIV Crimson XLE -1.00 %		
PROCION Blue H-EGN 125% -1.00 %		
TULACTIV Navy XLE -2.00 %		

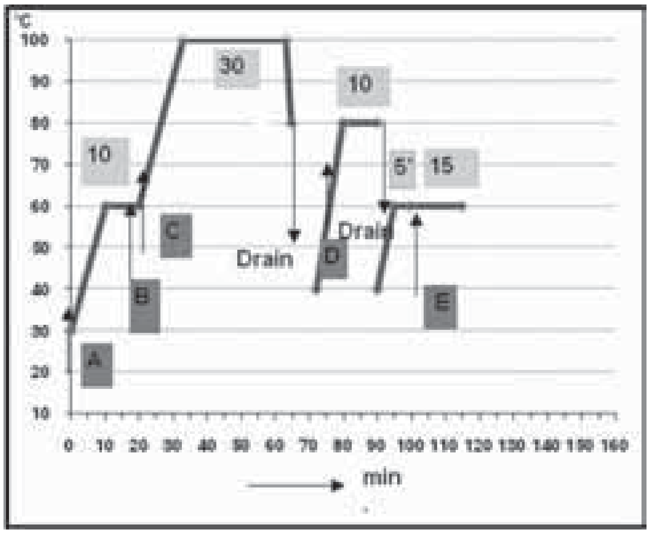
Methods of Beach Clean-up

Various methods of bleach clean-up are employed in the textile industry. These involve - repetitive washing, catalytic decomposition, reductive neutralisation and enzymatic killing.

1. Washing with fresh water was the popular method employed in the past and still adopted in some areas for complete removal | depletion of the left over oxidising agent. Though this is a simple process it
   - Requires high amount of water for repeated washing
   - Increases energy consumption for heating water which is unprofitable
   - Lengthens processing time due to draining and refilling of the machine
2. Catalytic decomposition involves use of salts of selected heavy metal ions which under controlled temp and alkaline pH conditions rapidly activate rate of decomposition of residual hydrogen peroxide and thereby destroying it completely. Though the process is simple, fast and cost effective, the disadvantage is if the residual peroxide content is high and the process is not controlled adequately it may result in degradation of cellulose causing breakages in yarn and pin holes in fabric.
3. Reductive neutralization is based on use of inorganic salt based reducing agent like RUCORIT INPK which works at the equal concentration of the residual peroxide and effectively cleans it up. The specific advantage of this product is
   - Cost economic
   - Ready to use, easy to handle, pumpable liquid formulation
   - Stable to hard water, robust under process conditions

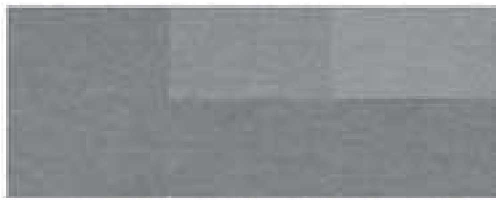
- Water and energy conserving application process
- Enhances whiteness index in case of full bleach process
- Effectively removes chloramine after chlorine bleach process
- Simple application process under high temp alkaline conditions
- Develops alkaline reductive atmosphere in dye bath making it highly suited for material to be dyed with Vat and Sulphur dyes
- Being Inorganic does not increase COD and BOD of effluent

Given below is one representative process along with general recommended chemicals for bleaching of cotton knit material by exhaust application in soft flow machine, prepared for subsequent dyeing with Reactive dyes.



A.	RUCOGEN WBL VEROLAN EP RUCOLIN AC	0.5-1.5 g/l 0.3-1.0 g/l 0.5-1.0 g/l
B.	Caustic Soda Flakes	1.0-2.0 g/l
C.	Hydrogen Peroxide (50%)	2.0-3.0 g/l
D.	RUCORIT INPK	0.5 g/l
E.	Acetic acid RUCOACID C	1.0-1.5 g/l 0.3-0.5 g/l

Given below is an example of effect of varying amount of residual bleaching agent on color value of a medium black shade developed with a recipe of a combination of bi-functional reactive dyes.

	No Residual Peroxide in bath	5 mg |l H_2O_2 in bath Rel Depth 89%	25 mg |l H_2O_2 in bath Rel Depth 76%
Without Bleach Clean-up			
With RUCORIT INPK			

4. Enzymatic Killing - this is the latest and advanced method of bleach clean-up specifically developed for neutralization of residual hydrogen peroxide based oxidizing agent in post bleaching process. Generally, the enzyme used here is "Catalase" which belongs to oxidoredutase class having classification no EC 1.11.1.6. This enzyme catalyses the decomposition of hydrogen peroxide to oxygen according to:

$$2H_2O_2 \xrightarrow{\text{Catalase}} 2H_2O + O_2$$

The Enzyme is a bio catalyst produced by fermentation of microorganisms, acts very specifically on hydrogen peroxide and increases reaction speed by lowering the activating energy without any harmful side effects. Enzymes present a more convenient alternative because they are easier and quicker to use. With the increasingly important requirement for textile manufacturers to reduce pollution during production, the use of enzymes is rapidly gaining wider recognition because of their non-toxic and eco-friendly characteristics. The advantages of Enzymatic treatment over other methods are

- Complete and quick elimination of residual hydrogen peroxide
- Improved RFT and reproducibility in subsequent dyeing
- By-products are completely inert to dyestuffs and fabrics
- Suitable for combined peroxide killing and same bath dyeing
- Compatible with biopolishing process for combined application
- Reduced processing times, thus increasing pro-

duction throughput

Biodegradable - return to nature characteristic, no impact on pollution

The catalase enzyme has few limitations, interms of its stability and applicability under specified narrow range of pH and temperature conditions. Generally, the conventional enzymes are susceptible to high temperature and strong pH conditions and get deactivated losing its effectiveness during bleach clean-up. Also, such conventional enzymes can be decomposed by enzyme poisons e.g. complexing agents, heavy metal ions.

RUCOLASE KAT is a specialty enzyme developed by RACL, formulated to withstand variation encountered during practical application conditions. The specific advantages include

Easy to use, safe to handle liquid formulation for auto dispensing

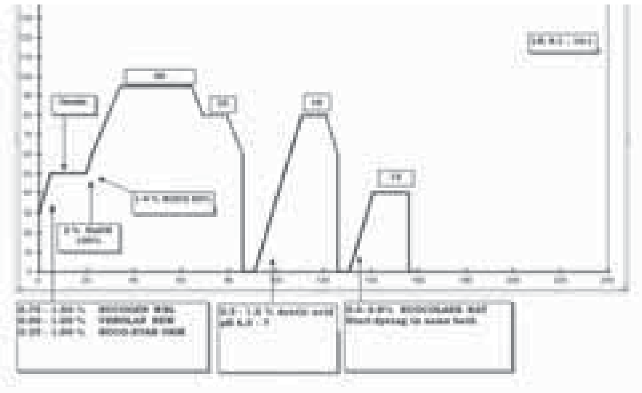
Foam free characteristics helps improve machine runnability

Broad application spectrum from pH 4 to 9, maximum activity at pH 5.5-6.5

Stable up to 65°C, highly effective in range 45-55°C

Compatibility with selected complexing and /or neutralizing agent

Given below is a schematic process flow of cotton yarn preparation regularly running at a leading textile unit in India.



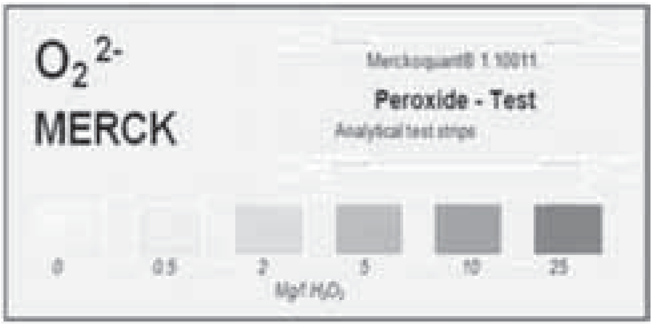
Assessment of bleach clean-up

To ensure effectiveness and efficiency of removal of residual bleaching agent, it is necessary to evaluate the same and various quantitative and qualitative methods of assessment are

1. Titrimetric analysis - peroxide content in cotton is determined by titration of the extract in sulphuric acid with potassium permanganate solution. Violet coloration indicates presence of residual peroxide.

2. Chemical Spot test - spotting textile substrate with Titanyl Chlroride indicator solution, yellowish-orange color indicates presence of residual peroxide.

3. Dab strip test - this is the most commonly used and fairly accurate qualitative as well as quantitative method for assessing presence of residual peroxide after bleaching. Generally, Merck peroxide indicator paper strip is gently touched | dabbed on the textile substrate and the development and extent of bluish color is compared with the indicator strip as represented below



Summary

Consistent bleach clean up is key to even dyeing and shade reproducibility.

The removal of residual bleaching agent is an important step to ensure uniform, level dyeing and obtaining the highest final depth of shade. Bleach clean-up is very important when cotton substrate is to be dyed with bleach sensitive dyes, such as direct and reactive dyes.

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A Series of Papers on Biotechnology and its Application in Textiles

The last chapter in this series of chapters under the title, 'Biotechnology and its application in textiles" will introduce readers to the upcoming applications of biotechnology in textiles. This series was written primarily as an introductory text for those who are interested or already working in, textile related areas and wish to acquire a broad knowledge of biotechnology and its application in textiles. We hope that the purpose is fulfilled and thank our readers.

Chapter 6: Upcoming Bio-technology based applications in textiles

Manasi Damle, Madhura Nerurkar, Ravindra Adivarekar

Application of biotechnology in textiles is not confined only to the use of enzymes and antimicrobial finishes. There are various new aspects in this field which are being researched or still in the nascent stage. In this chapter we will focus on those upcoming areas.

The rapid developments in the field of genetic engineering have given a new impetus to biotechnology. This introduces possibility of 'tailoring' organisms in order to optimize the production of established or novel metabolites of commercial importance and of transferring genetic material (genes) from one organism to another to ensure mass production.

With an improved understanding of how different genes are responsible for the various characteristics and properties of a living organism, techniques have been developed for isolating the DNA which carries the genetic code and manipulating them outside the cell.

The next step is to introduce fragments of DNA obtained from one organism into another (Host organism), thereby transferring some of the properties and capabilities of the first to the second to achieve mass production.

Production of natural fibres

Biotechnology can play crucial role in production of natural fibres with highly improved and modified properties. Genetic engineering methods are being investigated for their potential to produce new kinds of textile fibres. The systems fall into two main groups; one that can produce monomeric protein molecules in solution from appropriately engineered genes and include expression of those genes in bacteria, cell cultures or in the milk of transgenic animals such as goats or sheep. The protein monomers are then isolated from the chosen system and spun and drawn into fibres. The other approach is to modify keratin fibres such as wool by expressing other proteins in the internal components by trangenesis, wherein an exogenous gene - called a transgene is introduced into a living organism so that the organism will exhibit a new property and transmit that property to its offspring. In the following section, development in manufacture of cotton and silk with advent of genetic engineering will be elaborated upon.

Genetically modified cotton

More than 80 countries in six continents grow cotton, providing fibre for clothing, home furnishings, industrial products and food for animals and humans. The four largest cotton-producing countries, China, India, the United States and Pakistan, account for 75 percent of the world's production. China, India and Pakistan, three of the most populous countries in the world, also are the largest consumers of cotton, accounting for 66 percent of total use.

Cotton (Gossypium spp.) is a very important cash crop in the world. With the acceleration of spinning speeds and the improvement of the people's living level, the demand of improving cotton fibre qualities is getting stronger and stronger. Elucidating systematically the molecular mechanisms of cotton fibre development and regulation will produce a great significance to make full use of cotton gene resources, raise cotton yield and improve fibre quality, and even develop man-made fibre.

Monsanto were pioneer in introduction of Bt cotton plant. Biopesticides based on a strain of soil bacteria known as Bt are already being used for control of caterpillar and beetle pests in a wide variety of fruits, vegetables and crops. Genetically modified cotton was engineered to reduce insect pests so farmers could reduce their chemical dependence on pesticides, and buy less of them. The gene coding for Bacillus thuringiensis (Bt) was inserted into the cotton. Bt is a protein that acts as a natural toxin to the larvae of certain moths, butterflies, beetles and flies (including the dred bollworm) and is harmless to other forms of life. When the larvae feed on the cotton they are killed by the Bt protein - thereby eliminating the need for a broad spectrum insecticide. Genetically modified cotton was designed to be resistant to herbicides so that weed killers could be liberally sprayed on crops without worrying about killing the cotton plants.

More stable, longer lasting and more active Bts are now being developed for the suppression of loopers, bollworms and budworms in cotton. The next stage will be to introduce greater insect and herbicide resistance by direct genetic engineering of the cotton plant itself. Currently Monsanto's cotton pipeline focuses on: protecting the plant from bugs, such as bollworm, armyworm and lygus from attacking the plant, which impacts cotton production potential; providing an additional herbicide tolerance trait; and protecting the plant from nematode which chews on the early-developing cotton seedlings.

Fourth generation Bollgard is a product from Monsanto is under development which has novel proteins that could guard cotton crops against key cotton pests. Lygus bugs damages cotton balls and reduces crop's quality. Product which is under biotech phase 2, will be the first product to extend the spectrum of insect control to this pest. Another product termed as root - knot nematode resistance is under breeding -launching phase at Monsanto.

Coloured cotton is also being produced not only by conventional genetic selection but also by direct DNA engineering. The transfer of a gene from a blue flower to the cotton plant to produce blue cotton has been envisaged.

An attempt is also being made to produce natural polyesters such as polyhydroxy butyrate (PHB) to grow within the central hollow channel of the cotton fibre, thereby creating natural polyester-cotton.

Recombinant silk

Natural spider silk fibres combine extraordinary properties such as stability and flexibility which results in a toughness superseding all other fibre materials. As the spider's aggressive territorial behavior renders their farming not feasible, the biotechnological production of spider silk proteins (spidroins) is essential in order to investigate and employ them for applications. In order to accomplish this task, two approaches have been tested: firstly, the expression of partial cDNAs, and secondly, the expression of synthetic genes in several host organisms, including bacteria, yeast, plants, insect cells, mammalian cells, and transgenic animals.

AMSilk, a spin-off of the Technische Universitaet Muenchen (TUM), has produced the world's first artificial silk fibre that is entirely made of recombinant spider silk proteins. The fibre's tensile strength is comparable to that of natural spider silk, which led to the name Biosteel. The present fibre prototypes are smooth to the touch and pleasant to the skin, and they shine like silk. They are brilliant white and can be dyed with common techniques used in the textile industry. Applications for Biosteel may include high-performance technical textiles, sporting goods, medical textiles and surgical products, such as meshes and other support textiles or wound coverings.

DNA probes

DNA probes are another technology which has grown out of genetic engineering. DNA probes are small segments of DNA which help to detect the presence of a gene of a long DNA sequence, in a biological systems. Short pieces of DNA can be designed to hybridize with very specifically to other pieces of DNA and thereby, to help identify target sequence. To detect hybridization of the probe to its target sequence, the probe is tagged (or "labelled") with a molecular marker of either radioactive or fluorescent molecules; which will generate signal upon hybridization depending on hybridization conditions.

The technique can be applied, for example, to distinguish Cashmere from Wool and other goat fibres.

Nelson et. al. for the first time designed goat-specific probe that can be used to distinguish DNA samples extracted from goat (e.g., cashmere or mohair) fibre from wool. The probe is sensitive enough to allow analysis of as little as 100 mg of raw fibre and only a few grams of processed material. Thus this technique aids in identification of speciality fibres. Now, similar probes are being identified to distinguish between cotton, ramie, kapok, coir, flax, jute and hemp.

Exact analytical methods are required to distinguish expensive fibres which may be deliberately adulterated with wool. The initial drive for application of DNA probes in the textile industry has come from importers and processors of specialty animal hair fibre who have seen a surge in trading and labelling fraud, especially in the stir of recent high fibre prices.

Monoclonal antibodies

Monoclonal antibodies are monospecific antibodies which are made by identical immune cells that are all clones of a unique parent cell. Given almost any substance, it is possible to produce monoclonal antibodies that specifically bind to that substance; they can then serve to detect or purify that substance. This has become an important tool in biochemistry, molecular biology and medicine. The technology has already been evaluated for marking of branded denims. Methods have been perfected for use in nylon and acrylic resins and markers can also be incorporated into dyestuffs or applied to surfaces using ink jet printers.

Biosensor

A biosensor is an analytical device, used for the detection of an analyte, that combines a biological component with a physicochemical detector. Application of biosensor can be envisaged which incorporate bio sensitive materials into textiles, for example, to produce intelligent filter media or protective clothing which detects as well as protects against chemicals, gases and biological agents.

A major issue in monitoring biological samples in vivo is sensor placement and sample delivery. As a result non-invasive sensing device is essential. Urine, saliva, sweat, tears and breath are possible samples that may be acquired non-invasively. Sweat is the most accessible specimen within a garment, and there are many developments within the textile industry to accommodate the movement of sweat through fabrics for sports performance clothing. Wearable sensors provide personalised healthcare through monitoring the wearer in their natural environment, providing a far more realistic outlook than in a clinical setting.

Coyle et. al have developed textile pH fabric sensor for measuring sweat pH.

Bioactive fabrics

These fabrics contain genetically engineered bacteria or mammalian cells incorporated into them that will enable them to generate and replenish chemical coatings and chemically active components. Clothing is an ideal medium in which mobile bioenvironments can be implanted easily. Novel applications for bio-active fabrics exist in the medical and defence industries e.g. drug producing bandages or protective clothing with highly sensitive cellular sensors. Bio-fabrics may form the basis of a whole new line of commercial products as well: fabrics that literally eat odours with genetically engineered bacteria, self cleaning fabrics and fabrics that continually regenerate water and dust repellents. Trevira has developed bioactive textiles that are permanently antimicrobial and compatible with the skin. A report by the Hohenstein Institute confirms that Trevira Bioactive has no effect on skin flora even after long wear. Bioactive fibres from Trevira inhibit this growth in and on textiles, at the same time reduces the build-up of unpleasant odours. Along with the benefits in terms of hygiene and compatibility with the skin, Trevira Bioactive gives the user a feeling of cleanliness and freshness. Underwear, shirts, socks and other garments stay fresh for longer period and enhance the feel-good effect. Easy care functional clothing is, therefore, not only breathable, quick drying, and able to transport moisture, it also delivers the added benefit of its bioactive effect.

3D printing

The emerging process of 3D printing, which uses computer-created digital models to create real-world objects, has produced vast range of products, viz. Toys, jewellery, food.

3D printers, because of their precise process can reproduce the vascular system that is necessary to make organs viable. Scientists are already using the machines to print tiny strips of organ tissue and technology for printing whole human organs for surgical transplants is rapidly developing. Bioprinting works like this: Scientists harvest human cells from biopsies or stem cells, and then allow them to multiply in a petri dish. The resulting mixture, a sort of biological ink, is fed into a 3-D printer, which is programmed to arrange different cell types, along with other materials, into a precise three-dimensional shape. Doctors hope that when placed in the body, these 3-D-printed cells will integrate with existing tissues.

There is currently a huge amount of research and development being conducted across the globe from universities to global corporations to design and create the next generation textiles. Venture Development Corporation (VDC) estimates that consumption in the smart and interactive textiles market is today worth about US$720 million. Today's smart materials are expected to detect changes in their environment and respond with specific actions. Many ideas for such functional materials have been inspired by nature. Azymogel on skin of Globicephala melas (species of Whale) hydrolyses adhesive glycoconjugates secreted by biofouling microorganisms thereby preventing their settlement (Baum et.al. 2001). Mimicking this strategy, coatings containing proteases have been developed for use in self-cleaning textiles (Tong et. Al 2008) or antifouling membranes (Chen et.al. 1992). Also textiles that can self decontaminate from warfare agents and pesticides or toxic microbes have already become reality (Edwards and Goheen, 2006).

Many active agents in pharmaceutics, food and agriculture require temporal stabilization, protection against degradation, oxidation. Efficiency of these substances can be increased by increasing their solubility or by masking toxicity or bad taste. It is also many times required that there is triggered release for these substances. Therefore such active ingredient is nowadays combined judiciously with textile material to allow controlled release of material at target site.

Wound dressing

Cotton based wound dressings were functionalized by immobilization of different biomolecules such as peptide that inhibit human neutrophil elastase or enzymes to impart haemostatic or antibacterial properties (Edwards and Goheen, 2006).

In another case woven polyester fabrics were activated with ethylendiamine followed by immobilization of thrombin. These thrombin functionalized fabrics led to thrombus formation at affected site.

For military purposes organophosphorous hydrolase was covalently immobilized on cotton for detoxification of organophosphorous warfare agents such as Sarin, soman, tabun.

Lysozyme was used for construction of antimicrobial fabrics and packaging materials. In one case lysozyme was covalently attached to cotton fabric and then activated via esterification with glycine and a glycine dipeptide. It was also covalently immobilized on wool fabric activated with glutaraldehyde. Lysozyme hydrolyzes beta -1,4 glucosidic linkages between N-acetylglucosamine and n acetylmuramic acid of the cell wall of many microorganisms thereby giving antimicrobial activity.

Alakaline pectinases, alpha amylase or laccase lead to antimicrobial fabrics retaining full activity for at least ten wash cycles. (Ibrahim et.a., 2007).

Immobilization of glucose oxidase and alcohol oxidase on polypropylene and polyethylene has been demonstrated to improve shelf life of food products by preventing growth of yeast, mould and aerobic bacteria. (Vermeiren et al, 1999).

Enzymes have been incorporated into packaging materials to control off flavours. Naringinase was incorporated into cellulose acetate film to reduce bitter flavour in grapefruit juice by hydrolysis of naringin and pruning (Soares and Hotchkiss, 1998)

Catalse was photochemically immobilized on PET and polyamide 6,6 using dialylphthalate or cyclohexane-1,4-dimethanoldivinylether as cross linking agent. Another strategy of catalase immobilization on cotton included oxidation of cotton by sodium periodate followed by covalent attachment of enzyme (Wang et. al , 2008)

In summary high specificity of enzymes can be exploited for the design of smart materials. On one hand enzyme can impart novel functionalities ranging from antimicrobial effects to self cleaning properties. On the other hand, enzymes can be used as triggers to impart bioresponsive properties to materials containing specific elements susceptible to modification by these catalysts. Both concepts have been used for generation of smart fabrics.

Earlier textile production was limited to exclusive use of natural fibres like cotton, hemp, jute etc. The invention of synthetic fibres in the 20th century broadened the application range of textile materials enormously. Development of modern fabrics by mingling two or more scientific fields (textiles and biotechnology) enables industry to produce multifunctional textile. This multifunctionality has broadened use of fabric such that apart from being used as clothing , it is finding application in space technology, agricultural, biomedical technology etc.

Trend towards using textile material made up of biodegradable polymers has been paid great attention. Biodegradable products can be broken down into their constituent natural elements and be absorbed by the environment. The ASTM (The American Society of Testing and Materials) defines 'biodegradable' as "capable of undergoing decomposition into carbon dioxide, methane, water, inorganic compounds, or biomass in which the predominant mechanism is the enzymatic action of microorganisms, that can be measured by standardized tests, in a specified period of time, reflecting available disposal condition". Packaging materials (Film wrapping, trash bags), disposable nonwovens (engineered fabrics) and hygiene products (diaper back sheets, cotton swabs) are different forms of textile in which biodegradable polymers are being used as starting material as given in the Table.

Sr. No.	Biodegradable polymer	Use
1.	Poly Lactic Acid (PLA)	Packaging (film, thermoformed containers, and short shelf life bottles). silky, durable, and moisture resistant fabric
2.	Poly caprolactone (PCL)	Scrub-suits, incontinence products, and bandage holders (blending PCL with fibre forming polymers such as cellulose)

3.	Poly (aspartic acid) (thermal polyaspartate)	Diapers
4. 5.	Poly (vinyl alcohol) Polyketals	Preparation of coatings, adhesives, and films Injectable, biodegradable scaffolds for tissue engineering and drug delivery
6.	Chitin	Incorporated into wound dressings
7.	Collagen	Generation of artificial skin
8.	Alginate	Wound dressings

Nanotechnology leads to value addition of textile material. The use of nanotechnology allows textiles to become multifunctional and produce fabrics with special functions, including antibacterial, UV protection, easy-clean, water and stain repellent and anti-odour. Nanotechnology imparts multifunctional effects to textile without compromising the inherent textile properties, including processability, flexibility etc.

Nanobiotechnology often studies existing elements of living organisms and nature to fabricate new nanodevices. Generally, nanobiotechnology refers to the use of nanotechnology to further the goals of biotechnology. Nanotechnology can provide high durability for fabrics because nanoparticles have a large surface area to volume ratio and high surface energy, thus presenting better affinity for fabrics, leading to an increase in durability

of the function. Nowadays herbal nanaoparticles are being prepared using medicinal plnat extract and are applied to textile to impart antimicrobial effect.

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About the Authors

Madhura Nerurkar has completed her Ph.D. in biotechnology in the department of Fibres and Textiles Processing Technology, under Dr. Ravindra V. Adivarekar, at the Institute of Chemical Technology (ICT), Mumbai, India. Her research area of interest includes microbial enzymes and their applications, fermentation, microbial colorants, detergency and antimicrobial property of fabrics.

Manasi Damle is currently pursuing Ph.D. in biotechnology in the department of Fibres and Textiles Processing Technology, under Dr. Ravindra V. Adivarekar, at Institute of Chemical Technology (ICT), Mumbai, India. Her research areas of interest are microbial enzymes and their applications, biofilms, fermentation, antimicrobial property of fabrics and detergency.

Ravindra Adivarekar is currently a Professor and the head of the Department of Fibres and Textiles Processing Technology at the Institute of Chemical Technology (ICT), Mumbai, India. His research areas of interest are microbial enzymes for textile processing, detergent formulations, natural dyes and mordants, dyeing and printing of textiles, medical textiles, fiber modification, composites and energy conservation.

The Textile Association (India)

TAI - Karnataka

2nd Managing Committee Meeting

The Textile Association (India), Karnataka Unit organized its Managing Committee Meeting on Sunday, 22nd June, 2014 at The Roost, Hinkal Village, Mysore.

The following members were present for the 2nd Management Committee Meeting (2014-15) with the invitees.

Mr. T.G. Mruthyunjaya	President
Dr. H.L. Vijaya Kumar	Chairman
Dr. H.V.S. Murthy	Chairman, PAC,
Mr. Badarinarayana	Vice Chairman
Mr. Kannan Krishnamurthy	Hon. Secretary
Dr. H.R. Arun Kumar	Jt. Secretary
Mr. H.D. Nagaraj	Treasurer
Mr. Vijayaraghava Reddy	M.C. Member
Mr. H.H. Shambhulingappa	M.C. Member
Mr. H. Jagadeesh	M.C. Member
Mr. SKG Rao	M.C. Member
Mr. H. Shekar	M.C. Member
Mr. Keshavan	M.C. Member
Mr. Y.A. Subramanya	M.C. Member
Mr. A.V. Dwarakanath	M.C. Member
Mr. Sitaram	M.C. Member
Mr. S.R. Anantha Krishna Shetty	M.C. Member
Mr. Basavaraju Kambi	M.C. Member
Mr. S. Mahdavan	Co-opt Member
Mr. R.S. Sarma	Co-opt Member
Mr. Shiva Yogi	Invitee

It was decided to organize International Conference on Textiles & Apparel in Commemoration of Diamond Jubilee of The Textiles Association (India), Karnataka Unit and Platinum Jubilee of Govt. SKSJTI during the month of July 2015. Also the consent has to be taken from the Principal, Govt. SKSJI to include their Platinum Jubilee along with the International Conference of TAI, Karnataka Unit. It was decided to put by Mr. Kannak Krishnamurthy, Hon. Secretary, before the Governing Council Meeting scheduled on 05th July, 2014 at Ahmedabad for the support and co-operation for this Conference.

The assembled members agreed to conduct an International Conference on Textiles & Apparel which should become a landmark in the history of TAI with an ambitious estimate of Rs 2 crore for this project proposed by Mr. Mrutunjaya, President, TAI.

Mr. S. Madhavan and Mr. R.S. Sarma gave their commitment whole heartedly and plan to be at Bangalore for maximum no. of days as required for the conference work during the preparatory for the International Conference.

Considering the herculean task of conducting successfully the International Conference, a Core Committee and Financial Committee were formed. Further committees for the International Conference will be made as and when needed by the core committee. Mr. T.G. Mrutunjaya proposed to rope in high profile personalities for the International Conference like Prime Minister/ Central Ministers, President/Vice-President Govt. of India, Chief Minister/Governor of Karnataka and make the conference a high profile one with an expectation of about 1000 delegates.

NIMHANS Convention Hall was suggested for the venue of the International Conference, which is having adequate vehicle parking place better than Jnana Jyothi Hall of Bangalore University. Availability of the hall during Saturday and Sundays during July 2015 is to be enquired by Mr. Kannan Krishnamurthy and Dr. H.R. Arun Kumar at the earliest.

Mr. Kannan Krishnamurthy, Dr. H.L. Vijay Kumar & Mr. T.G. Mrutunjaya

It was proposed for a Professional Fashion Show from Fashion Institute on the first day evening of the International Conference. Dr. H.L. Vijaya Kumar, Chairman, TAI, voluntarily informed that he can arrange a Fashion show from his students of Army Institute of Fashion Technology, Bangalore.

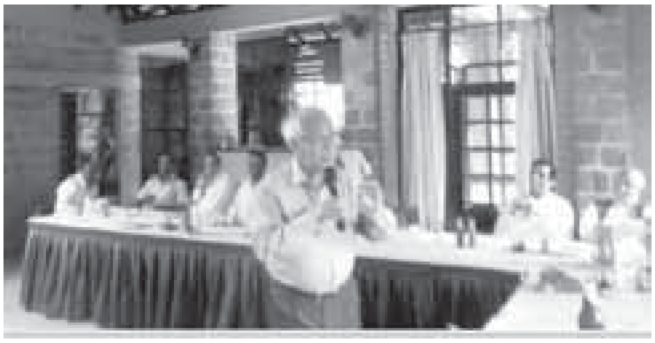
Dr. H.L. Vijay Kumar, Chairman suggested for starting up newsletter for updating TAI activities on a monthly basis. Mr. Badarinarayana has taken responsibility to do the needful from next month onwards.

The committee members decided to have a number of interaction /onsite programmes at different institutes, industries, Apparel, Textiles across Karnataka and Andhra Pradesh as a Road Show from July 2014 onwards. Various activities were discussed and responsibilities were shared within members to spread up the contacts. Further it was suggested that the responsible persons shall keep in touch with the Hon. Secretary for the updates of follow-up and to coordinate with others concerned.

Mr. Badarinarayana and Mr. R.S. Sarma suggested bringing out a 'Who's who Directory'. The members presented decided to bring out a Directory containing the photo and details with name, qualification, professional experience, extracurricular activities, and achievements etc. of each member.

Mr. H.R. Arun Kumar Jt. Secretary was assigned the responsibility of collecting the details of members and compiling the directory. Dr. H.V.S. Murthy informed that the application for the Authority to TAI, for Skill Assessment (ISDS PROJECT) is in progress and routed through TAI Central office and advised Mr. Kannan Krishnamurthy to discuss during the TAI G.C. Meeting to be held on 5th July 2014, at Ahmedabad. Mr. Vijaya Raghava Reddy, Management Committee Member, volunteered to host a meeting on any suitable date at Chitradurga. Mr. T.G. Mruthunjaya, President, volunteered to arrange meeting at Coorg.

Mr. Nagaraj H.D., Mr. R.S. sarma & Mr. S.K.G. Rao



Mr. R.S. Sarma

Mr. S. Madavan and Mr. S.K.G. Rao recalled their college days and cracked jokes of 1959 when roll cameras were in use. Mr. R.S. Sarma sang a song touching the hearts of everyone.

Mr. Kannan Krishnamurthy proposing Vote of Thanks

Mr. Kannan Krishnamurthy, Hon. Secretary, proposed the vote of thanks. He thanked each and every one for giving a golden opportunity to meet and discuss in a wonderful ambience of 'The Roost" away from the overcrowded Bangalore city. Such Meetings in different locations should be held once in a way. Such meetings would aid as a Stress Buster & make way to make for effective interaction.

Such meetings would give an insight of many experienced / talented experts and bring members of age of 21 years to 84 + under a common forum to exchange knowledge and experience among the Textiles/apparel community and bring overall development. Such meetings would give way to strengthen the bond between members and improve relationships to work as a team and in future such meetings would be opted.

Special thanks were emphasized to Mr. S. Madhavan, Mr. R.S. Sarma, Mr. A.V. Dwarakanath, Mr. Y.A. Subramanya, Mr. D.K. Keshavan and Mr. H.K. Sitaram members residing at Mysore who hosted this Memorable Meeting with Delicious Lunch.

Lunch was followed after concluding the meeting.

Challenges for Nonwoven Materials

By Seshadri Ramkumar, Texas Tech University, USA

Three big challenges were highlighted by Dr. Bryan Haynes, Director, Global Enterprise Research and Engineering, Global Nonwovens, Kimberly-Clark for effective utilization of nonwovens in the medical and consumer product sectors.

Nonwoven Medical products

Dr. Bryan Haynes delivered his keynote talk at the NET Innovation in Nonwovens Conference (NETInc) of TAPPI held in Nashville. It emphasized the importance of market differentiation; raw material cost and scalability. These major issues have to be taken into consideration by the nonwovens medical and consumer products industry.

Nonwoven Consumer Products

Bryan Haynes said, by differentiation in product design, developing composites for new functions and creating novel materials, new opportunities will evolve for the nonwoven industry.

Investment in new process technology that could develop new nonwoven products should be the way forward. Although incremental development is good, emphasis should be placed on new and disruptive technologies, said Haynes. Sustainability and recycling should also be taken into consideration. Finally, Haynes commented on the importance of taking laboratory products to commercial reality.

Partnering to develop disruptive technologies should be an important mantra for the nonwovens industry. The keynote session was chaired by Uday Raval, Chairman of NET Division of TAPPI.

Durable Clothing Thanks to Suitable Yarn

The spinning company Hermann Bühler AG relies on air-jet spinning technology from Rieter. The Com4®jet yarns spun on the latest J 20 air-jet spinning machine were centre of attention at various trade fairs. No wonder, then consistent quality and durable textiles are more in demand than ever.

The latest Rieter J 20 air-jet spinning machine excels with 200 spinning units and up to 500 m/min production speed. Newly developed components make it possible to influence the yarn character. For instance, selection of the appropriate technology components optimises the tenacity of combed cotton yarns. Knitted fabric with a pleasing feel is gained by influencing the yarn structure.

Hermann Bühler AG scores at exhibitions

The spinning company Hermann Bühler AG with headquarters in Winterthur-Sennhof, Switzerland collaborated from the very beginning in the development of the Rieter air-jet spinning machine. The company has wide experience in the development and production of air-spun yarns and can therefore specifically respond to the customers' wishes. Ms. Renata Franz, Business Development Manager at Hermann Bühler AG, confirms the demand for consistent quality and durable textiles at exhibitions in Paris and Milan. Bühler has scored points on these occasions with the positive characteristics of its air-spun yarns.

Durable clothing due to suitable yarns

The modern air-jet spinning technology creates yarns with a unique structure. They have the most beautiful colour brilliance, even after frequent washing. With this spinning process, the fibre ends are deeply embedded in the yarn structure which ensures incomparable fabric stability. The coveted elegance and softness are thereby fully preserved. The air-spun yarns are distinguished by their minimal hairiness and high abrasion resistance. Consequently, clothing retains its high-quality character.

For more information please visit,
www.buhleryarn.com

VDMA Textile Machinery

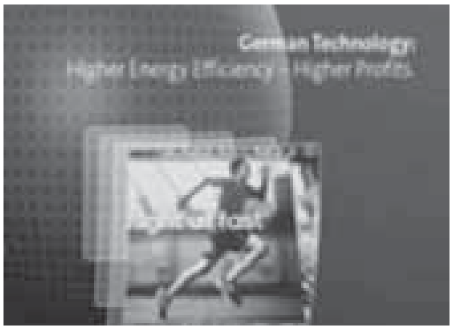
German Technology @ ITMA ASIA: Higher Energy Efficiency - Higher Profits

Frankfurt/Main, Shanghai, 15th May 2014 - Efficient textile production in terms of energy and resources was the main topic of German exhibitors at ITMA ASIA + CITME 2014, mid of June in Shanghai. Volatile prices and sporadic shortages for energy as well as commodities and stricter environmental legislation put textiles producers in Asia under pressure to adjust. Member companies of the VDMA Textile Machinery Association demonstrate at ITMA ASIA + CITME 2014 that latest German technology increases profits by higher energy efficiency. VDMA experts examined the energy saving effects over the entire production chain of three textile products. Major results of this in-depth analysis of German Technology were summarized in brochures that were obtained at the VDMA booth and the booths of numerous VDMA member companies at ITMA ASIA.

Energy-efficient processes - from fibre to the final textile product

VDMA's approach of the analysis is to cover the complete value chains from the raw material to the finished product, e.g. a functional T-Shirt. To manufacture this type of product, the process starts with spinning and texturizing of polyester yarn followed by the warp preparation. To produce the textile fabrics, warp-knitting technology is used, e.g. an automatic warp knitting machine. In the following process step of textile "finishing", this material is washed, dyed black and finished (i.e. functionalized by applying special properties such as dirt repellent, waterproof and water vapor permeable layers), dried and finally completed by setting. For all these steps, from filament production to finishing not only the electrical energy consumed - including compressed air and air-conditioning - but also the thermal energies like gas, oil, or steam have been taken into account.

From the beginning of June, trade professionals have the chance to read the full stories of three product specific examples and witness the huge energy saving potential that can be realised with the help of German textile machines on http://machines-for-textiles.com/blue-competence (in English) and on http://china.vdma.org (in Chinese).



Competition featuring attractive prizes

Visitors to the websites have the chance to prove their know-how in energy efficiency in a competition featuring attractive prizes on http://machines-for-textiles.com/blue-competence and
http://china.vdma.org.

German exhibitors - Sector groups

115 German companies have registered for ITMA ASIA + CITME 2014. All renowned German manufacturers will be present at the leading trade fair for the Asian

market. The German exhibitors will cover almost all different machinery chapters with a strong focus on spinning, finishing, knitting, nonwovens, weaving and winding technology. For visitors it will be easy and convenient to find and visit German exhibitors as most of them will use the "German Technology" logo. Furthermore, VDMA has initiated German sector groups in hall E1 (weaving), E6 (finishing) and W1 (spinning).

GERMAN Technology

At the booth the above mentioned brochure "German Technology: Higher Energy Efficiency - Higher Profits" will be presented. Furthermore VDMA provides useful information for visitors:

- The VDMA ITMA ASIA Guide, listing all exhibiting VDMA member companies according to halls,
- The 2014 Chinese edition of the Buyers' Guide "German Technology - The investment always pays off", showing in a neat matrix the production program of all member companies of the VDMA Textile Machinery Association,
- The VDMA textile machinery energy efficiency guide "Conserving resources - securing savings-potential".

For further information please contact,

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nicolai.strauch@vdma.org

VDMA Textile Machinery

German Technology Combats Pollution

German technology can play a major role in Chinese efforts to make the environment cleaner and to increase the energy efficiency of the textile industry. On occasion of a guided tour initiated by the German VDMA Textile Machinery Association at ITMA ASIA + CITME in Shanghai, high representatives from Chinese authorities and associations and the German General Consul in Shanghai, Dr. Wolfgang Röhr could convince themselves of the energy saving equivalents enabled by German textile machinery. The savings potentials are enormous: The output of two coal power stations every year, the daily output of the Three Gorges Dam power station, the electricity to power 200 million notebooks one day.

In his address to the Chinese trade press, Dr. Röhr said: "Facing the global challenges climate change is imposing, it is of utmost importance to find a way to decouple economic growth and energy demand. The use of energy efficient technology is one of the most promising measures to approach this goal." Thomas Waldmann, Managing Director of the VDMA Textile Machinery Association added: "Adjusting to volatile energy prices as well as stricter environmental standards provide a challenge for many textile producers. The German exhibitors here in Shanghai provide profound technological answers on how to cut costs by increasing efficiency."

Energy-efficient Processes From Fibre to the Final Textile Product

VDMA experts examined the energy saving effects over the entire production chain of three textile products: A cotton T-Shirt, a functional T-Shirt and a textile billboard. Major results of this in-depth analysis of German Technology are summarized in a brochure titled "German Technology: Higher Energy Efficiency - Higher Profits", that can be obtained at the VDMA booth and the booths of numerous VDMA member companies at ITMA ASIA or can be downloaded from the websites china.vdma.org (Chinese) or machines-for-textile.com/blue-competence/stories (English and German). On theses websites trade professionals can also read the complete three examples that provide detailed information on which technological measures the increase in energy efficiency is realised. The analysis is comparing German technology of model year 2013 with German technology available one decade ago. This energy efficiency campaign of VDMA and its members is embedded in the sustainability initiative Blue Competence.

What have cotton T-shirts to do with power plants?

Cotton T-shirts are part of the basic garment. German technology reduced 28 % of energy consumption for the production of jersey fabric during the past ten years. The saving effects applied to the production of one T-shirt per year for each of the 7 billion inhabitants of the earth are enormous. If the worldwide production of cotton T-shirts was made completely on German state-of-the-art technology the output of two coal power stations in Beijing with a total gross power of 1000 megawatt could be saved every year.

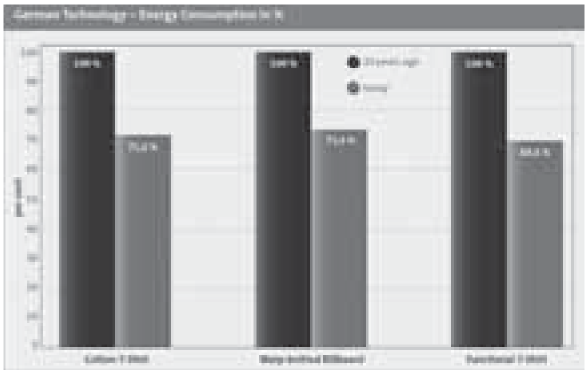
Functional T-shirt - Energy savings feed 200 million notebooks

The production of functional T-shirts for sports and leisure clearly shows the progress that was made. German technology of model year 2013 consumes 30 % less energy than the predecessor machines and components ten years ago. Translated to 125 million functional T-shirts, which are produced per year worldwide, the overall energy saved for the process steps from yarn manufacturing over warp-knitting up to finishing sum up to 23.5 billion watt hours per year. This is the same energy necessary to power 200 million notebooks during one working day. There is one prerequisite only: All T-shirts will have to be produced with German state-of-the-art textile technology.

The bigger textile billboards get, the more energy matters

Large-area advertising at facades and highways represent a young and ever growing sales segment. The warp-knitted fabric used for outdoor advertising of roundabout 400,000 tons produced worldwide throughout one year would be sufficient to transform the overall metropolis of Guangzhou - covering at least 3,442 square kilometres - into a giant textile billboard. If German machinery technology of latest generation was used exclusively for the production of these textile advertising media, enormous energy savings would be possible for each individual process step.

This sum up to 26 %. This is equivalent to 300 billion watt hours (300 GWh) per year and the daily output of the world's biggest hydroelectric power station at the Three Gorges Dam in the Yangtze River.



Lucky draw featuring attractive prizes

Until 30th June 2014, textile manufacturers have the chance to prove their know-how in energy efficiency in a competition featuring attractive prizes. The questionnaire can be answered and sent via internet at china.vdma.org (Chinese) or machines-for-textile.com/blue-competence (English).

German technology on more than 7,400 square meters

About 115 German exhibitors are on hand at ITMA ASIA + CITME 2014, occupying more than 7,400 square metres of booked space. Measured by square meters, Germany is the biggest foreign exhibiting nation at the major fair for the Asian market. All renowned German manufacturers are present. The German exhibitors cover almost all different machinery chapters with a strong focus on spinning, finishing, knitting and warp knitting, nonwovens as well as weaving technology. For visitors it will be easy and convenient to find and visit German exhibitors as most of them will use the "German Technology" logo. Furthermore, VDMA has initiated German sector groups in hall E1 (weaving), E6 (finishing) and W1 (spinning).

The first point of contact for trade professionals interested in German technology was at the VDMA information booth in the Association Village Tent: Booth T1A01.

For more information please contect,
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Textreasure

A smart man makes a mistake, learns from it, and never makes that mistake again. But a wise man finds a smart man and learns from him how to avoid the mistake altogether.

- Roy H. Williams

ITAMMA India's strong participation at 'INDO inter TEX 2014'

The 12th Indonesia International Textile and Garment Machinery & Accessories Exhibition was held on April 23-26, 2014 at Jakarta International Expo - Kemayoran, Jakarta, Indonesia.

ITAMMA was the only Indian association that participated in the 12th edition of 'INDO inter TEX 2014', the Indonesia International Textile and Garment Machinery & Accessories Exhibition, organized jointly by PT. Peraga Nusantara Jaya Sakti, Indonesia. The exhibition received a tremendous response from 807 exhibitors from 25 countries, including 41 Indian exhibitors. ITAMMA took 23 of its members to showcase their specialized services.

Mr. Rakesh Kumar Arora, First Secretary from the Indian Embassy of Indonesia interacting with ITAMMA's President Mr. Diven Dembla

Activities organized at ITAMMA Stall 49 in the Hall D-2:

ITAMMA showcased its services as well as the products of its members at Stall No.49 in Hall D2. The trend of visitors registered at ITAMMA Stall was 52.81% from Spinning, 23.59% from Weaving, 12.36% from Wet Processing, and 11.24 % were from Garment Apparel Industry & others. While the category of visitors were 8.89% of Traders/Agents interested in purchasing and selling the products, 7.87% of Owners from all fields (out of this 20% Owners were from Garment & Apparel Industry)

Catalogue display of ITAMMA members during the Networking Dinner at Sunlake Hotel

ITAMMA's initiative during 'INDO inter TEX 2014' for its members:

A special 'Catalogue Display Scheme' was organized for its members who were not able to participate in the above Exhibition and there was an overwhelming response from the following members:

Continental Engineering Industries Pvt. Ltd.	info@continentals.in
Dynamic Autolooms India Pvt. Ltd.	acc@dynamiclooms.com
Excel Industrial Gears Pvt. Ltd.	mayank_roy@hotmail.com, excelpiv@mtnl.net.in
KRSNA Engimech Pvt. Ltd.	chandreshshah09@gmail.com
Maksteel Wire Healds Pvt. Ltd.	maksteel@maksteelindia.com
Manvi Textile Air Engineers Pvt. Ltd.	info@textair.in / textair@vsnl.net
Patco Exports Pvt. Ltd.	patcoexports@gmail.com
Sanjay Plastics & Industrial Service	info@sanjayplastics.com
Shiva Engineering Works	sewgwl@gmail.com
Shreejikrupa Exports Pvt. Limited	info@shreejikrupa.com

Shree Ram Textile textile@shreeram-group.com
Srinivasa Textile
Equipment Company srinivasaspikes@yahoo.com
Sumanlal J. Shah & Co. sumanlal90@gmail.com
Sumanlal J. Shah Sons
(P) Ltd. sumanlal@sumanlal.com
Sunrise Industries panchal@sify.com
Suprabhatam Textile
Equipments supratex1@gmail.com
Technocraft
Industries techno_craft@yahoo.co.in
Texpares Machine
Works texsparesmachineworks@gmail.com
Unitech Texmach
Pvt. Ltd. admin@unitechtexmach.com,
Vinit Rubber
Works vrw@shahpolychem.com,
vinitrubberworks@gmail.com

Also during the exhibition, ITAMMA Logo was displayed at 23 Stalls of the Member-Exhibitors of ITAMMA. During the Exhibition among the renowned identities, Mr Rakesh Kumar Arora, First Secretary from the Indian Embassy at Indonesia, visited ITAMMA Stall & also had interaction with ITAMMA's Office Bearers & other members.

Mr. Diven Dembla, delivering the Welcome Speech

A Networking Dinner was organized by ITAMMA for ITAMMA member-exhibitors & the Entrepreneurs/Industrialists from the User Industry on 23rd April 2014 at the Sunlake Hotel in Indonesia. Mr Diven Dembla, President, ITAMMA Welcomed the guests & ITAMMA members. About 88 participants attended the event, which was clubbed with a Catalogue display of about 32 ITAMMA members.

Mr. Rakesh Kumar Arora, First Secretary from the Indian Embassy of Indonesia interacting with Mr. J.M. Balaji at LRT Stall

Mr. Rakesh Kumar Arora, First Secretary from the Indian Embassy of Indonesia interacting with Mr. Senthil Kumar at Simta Manufacturing Company stall

Mr. Rakesh Kumar Arora, First Secretary from the Indian Embassy of Indonesia interacting with Mr. Kishore Khaitan at Basant Wire Industries stall

Mr. J M Balaji & Mr Pawan Kumar along with Mr. N D Mahtre at ITAMMA Stall no 49, D-2

THE TEXTILE ASSOCIATION (INDIA) - Central Office

Mr. ArvindSinhaelected as New President of TAI

The Textile Association (India) has been elected the new Office Bearers for the term 2013-2015 during their Governing Council Meeting held on 05-07-2014 at Ahmedabad.

In the election by ballot papers, Mr. ArvindSinhahas been elected by majority and Mr. K.D. Sanghvihas been elected unopposed as Vice President.

Mr. ArvindSinha
President

Mr. ArindSinha is B.Text Tech from TIT, Bhiwani and MMS from Bombay University have been involved with various industries in India and abroad for last thirty years. He has been very actively involved with World Bank and IMF for last many years for various projects and received many Appreciation and merit Certificates for his involvement his studies and project work.

Mr. Sinha is currently Chief Advisor and CEO of Business Advisors Group which is a leading sourcing company for Relief Supplies globally and also the content creator and provider for critical studies and management issues.

He is a Specialist on Chinese matter and involved internationally with various Institutions for studies on China and Far East. He is also a speaker on Chinese matter, Chinese Economics and Chinese model for success. He is also actively involved in promoting and implementing Food Safety Management System under USFDA guidelines. He is an Art and Antique collector and three of his records are listed in Guinness World Record.

Mr. D.R. Metha
President Emeritus

Looking to the initiative taken by Mr. D.R. Mehta, Immediate Past President, for the growth and development of TAI, the Governing Council appreciated his meticulous services rendered by him and honoured as President Emeritus.

Mr. D.R. Mehta is B.Sc.(Textiles), P.G.C.B.M., F.T.I. (Manchester), F.I.E., F.T.A. & Chartered Engineer. He is having more than 43 years working experience in India & Abroad in Textiles, Manmade Fibres, Embroideries, Administration and Liaisoning with Govt. Authorities. He is Ex-Chairman & Managing Director, NTC, MN (Govt. of India). He is associated with Hakoba Embroideries and with Eurotex Industries & Export Ltd. since last 8 years.

Mr. K.D. Sanghvi
Vice President

Mr. K.D. Sanghvi is B-Text from VJTI and having done Industrial Management. He is techno-commercial man and vast experience in the Textile Industry. He is very enthusiastic and trouble shooter. He is associated with several social organizations. He has been conferred by Service Gold Medal in the year 1997 by The Textile Association (India). He is associated with TAI since last 28 years and has had important positions in TAI. He has been awarded Service Memento in 1993. Now Mr. K.D. Sanghvi has been elected unopposed as Vice President.

Presently he is dealing with Yarn Trading.

Mr. V. D. Zope
Chairman

Mr. V.D. Zope obtained a Bachelor Degree in Textile Technology in the year 1975 from Bombay University with 2nd rank in the merit list. He was awarded Research Fellowship by Century Mills, Mumbai under the guidance of BTRA, Mumbai for obtaining Post Graduate Degree in Textile Technology of Mumbai University. He has vast experience of 34 years in private and public sector textile mills. He is very much associated with The Textile Association (India) and had worked with the capacity as Hon. Treasurer, Hon. Jt. Secretary.

Mr. Haresh B. Parekh
Hon. Gen. Secretary

He is an x-student of SASMIRA, who has completed his Diploma in Weaving in the year 1977. After the completion of studies he joined Hindustan Spinning and Weaving Mills, Mumbai and there after served in reputed textile houses like, Mafatlal Group of Industries and Standard Group and Orkay Silk Mills.

Mr. Parekh is the active member of The Textile Association (India) (TAI), Mumbai Unit since 1983 and has been serving as Hon. Jt. Gen. Secretary of TAI, Central Office since 2007.

He takes keen interest in encouraging educational activities of the association and actively organized many conferences / seminars with the main intention of keeping the textile professionals updated with the various developments in the technological field.

Also Following Members were elected:

Dr. N.N. Mahapatra
Vice Chairman

Mr. M.G. Shah
Hon. Jt. Gen. Secretary

Mr. VirendraJariwala
Hon. Jt. Gen. Secretary

Mr. V.N. Patil
Hon. Treasurer

Jeanologia bets on the introduction of the technology in China to be kept as textile power

The Spanish company world leader in sustainable technologies for garment finishing, it has been awarded with WGSN Global Fashion Award for the best sustainable design team in the world.

The use of techniques for processes automation and the development of sustainable production are the key to reducing costs and increasing productivity in the sector.

Since 2013, the company has a Demo Center in Guangzhou which provides specialized training in technologies that allow savings in water, energy, chemicals and time in garment finishing.

Jeanologia participated at the ITMA Asia which was from between 16 to 20 June, where they showcased the latest developments such as lasers, ozone and e-flow.

The Spanish company Jeanologia, specialized in the development of sustainable technologies for garment finishing is committed to the introduction of technology in China in order to remain a textile power.

As stated by the president of Jeanologia, Enrique Silla, "the costs of labor in China have increased and this has made, in just two years, a change in the industrial scenario. Before it was based on cheap labor force, now must invest in technology to obtain lower costs. "

"It is a key to the introduction of technologies that automate manufacturing while ensuring sustainable production basically eliminating waste of huge amounts of water and environmental contamination. This change has to be fast because many companies would not survive ", Enrique Silla emphasized.

In this sense, sustainable technologies such as laser, ozone and e-flow, developed by the Spanish company, are the best partner for transforming the textile industry in China because they save water, energy and chemicals while reducing costs in the garment finishing process and highly increases productivity.

Jeanologia, working in China for the last 10 years, shows its strong commitment to this country as a power of the textile industry and example of this is the recent opening of a development center in Guangzhou and the incorporation of a technical and commercial team in Hong Kong.

Currently, 5% of the jeans produced in China are made with Jeanologia technology both for the export of global brands such as GAP, American eagle or G-start, as the domestic market for brands such as Jack & Jones China, Meters bonwe, Peace bird.

A path supported by over 20 years of experience and the prestigious WGSN Global Fashion Award for best sustainable design team in the world, has become the Spanish company Jeanologia the world's leading in the development of sustainable technologies for finishing garments.

Jeanologia in China

Since 2013, as a demonstration of its commitment to sustainable and efficient growth of the textile industry in China, Jeanologia has Demo Center of sustainable technologies in Guangzhou

In this center, which is the first of its kind launched in China, shows "one to one" are carried out and has been established as a reference center in Asia for the demonstration and specialized training in sustainable technologies, such as laser and ozone to automate the production process while reducing costs of production and saving water, energy and chemicals to avoid processes damaging the health of workers.

From Jeanologia, which is committed to ethical and responsible industry, it is expected that in just five years China will remain the largest producer of jeans in the world thanks to the efficiency of this type of technology.

Jeanologia in ITMA ASIA

Jeanologia showcased its latest innovations in sustainable technologies in the ITMA ASIA which was held on 16 to 20 June in Shanghai.

At its booth, E4 H01, they presented the G2 ecowasher that reduces by more than 60% water consumption and energy and about 85% in chemicals. Furthermore, it eliminates the use of toxic processes

like bleaching and using permanganate. This machine uses ozone and oxygen in the atmosphere to wear down color in the garment creating an authentic vintage style.

E-flow system that, based on the technology of nanobubble acts as a properties carrier vehicle for clothes without using water or chemical will be also displayed. This technology "zero discharge" of waste is completely free and allows multiple features such as softening, 3D effects with resins, water repellence and easy care.

Finally, the Flexi HS, textile laser machine reproduces in an automatic and efficient way wear and tear, denim elements, ripped or broken textures in garments without harming the health of workers and the environment, saving energy, water, chemicals, hand labor and time in the production process. The Flexi HS works both as mannequin and table and is designed to work in 5-pocket trousers, shorts, shirts, jackets and accessories, adapting to the needs of each manufacturer or designer.

It also incorporates the latest electronic technology that increases the marking speed, while the power consumption is reduced in each garment.

About Jeanologia

Nowadays the Spanish company has customers across 5 continents and exports of machinery and services accounts for 90% of turnover. Jeanologia products and solutions are currently being used in more than 45 countries including: México, Colombia, Brazil, USA, Germany, Italy, Portugal, India, China, Russia, Japan, Morocco, Bangladesh and Vietnam.

Specifically, major brands such as Levi's, Polo Jeans, Abercrombie & Fitch, Edwin Japan, Pepe Jeans, Diesel, Hilfiger Denim, Salsa jeans, Jack &Jones, Replay and other large retailers such as GAP, Uniqlo, Zara, and H&M among others have placed their trust in this leading Spanish company and the techniques and technologies developed by it.

Jeanologia will present EIM in Bangladesh

The Spanish Company, world leader in sustainable technologies development for garment finishing, has been recently awarded with WSGN Global Fashion award for the best sustainable design team in the world.

Begoña García, head of sustainable processes of Jeanologia, participated in the "The Bangladesh Water PaCt" which will also display technology developed by the company for sustainable garment finishing.

Jeanologia has since 2013 a training center in Bangladesh specialized in laser technology and ozone to improve the conditions of workers in the jean industry and respect the environment.

The Spanish company Jeanologia specialized in the development of sustainable technologies for garment finishing will present in Bangladesh its EIM (Environmental Impact Measuring) software. This is the first software in the world able to measure the environmental impact of the textile industry and allow the industry laundries and garment finishing processes to carry out a more sustainable activity.

Begoña García, responsible of sustainable processes for Jeanologia, presented this tool at "The Bangladesh Water Pact", held on 9 and 10 June 2014 in Dhaka. Specifically, participated in the conference, "Alternatives to conventional denim finishing practices" where she explained that, using EIM, the technology developed by the company for sustainable garment finishing, it is possible to save huge amounts of water, chemicals and energy in addition to respect the health of employees.

The software powered by Jeanologia is a great contribution to the denim industry because it allows industry professionals to assess the environmental impact of its activity by calculating the consumption of water, energy, chemical use and the impact on the health of workers.

As highlighted by Jeanologia President, Enrique Silla, the EIM software enables professional laundry and textile brands to optimize both their washing processes and production costs.

"EIM helps brands to work with its production centers, regardless of the country of production, following all the same parameters for creating their collections in a way that respects the environment," remarked Enrique Silla.

In this regard, he stated that it is essential that the denim industry become aware of the importance of protecting the environment through technological advances that allow the creation of vintage collections respecting the environment and health of workers. "The future of the textile industry through integration and sustainable design techniques developing good products that respect the environment," stated the president of Jeanologia.

Currently brands such as Jack & Jones, H & M or G-Star use the EIM software in its production centers around the world.

Over 20 years of experience and the prestigious WGSN Global Fashion Award for best sustainable design team in the world, supports the path of this company, which has been positioned as a world leader in the development of sustainable technologies for garment finishing.

The goal of "the Bangladesh Water PaCt" is to show the commitment of both brands of jeans as well as retailers and the government itself to work in the same direction in order to reduce water consumption and improve working conditions for the denim production. Another aim is to show solutions and products that have proven successful from the perspective of sustainability and viability and that are available in Bangladesh market.

JEANOLOGIA IN BANGLADESH

Jeanologia has a training center specialized in laser technology and ozone in Bangladesh, since 2013, to improve the conditions of workers, demonstrating its social commitment to the more than 3 million people who are dedicated to making Jeans in this country.

In its commitment to ethical and responsible industry, this initiative has been introduced into this country friendly technology to operator's health and environment

The headquarters, located in Dhaka, is a training and demo center of laser and ozone technologies, teaching how to process jeans while ensuring health and safety conditions for workers, maintaining quality and the most competitive price, first respecting people involved in the process and then the environment.

On the 11th of June, Begoña García, responsible of sustainable processes for Jeanologia, performed a workshop at this center in which laundries and brands learned how to optimize their production processes and reduce their EIM score for, in this way, achieve more sustainable production.

Through this project, Jeanologia wants to contribute to the textile industry in such an important market as the Bangladeshi with about 44,000 textile factories that has become the country with the world's largest textile production.

About Jeanologia

Today Jeanologia is considered a world leader in sustainable technologies for garments finishing. This company designs and develops laser and eco systems that improve industrial productivity, provide energy efficiency, reduce water consumption and eliminate waste and harmful emissions such as Eco washer G2 and E-flow technology.

Nowadays the Spanish company has customers across 5 continents and exports of machinery and services accounts for 90% of turnover. Jeanologia products and solutions are currently being used in more than 45 countries including: México, Colombia, Brazil, USA, Germany, Italy, Portugal, India, China, Russia, Japan, Morocco, Bangladesh and Vietnam.

Specifically, major brands such as Levi's, Polo Jeans, Abercrombie & Fitch, Edwin Japan, Pepe Jeans, Diesel, Hilfiger Denim, Salsa jeans, and other large retailers such as GAP, Uniqlo, Zara, have placed their trust in this leading Spanish company and the techniques and technologies developed by this company.

World-Renowned Color Management Experts Speak at Workshop

AATCC's Color Management Workshop will be held on August 26-27 at the AATCC Technical Center in Research Triangle Park, NC, USA.

Color plays a vital role in a consumer's decision to purchase a particular product. In order to get the color envisioned by the designer and demanded by the consumer, the communication of color throughout the supply chain is imperative, especially in textiles items which contain many components.

AATCC's Color Management Workshop on August 26-27 at the Association's Technical Center in Research Triangle Park, NC, USA, will feature world-renowned color experts. These experts will discuss color principles and the effect of lighting; factors to consider when developing a color palette and how these choices affect cost, fashion, durability, and dyeing reproducibility; how to implement a digital color program with a supplier; managing color on multiple textile substrates; how to control shade from concept to production; and much more.

This workshop is designed for merchandisers, retailers, manufacturers, product developers, color approval managers, specifiers, and designers. Participants will have an opportunity to have their color questions answered during the presentations and breakout sessions. Breakout sessions will focus on illumination and observer issues; sample analysis and measurement technique; creativity with trends and virtual development; what is color matching; production evaluation and control; and how to do the right color right.

For further information please contact,
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Email: nicholk@aatcc.org | www.aatcc.org I www.aatcc.org/media/pr

Textsmile

Son to his mother "The people next door must be poor."
Mother said, "Why do you say that?" The son replied, "Because they made such a fuss when the baby swallowed a ten paise coin."

Overall Shipments of New Textile Machinery Slightly Down in 2013

In 2013 shipments fell in most segments, though remained on a relatively high level. In comparison to 2012 global shipments of new short-staple spindles rose by +10% while those of open-end rotors decreased slightly by -2% and those of long-staple spindles dropped by -45%. Also the number of new draw-texturing spindles shipped was down by -29%, those of new shuttle-less looms by -4%,and those of new electronic flat-knitting machines by -24%. Worldwide shipments of new large circular knitting machines in 2013 remained unchanged on the record level of 2012.

These are the main results of the 36th annual International Textile Machinery Shipment Statistics (ITMSS) just released by the International Textile Manufacturers Federation (ITMF). The report covers six segments of textile machinery, namely spinning, draw-texturing, weaving, large circular knitting, flat knitting and finishing machinery. The 2013 survey has been compiled in cooperation with some 117 textile machinery manufacturers, representing a comprehensive measure of world production.

Spinning Machinery

After shipments of new short-staple spindles plummeted in 2008 (-33%) and 2009 (-17%) they soared in 2010 (+75%) to pre-crisis levels and increased in 2011 by a further +15% reaching 14.33 million, an all-time high. In 2012 shipments of short-staple spindles fell by -27% to 10.51 million spindles but rose again in 2013 by +10% to 11.56 million. 93% of all shipped short-staple spindles in 2013 were destined for Asia (10.72 million), with China alone absorbing 6.21 million or 54% of global shipments, followed by India as distant second (2.19 million spindles or 19%), Indonesia (757,000 or 6.6%), Turkey (566,000 or 4.9%) and Pakistan (546,000 or 4.7%).

Global shipments of long-staple (wool) spindles dropped in 2013 by -45% from 146,400 to 80,800. Europe was the main recipient (49,900 or 62%), followed by Asia (28,950 or 36%) and the Americas (1,900 or 2.4%). The single biggest investor in long-staple (wool) spindles was Turkey wit 34,300 spindles (or 43%), followed by China with 26,550 spindles (or 33%), Romania with 6,050 (or 8%), Italy with 5,000 spindles (or 6%) and Poland with 2,900 (or 4%).

As far as open-end rotors are concerned global investments decreased slightly in 2013 by -2% to 443,200. Asia was once again the region that absorbed by far most of the new rotors (351,400 or 79% of global shipments). By country, China was the dominant investor putting in place 271,740 or 61% of global shipments. India was again distant second with a total of 30,980 new open-end rotors (7.0%), followed by Turkey with 28,640 rotors (6.5%), Brazil with 13,780 rotors (3.1%), Vietnam with 13,660 rotors (3.1%) and Malaysia with 12,040 rotors (2.7%).

Texturing Machinery

From 2010 to 2011 global shipments plummeted from 13,200 to only 1,824 (-86%). In 2012 no shipments of single heater draw-texturing spindles (mainly used for polyamide filaments) were recorded. In 2013 shipments reached 2,600 spindles of which 2,120 went to Asia (China 960, Chinese Taipei 840 and Thailand 320) and 480 to Europe, Others (Turkey).

In the segment of double heater draw-texturing spindles (mainly used for polyester filaments) investments dropped from 717,760 to 505,080, a decline of -29%. 90% (or 455,640) of all shipments went to Asia. By far the biggest single investor in this type of draw-texturing machinery was again China where 366,480 new spindles or 73% of global shipments were installed, followed by distant second Japan with 30,860 or 6.1%, India with 21,640 or 4.3%, Vietnam with 8,160 or 1.6%, and Egypt with 7,920 or 1.6%.

Weaving Machinery

Worldwide shipments of shuttle-less looms fell slightly in 2013 from 86,450 machines to 83,420, a fall of -4%. The main reason for this development was a further decline in shipments of water-jet looms. After a skyrocketing jump of +537% to 73,250 in 2010 and to 112,930 in 2011, which was partially due to the fact that more weaving machinery manufacturers reported for the first time in 2010, global deliveries of water-jet shuttle-less looms dropped by -65% to 39,920 machines in 2012 and by -13% to 34,580 in 2013. In the shuttle-less loom segment of rapier/projectile looms shipments increased marginally from 23,250 in 2012 to 23,830 in 2013, an increase of +2.5%. Also deliveries of shuttle-less air-jet looms increased from 23,300 in 2012 to 25,010 (+7%). As in previous years the main destination of shuttle-less looms was Asia, where 76,390 or 92% of all new shuttle-less looms were installed. Country-wise the biggest global investor was again China with 54,830 looms (66%), of which 30,590 were water-jet looms, 16,330 air-jet looms and 7,910 rapier/projectile looms. With 10,060 shuttle-less looms (12%) of global shipments India was the second biggest investor, followed by Indonesia (3,110 or 3.7%), Turkey (3,010 or 3.6%), Bangladesh (2,820 or 3.4%) and Korea (1,290 or 1.5%).

Circular & Flat Knitting Machinery

Global shipments of large circular knitting machines increased by +27% from 28,900 in 2011 to 36,640 in 2012 which set a new record. In 2013 the amount of machines remained practically unchanged at 36,575. Also in this segment Asia was the main regional investor in this type of machinery absorbing 33,440 units or 91% of all new machines shipped in 2013. The biggest single investor was once more China with a total of 27,460 (a global market share of 75%) followed by India with 1,600 (or 4.4%), Turkey with 1,490 (or 4.1%), Bangladesh with 910 (or 2.5%), and Indonesia with 850 (or 2.3%).

In the segment of electronic flat knitting machines, global shipments in 2012 dropped by -34% to 46,100 machines. Also in 2013 global shipments recorded a decline of -24% to 35,180. The bulk of global shipments of electronic flat knitting machines was delivered to Asia (30,300 or 86%), while Europe's share (including Turkey) reached 12% (4,350 machines). The biggest single investor in 2013 was China with 20,800 new machines (59%), followed by Bangladesh with 3,960 (11.3%), Turkey with 2,790 (7.9%), Hong Kong with 1,850 (5.3%) and Italy with 790 (2.3%).

Finishing Machinery

The 2013 edition of ITMF's International Textile Machinery Shipments Statistics included for the nineth time also data on finishing machinery (wovens and knits continuous machinery).

Rieter in China: Successful Forum for Spinning Industry Entrepreneurs Cross Strait

In Spring 2014?the forum for spinning industry entrepreneurs cross strait organized by Rieter achieved a great success in Taiwan. The 5-day forum attracted nearly 40 participants from the China Cotton Textile Association (Mr. Jianchun Ye), top Chinese spinning mills, the Taiwan Textile Federation, the Taiwan Spinners' Association and Taiwanese spinning mills.

Far Eastern management and representatives from the China Cotton Textile Association and mainland top spinning mills.

Stimulating discussion among the across strait entrepreneurs and associations

The forum took automation in the spinning industry as its subject. The topic mainly focused on the solution to lack of labour and sustainable development, on which the attendees held a stimulating discussion, especially on the hotspots such as automation realization, product innovation and spinning mills' core competency. A subsequent plant visit was arranged to the highly automated spinning mill of Far Eastern New Century Corporation.

Great interest in automation in Far Eastern

Total Automation in Far Eastern

Since 1998?the Far Eastern New Century Corporation Hukou Mill has adopted the fully automatic Rieter system including ring spinning machines (70 000 spindles) and rotor spinning machines (2800 rotors). To ensure perfect product appearance and efficiency, Far Eastern integrated the whole process from fibre preparation to stocking and delivering products with highly-automated equipment like link system between roving, ring and winding, automation transportation system for laps, sliver cans, yarn bobbin, automatic packing and stocking warehouse. Even after running for 16 years, the machines still remain in a fairly good condition. "After launching Rieter spinning machines, the manpower went down to 10 operators/10,000 spindles and the production efficiency keeps 5 % higher than that of the peers, and the stable Com4® yarn quality is well recognized by their customers. And that's why we installed another 9 Rieter R 60 fully automatic rotor spinning machines (3,600 rotors) in 2012" said Mr. Tianjue Lo, Senior Vice President of Far Eastern Spinning Division.

Far Eastern management and representatives from the China Cotton Textile Association and mainland top spinning mills

Changed mindset to total automation in spinning mills

The representatives from top mainland spinning enterprises like the Esquel Group and the Anhui Huamao Group expressed great thanks to the forum: it not only helped them to understand and learn the Taiwanese spinning mill management experience, but also impressed and changed their mind-set towards the concept of total automation in the spinning mill. They will review and upgrade their machines to secure a more highly modern automated spinning mill upon their return.

About Rieter

Rieter is a leading supplier in the world market for textile machinery and components used in short staple fiber spinning. Based in Winterthur (Switzerland), the company develops and manufactures systems, machinery and technology components used to convert natural and manmade fibers and their blends into yarns. Rieter is the only supplier worldwide to cover spinning preparation processes as well as all four final spinning processes currently established on the market. With 18 manufacturing locations in ten countries, the company employs a global workforce of some 4800, about 25 % of whom are based in Switzerland.

Rieter is listed on the SIX Swiss Exchange under ticker symbol RIEN. (www.rieter.com)

Successful Exhibition Start at the ITMA ASIA + CITME 2014 in Shanghai

Rieter delighted its customers at the ITMA Asia + CITME 2014 with many novelties and highlights. On its booth D01 in Hall W4 Rieter presented products and services for the success of their customers. The 4 end spinning technologies presented live on the booth draw the attention of the visitor as well as the technology corner representing the application of the 4 Rieter Com4® yarns in fabrics and end products.

High Ranking Visitors

From the beginning of the exhibition Rieter was proud to welcome many visitors on its booth. Besides important customers from all over the world, a couple of high ranking visitors from textile associations visited Rieter during the first days. It was an honour for Rieter to welcome the CNTAC (China National Textile & Apparel Council) delegation to the stand.

From left to right: Wang Tiankai (President CNTAC), Dr. Norbert Klapper (CEO Rieter), Christian Flüge (Head of Markets Rieter)

Stimulating Discussions

With customers and visitors the booth staff could discuss many interesting projects. In focus were discussions about Rieter's energy saving solutions, the 4 end spinning technologies and the latest parts and conversions. Thanks to the interesting exhibits the innovations could be discussed either by means of models or running machines.

Stimulating discussion on the Rieter Booth

Far Eastern Cares for the Environment

After one year testing on one machine Far Eastern decided to retrofit 40,000 ring spindles with suction tube ECOrized.

The well maintained G 33 ring spinning machines run since 1998 to the full satisfaction of Far Eastern at high speed and low yarn break rates.

From left to right: (front, Far Eastern) Tseng Hwa-Hong, Jack J.J. Wu, David Tang; (back, Rieter) Dennis Chen, Kurt Frei, Edda Walraf, Roger Eberhart, Urs Tschanz, Michael Kuo

After one year testing Far Eastern summarizes that thanks to suction tube ECOrized they are able to reduce power consumption of the test machine from 5.5 to 1.9 KW. This high savings led to the decision to retrofit the total ring installation.

The New R 35 Rotor Spinning Machine with 500 Spinning Positions for Highest Productivity

The semi-automatic R 35 rotor spinning machine is now available with 500 spinning positions and is therefore the longest rotor spinning machine in its class. The R 35 is a smart and economical solution combined with high productivity.

The semi-automatic R 35 rotor spinning machine is now available with up to 500 spinning positions and is therefore the longest machine in its class.

The R 35 is an economical alternative for production of high-quality rotor yarns in the yarn count range from Ne 2 to Ne 40, for applications that can dispense with full automation. The machine offers the greatest flexibility and easiest operation in its class.

Increased productivity with 500 rotors and higher speed

The R 35 with up to 500 rotors is currently the longest machine in its segment. The improved spinning stability enables a high level of machine efficiency, even at maximal machine length. Due to its stable construction, it achieves constant rotor speeds of up to 1,20,000 min-1 and delivery speeds of up to 200 m/min.

Better yarn quality from the same raw material

The new S 35 spin box with more efficient sliver opening, designed to the newest technological standards, allows better yarn evenness and fewer imperfections. By means of the optimized fibre guidance in the spin box, the raw material is better utilized and the spinning stability increased. The improved yarn quality is enhanced with the further developed AMIspin® yarn piecer with higher strength and lower variation as well as with the new optical Q 10 quality sensor. This guarantees an excellent and comprehensively controlled yarn quality.

Easy and flexible operation

The machine concept with a low working height makes easy operation and quick handling of the AMIspin® piecer possible. The extraordinary flexibility of the R 35 is guaranteed by two package transport belts for the yarn bobbins and independent drives for both machine sides. This means that two lots can be simultaneously spun on one machine.

Rapid Start after Power Cut

After a power cut or clearer cuts, the R 35 can carry out piecing very rapidly because thanks to Fast Spinning-In (FSI) searching for the yarn end is eliminated. The piecing action is also easy to prepare for a whole machine so that the start can be made in the shortest possible time. In the process, all piecing are tested by the yarn clearer and have the usual high quality of the AMIspin® technology.

WACKER POLYMERS to Raise Prices For Dispersions in EMEA

WACKER POLYMERS is to maintain its price adjustment for vinyl acetate-based homopolymer dispersions as well as vinyl acetate-ethylene and ethylene-vinyl chloride-based copolymer dispersions of the VINNAPAS® and VINNOL® brand in Europe, the Middle East and Africa (EMEA).

The temporary surcharge of •140 per ton implemented on May 1st 2014 will persist, as customer contracts allow, until further notice. This measure has been necessitated by the ongoing high costs for vinyl acetate monomer (VAM), a crucial raw material for the manufacturing of WACKER's dispersions.

"As long as the prices for vinyl acetate monomer in Europe remain on the current elevated level, we will have to keep in place this surcharge for our dispersions to partially compensate our increased cost", explains John Fotheringham, Vice President Dispersions & Resins at WACKER POLYMERS. "Our focus remains on securing supplies of our critical raw material, and reliably supplying innovative high-quality products to our customers."

Dispersions of the VINNAPAS® and VINNOL® brand are applied in a broad variety of industries, ranging from adhesives, construction, nonwovens, paints and coatings to paper, carpet and textiles.

About WACKER POLYMERS

WACKER POLYMERS is a leading producer of state-of-the-art binders and polymeric additives based on polyvinyl acetate and vinyl acetate copolymers. These take the form of dispersible polymer powders, dispersions, solid resins, and solutions. They are used in construction chemicals, paints, surface coatings, adhesives and nonwovens, and in fiber composites and polymeric materials based on renewable resources.

WACKER POLYMERS has production sites in Germany, China, South Korea and the USA, as well as a global sales network and technology centers in all major regions.

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2nd National Seminar on Non Woven Technical Textiles: Opportunities and Challenges

The PHD Chamber of Commerce and Industry organized second National Seminar on Non Woven Technical Textiles: Opportunities and Challenges on 4th July 2014 at PHD House.

India's technical textiles market which currently is estimated at USD 14 billion is likely to reach a level of USD 32 billion by 2023, hitting a Compounded Annual Growth Rate (CAGR) of 9%, the way the domestic textiles industry is diversifying towards non-woven technical textiles with technological innovations and building global partnership with its counterparts, revealed a paper brought out by PHD Chamber of Commerce and Industry and Technopak on "Non-Woven Technical Textiles: Opportunities and Challenges".

The paper released at the National Seminar on "Non-Woven Technical Textiles: Opportunities & Challenges" by, Mr. Ajay Shankar, Member Secretary, National Manufacturing Competitiveness Council (NMCC) with Mr. Anil Khaitan, Chairman, Industry Affairs Committee of the PHD Chamber, Mr. Ram Singh, Director, Ministry of Textiles and Mr. VivekSeigell, Senior Secretary, PHD Chamber further states that textiles and apparel industry size would balloon at USD 226 billion by 2023.

Left to Right: Mr. Ram Singh,Director,Ministry of Textiles;Mr. Anil Khaitan,Chairman,Industry Affairs Committee, PHD Chamber;Mr. Ajay Shankar,Member Secretary,NMCC and Mr. VivekSeigell,Senior Secretary, PHD Chamber releasing Knowledge Report on Non Woven Technical Textiles

Immediately after releasing the paper, Sh. Ajay Shankar Member Secretary, NMCC pointed out that "given the scope of the technical textiles in emerging economies, the Government of India and the industry needed to build a close partnership and roll out their joint vision for development and promotion of technical textiles now, setting targets for 2025."

Shri Anil Khaitan, Chairman, Industry Affairs Committee, PHD Chamber in his welcoming address said that Inadequate awareness about the benefits of technical textiles among end-users; Lower scale of production; Absence of defined standards and regulations; Lack of indigenous availability of specialized raw-materials hampering cost competitiveness; Lack of skilled manpower for new technologies in Nonwovens; Lack of technology/consultancy support to manufacturers; Lack of basic infrastructure and lack of training / educational facilities are few important issues which need to be addressed in order to accelerate the growth of technical textiles.

During the vote of thanks at the inaugural session Mr. VivekSeigell said, "India's consumer spending is going through a fundamental shift. The increase in per capita income, strong demand for better lifestyle and high disposable income have increased the per capital consumption in textiles and apparel market, benefiting the manufacturers. The Indian technical textiles market has shown new trends due to the expansion of Indian market".

Currently, Indian textiles and apparel industry is estimated to be worth USD 99 billion which includes both domestic consumption and exports and is projected to grow at a CAGR of 8.6 per cent to reach USD 226 billion.

Textiles and apparel exports of India are expected to grow at a CAGR of 8.6 per cent from the estimated value of USD 40 billion at present to USD 85 billion in 2023, further points out the paper.

The factors that contribute to the growth of the industry are vertically integrated supply chain and diverse range of products. In textiles and apparel exports of the country, the share of textiles (60%) is much higher than that of apparel of 40%. Textiles and apparel sector contributes 5.2% of the country's GDP.

During the technical Session Mr. V K Kohli,Director and Office In-charge, Regional Office of the Textile Commissioner,Noida spoke on Schemes of Government of India to promote the Technical Textiles. Dr. ArindamBasu, Director General, North India Textile Research Association (NITRA) spoke on Protective Textiles. Mr. Vikramjit Roy, Managing Director, Maccaferri Environmental Solutions Limited spoke on use of Geosynthetics in Infrastructure Development. Mr. ShrichandSantani, Assistant Vice President, Reliance Industries Limited spoke on Agrotextile and how it can increase productivity. MsSanchitaMajumdar, AGM, Small Industries Development Bank of India (SIDBI) spoke on Financing by Banks and NON Banking Financial Companies. MsVandanaArora Spoke on Various advancements and innovations in technical textile and Mr. Ingo Maehlmann spoke on Machinery or Technology for the Non Woven Technical textile

Addons Accessories to participate in CMAI Trade Fair 2014

Launches their autumn winter collection 2014

Addons the only fashion accessory brand has participate in the year's biggest trade fair CMAI (Clothing Manufacturers Association India) 2014, held in Mumbai from 23rd June to 25th June 2014 at NSE in Goregaon, Mumbai. Addons presence in the event has marked a new beginning for getting both textiles and fashion accessories to come under one roof and provide the best of both the worlds to cater the growing hunger for the fashion industry in the country today.

Addons showcased an exclusive preview for their new collection for Autumn Winter 2014 at the event. Keeping in mind the beauty of mix and match of the outfits and the right accessories, Addons presented a wide array of the various fashion accessories like bags, shoes, earrings and neckpieces. The collection is fresh and adds to the glamour quotient and is apt for dressing up on various occasions, be it a coffee date or an official meeting.

The Addons Autumn Winter collection consist a mixture of trendy colors like shades of nude, the neon hits like greens, popping pink, yellow as well the bold metallic shades that are a popular rage today. The collection is classy yet affordable, being at par with the leading international brands in the country. The designs of these accessories are chosen keeping in mind the ever increasing rage and demand for accessories by various age groups and need state for new fashion on an everyday basis.

This new Autumn Winter collection 2014 by Addons will hit the stores by 1st Week of September.

"It is a very over whelming feeling to launch our new AW14 collection at CMAI. The Addons new Autumn-Winter collection is designed based on international Fashion Trends. The brand has received a lot of appreciation in the past and customers have liked our Collection. This year we have chosen to Launch our collection at CMAI and showcase it to Leading Retailers from every part of India" says Mr. Ashish Saboo, MD and CEO, AddOns Retail accessory brand.

About Addons

Addon Retail Pvt. Ltd. Mumbai, Maharashtra based company that provides Fashion Accessories to customers all over India. The company was incorporated in 1999 with the prime objective of creating the Biggest Fashion Accessories Brand of India. The company ventured into retailing of lifestyle products through reputed and popular international and national brands in Western India.

After gaining expertise, experience and understanding the complexities of retail business ventured into creating its own chain of retail stores through its own retail concept "Addons Women" and "Addons Men" offering customers wide range of products in Fashion Accessories under one roof providing international shopping experience. For more information on Addon Retail Pvt Ltd, visit www.addons.co.in.

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COLORANT Limited receives GDMA EXPORT and DOMESTIC AWARD

Colorant Limited,a leading Reactive dyes manufacturer and exporter based inAhmedabad received theAward for the outstanding performance in Export Market as well as Domestic Market by aSME for the year 2014-15 organised by Gujarat Dyestuff Manufacturer Association held on 27th June,2014 at Diamond Hall,Rajpath Club,Ahmedabad.Colorant is an ISO 9001:2008 & ISO 14001:2004 certifiedCompany and one of the leading Manufacturers and Exporters of Dyes in India.

Mr. SubhashBhargava, Managing Director, Colorant Ltd. receiving the award and certificate from Dr. S.K. Nanda, Principal Secretary, Govt. of Gujarat

Most of the products are "GOTS" Certified and Pre-registered with"REACH".The Company also enjoys status of Government recognised "Export House".Coloranthas become the first Indian Company to offer it's clients in India andoverseas a range of Fluorine based Reactive dyes in the name of COLRON "CN"series.Colorant is the sole selling agent forColor Root of China - thebiggest manufacturer of Fluorine based Reactive dyes in the world. Under theagreement, Colorant is having an exclusive marketing right for these dyesin India enabling the company to offer most modern and environmentally greenchemistry to it's customers for the first time in India thereby revolutionizing the dyeing industry due to the energy saving and emission reduction. Colron High Performance Reactive dyes like SD series, GLX series,CN series and SF series are already being used by more than650customers (including Corporate Houses) in India and well accepted inExport marketfor its quality,cost-effectiveness and timely supply.

Colron Reactive Dyes are very well accepted in Bangladesh, China, Turkey,Pakistan, Iran, Egypt, Costa Rica, Brazil, Nigeria, Gautemala and many othercountries.

Textsm ile

Girl: When we get married, I want to share all your worries, troubles and lighten your burden.

Boy: It's very kind of you, darling, But I don't have any worries or troubles.

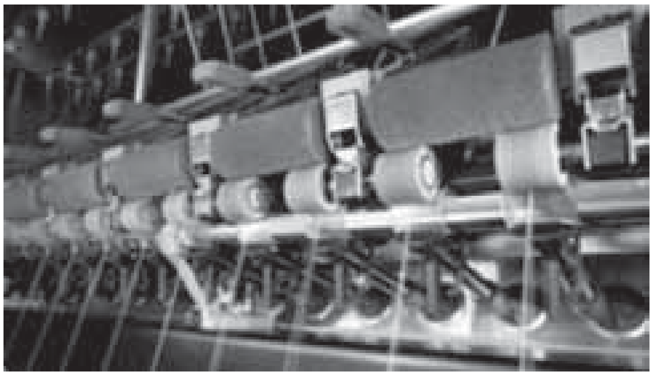
Girl: Well that's because we aren't married yet.

Eveready Mills Saves 10 % Energy and A Lot of Money

"We do not inherit the earth from our parents, we borrow it from our children" - Chief Seattle. So it is important to conserve energy and to investigate solutions for energy savings. Rieter has followed this direction to innovate the concept of "ECOrized" in its product portfolio. The Indian company Eveready Spinning Mills Pvt Ltd. realized a 10 % energy saving in ring spinning with the suction tube ECOrized. They regard this solution as a sustainable money saving innovation.

In January 2013 Swiss Government handed over to Rieter the "Watt d'Or" award for the new suction tube ECOrized as "excellent energy project, plausible concept and outstanding innovation".

The suction tube ECOrized for Rieter ring spinning machines replaces the existing suction tubes to reduce suction power by about 50 %. Each spinning position currently features a suction opening for extracting ends down and tangles. However, this is only needed in very few cases. So why not use a suction tube that opens fully only when necessary? The suction tube ECOrized offers this advantage and the resulting energy savings. Existing suction tubes can simply be replaced. Considerable energy savings are achieved.



Suction tube ECOrized

Winner of Rieter's suction tube "ECOrized"

Eveready Spinning Mills Pvt. Ltd - Unit 4 located in Dindigul, Tamilnadu - South India is one of the five winners of Rieter's "ECOrized" competition. They received a free kit of ECOrized suction tubes with free delivery and installation for one of their 18 ring spinning machines G 32, each with 1440 spindles.

Mr. S. Saravanakumar, Executive Director, Eveready Spinning Mills Private Limited, India

Power study in ring spinning

Three consecutive trials were undertaken by Eveready. The study compares power consumed by the standard suction tube and the suction tube ECOrized. On the G 32 with the suction tube ECOrized the frequency could be reduced to 35 Hz by a frequency inverter. The machine was running normally with good overall performance. The energy consumption of this machine was reduced by nearly 10 %.

PROCESS PARAMETERS			
Count	Ne 24	No. of spindles	1 440
Material	Cotton	Ring diameter	38 mm
Avg. spindle speed	16 792 rpm	Lift	170 mm
Twist per inch	16.52	Draft	24.24

RESULT COMPARISON FOR AVERAGE OF 3 DOFFS

Suction tube	standard	ECOrized
Suction motor	9 kW	9 kW
Frequency inverter	no	yes
Running frequency [Hz]	50	35
Actual yarn production per doff [kg]	64.944	64.848
Power consumed per doff [kW]	60.7	54.78
Power consumed per kg yarn (UKG) [kW/kg]	0.935	0.845
Savings with ECOrized	0.09 kW/kg	

ENERGY SAVING WITH SUCTION TUBE ECOrized	9.6 %
Savings in INR per G 32 per year (INR 6 per kWh)	INR 265 375
Savings in USD per G 32 per year (exchange rate INR 61 per USD)	USD 4 350

Eveready comments on the cost saving in practice

Mr. S. Saravanakumar executive director Eveready gave following statement. "Any saving in the energy cost impacts the cost of yarn manufacturing positively. Many controlled studies in our mill on G 32 ring spinning machine indicate a definite 8 to 10 % saving in the total ring spinning power consumption when we use Rieter's suction tube ECOrized.

We are also contemplating to retrofit the suction tube ECOrized on the remaining G 32 ring spinning machines. The suction tube ECOrized is sustainable, money saving innovation in ring spinning and proved worthwhile for the company."

OGTC - 10th International Conference on Apparel & Home textiles

OKHLA GARMENT & TEXTILE CLUSTER (OGTC) is organizing 10TH International Conference on Apparel & Home Textiles ICAHT - 2014 on 19th & 20th September, 2014 at India Habitat Centre, New Delhi with the Theme **"COMMITMENT TO EXCELLENCE".**

Department Institute MSME, Govt. of India and Office of the Textile Commissioner, Ministry of Textile, Govt. of India has consented for the their support for this event. AEPC is a lead sponsor.

India apparel industry has a hope of coming into the picture of preferred sourcing destination due to the changing scenario in China, Europe, US and Bangladesh.

The global apparel manufacturing industry is expected to grow more than ever in times to come. The apparel manufacturers are now adopting new techniques to increase their trade. New business models and competitive strategies are used to enhance profits and growth.

The conference is intended to cover all aspects of the apparel industry, including the problems of small-scale enterprises in the developing world, the barriers which are hindering the growth of this industry, the strength and weakness of the manufacturers in different region, globalization issues, resource and manpower scarcity, quality of the product, trade laws, adopting new techniques to improve productivity, managing global supply chain and finally changing apparel industry trends with ever-changing fashions.

The conference aims to provide an environment for academics, researchers and practitioners to exchange ideas and recent developments in the field of apparel manufacturing. The conference is also expected to foster networking, collaboration and joint effort among the conference participants to advance the theory and practice as well as to identify major trends in apparel manufacturing.

The Convention will be a great opportunity for international trade fraternity to know the dual strengths that India can offer, not only as a great supplier base, but also as a fashion destination for international brand.

KEY ISSUES TO BE ADDRESSED IN ICAHT - 2014

Environment: Carbon Foot Print Measurement in Garment Industry

Direction: A Clear sense of where the organization is heading and how it will get, there that is meaningful to all employees

Leadership: The extent to which leaders inspire action

Culture: Shared benefits and quality of interaction within and across unit

Accountability:The extent to which individuals understand what is expected of them, have authority to carry it out and take responsibility for delivering results.

Coordination: Ability to evaluate organizational performance and risk and to add opportunities when they arise.

Capabilities:The presence of institutional skills and talent required to executive strategy and create competitive advantage.

Motivation: Presence of enthusiasm that drives employees to put in extraordinary effort to deliver results.

External:Quality of suppliers, partners and other external shareholders to drive value.

Innovation:of new ideas and the ability of the organization to adopt and shape itself as needed

Responsible Fashion:Leading to Responsible Competitiveness

Technological Up gradation:Appropriate and Continuous up gradation and absorption

The garment industry owners, their CEO's, industry professionals, academicians, representatives from industry associations, researchers, consultants, service providers from India and other part of countries will be attending this conference also the final year and post graduate students etc. will get benefited.

Day One -19th September, 2014 - Presentations

1) Presentations from International and Indian invited speakers from varied fields of management, manufacturing, marketing, social responsibility etc. And
2) Design Creations in fashion Show format by Students of Lady Irwin College, Department of Fabric Science
3) On the sidelines of the conference there will be a Poster Presentationto encourage the research & postgraduate students a poster competition on the conference theme will be held where 3 best poster presentations will get cash reward.

Day Two - 20th September, 2014 - Workshops

Specific workshops are arranged on selected areas from the above list by eminent experts from India and Abroad for specific skill professionals

It may not be out of place to mention that **the concept of workshops and general interest presentations is a novel concept adopted by OGTC** and has been found extremely beneficial to the industry in terms of specific skill up-gradation and creation of general awareness in the present times, which are really termed as **knowledge economy.**

Organizing Committee:
Mr. PMS Uppal, Chairman
Mr. Vijay Mathur, Co-Chairman

For further details if any contact:
Mr. R.C. Kesar, Conference Chairman 09810091812
Mr. M.K. Mehra, Conference Advisor 09868200116

PROGRAMME
Day One - 19th September, 2014

09.00 A.M. to 09.30 A.M.	**Registration Session Title**	**Strategy for Growth**
	1.	Complementing Export Market Strengths with Domestic Market Opportunities- **Mr. JayantKochar** - Go Fish Consulting
09.30 A.M. to 11.00 A.M.	2.	Managing Supply Chain for Domestic Market Growth **- ITC**
	3.	Opportunities for Indian Exporters in Changing Global Scenario- **Mr. AnantSadana** - United Apparel
11.00 A.M. 11.30 A.M.		**TEA**
	Session Title	**Process to Progress**
	1.	Planning - First Step to Succeed- **Mr. Ashroff Omar** - Brandix Lanka*
11.30 A.M. to 01.30 P.M.	2.	Map Process: Sourcing & Pre Production Processes- **Ms. JyotiSaikia**- Triburg *
	3.	Training Processes - Plan/Execute/Sustain - **Mr. Mahesh D Amalean** - MAS Holdings (Pvt.) Ltd.*
01.30 P.M. 02.15P.M.		**LUNCH**
	Session Title	**Achieving Excellence**
	1.	Journey from 10 to 30 pcs a day - **Mr. NiteshBurman** - MRS Fashions WLL BAHRAIN
02.15 P.M. to 03.45 P.M.	2.	Saving Fabrics - A practical approach - OptiTex
	3.	Case Study- Performance and Winning Matrix - **Mr. RajatSikka**- Saivana Exports
	4.	In Pursuit Of Excellence - Unleashing The Potential In You & Your Organization- **Mr. Nikhil Desai** - Centre for Excellence
03.45 P.M. 16.00 P.M.		**TEA**
04.00 P.M. 05.00 P.M.	Inaugural Address & Award Function Chief Guest- **ShriSantosh Kumar Gangwar,**Hon'ble Minster of State for Textiles*	
05.00 P.M. 06.00 P.M.	Design Creations by Students in the Fashion Show Format- **Lady Irwin College**	

04.15

Day Two - 20th September 2014		
.	**Session Title**	**Management**
10.00 A.M. to 11.00 A.M	1.	Managing & Sustaining Consistent Growth in Indian & International Environment - **Mr. J.D. Giri** - Shahi Exports
	2.	**TBA**
110.00 A.M. to 11.30 A.M.		**TEA**

	Workshop 1	**Workshop 2**	**Workshop 3**	**Workshop 4**
	Production	**Merchandising**	**Finance**	**Miscellaneous**
11.30 A.M. to 01.30 P.M.	Case study- Lean Journey- **Mr. Manish Sachar**, Orient Fashion and **Mr. Promod**, Pee Empro Exports	Job Profile Develop and Sustain- **Ms. PoojaMakhija**	CSR, Company Law Changes and LPP vs Pvt. Ltd.- **Ms. PuriMarwaha** Jhalani & Co.	Professionalising HR- **Ms. DivyaniBhatnagar** -Crestcom International
01.30 P.M. to 02.15 P.M.			**TEA**	
	Workshop 5	**Workshop 6**	**Workshop 7**	**Workshop 8**
	Production	**Merchandising**	**Management**	**Miscellaneous**
02.15 P.M. To 04.15 P.M.	Achieving Superior Performance at Work Place by **Maj. Gen. N. K. Dhir** - Alphabet Teletec	(Smart Merchandising-Digital Tools) - **IAM TEAM**	Introducing Next Generation In to Family Business*	Apparel industry training programme for PWD- **Dr. JitenderAggarwal** - Sarthak Educational Trust Developing Training Modules for Person with disability (PWD's)- **Dr. ManpreetChachal** - Lady Irwin College
04.15 P.M. to 05.00 P.m.		**Summing up**		
05.00 P.M.		**High Tea**		

Contact for more details

Conference Secretary
OKHLA GARMENT & TEXTILE CLUSTER
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TAI spreading the image beyond the Indian Shores!

The Textile Association (India), the foremost leading and largest National professionals' body of Indian textiles, having more than 23000 strong memberships is serving since last 75 years to the textile industry.

Association has organized 69 All India Textile Conferences and 2 Asian Textile Conferences and now after the grand successful World Textile Conference 2011, which was the best gathering ever witnessed in the Indian textile industry, TAI to launch itself 3 days mega Global Textile Congress 2015 on overseas international platform to play leading role and to elevate the image globally. This mega event will be indeed first of its kind, from the point of view of Association's history. This event is going to be the first of its kind being held outside the Indian shores. When we talk about globalization of the trade, naturally Associations have to also find relevant venues and also subjects of regional importance rather than looking at the interests of a single country. In these modern times, no economy is totally isolated from the influence of the other and its time to take into consideration collective interests of population and business community so that trade grows healthily.

Global Textile Congress 2015 "Global Textile - Opportunities & Challenges in an Integrated World" is organizing by The Textile Association (India) in association with Thailand Convention & Exhibition Bureau (TCEB), Thailand during 13rd to 15th February, 2015 at Bangkok, Thailand.

Mr. Arvind Sinha, National President, TAI announced that Global Textile Congress 2015 would be truly international conference which will address all issues related to the textile industry in Middle East, West Africa, Far East region including China, Indonesia, South Korea, Japan, Singapore & Hong Kong including India.

As Global Textile Industry is heavily divided; every country has its own issues and its solution. Many times the facts are not known and therefore sufferings cannot be avoided. Of course many times the problems and its solutions are within the system. But identification becomes difficult. New Millennium changed dimensions of business and new business difficulties surfaces such as dealing with foreign exchange, shortage of labour, market conditions, collapse of economy etc.

Global Textile Congress will be conducted to identify global issues related to Textile Industry, discuss various problems of textile industry and draw a vision plan for 2030. In due course of time Global Textile Congress should become Global identity for addressing International Textile Issues.

Mr. D.R. Mehta, President Emeritus mentioned that the Textile Industry has maximum potential as the population is growing and second product we require after food is clothing, therefore the consumption of textile is going to go up. Therefore International conference can create a very positive global environment which ultimately attracts high quality sponsors and high quality speakers & participants. To develop the relation in between countries and update the trade and technology and also this will be business platform to cater business needs.

Texttreasure

Many people know so little about what is beyond their short range of experience. They look within themselves - and find nothing! Therefore they conclude that there is nothing outside themselves either. - ***Helen Keller***

Mr. R.K. Vij, Conference Chairman briefed about the Topics for Panel Discussion and Oral presentation of technical papers. There will be very meaningful panel discussion which will be mix of politicians, bankers; industrialists etc. and we can focus on Textile Industry.

In order to make a truly International Conference and Global Reference Conference on Textile Industry it has combined various International Issues, various markets, economical situations, banking, highly technical issues, research, latest developments, IT in textile etc.

He invited to participate in this Global Textile Congress and appealed to be a part of event as Congress Partner, Advertiser and delegate before you miss the opportunity.

Panel discussion topics:

- Advance manufacturing
- The Africa Context
- The Arab World Context
- Banks Role in today's Economy
- Building Innovation Capacity
- Catalyzing Innovative Development Partnerships
- Creating Multi stakeholder value
- Risks in the 21st Century
- China's growth (lesson for all)
- De-risking Africa
- The Digital Infrastructure Context
- Future of Europe
- The Future Value Chain

Topics for Speaker's Session:

- Global prospects and challenges faced by Textile Industry
- Technical Textile as future of Textile Industry
- Future prospects for functional textile
- Developments in medical textile
- Challenges faced by garment industry
- Importance of fashion changing
- Changing world of Global manufacturing
- Global Man Made Fibers
- Impact of packaging and transportation efficiency
- Current issues impacting ocean freight transportation
- Meeting the challenge of rising supply chain risk
- Impact of European & US recession on Asian Economy
- Changing Economy and its impact on global markets
- Impact on currency fluctuation on business
- Importance of knowing various countries economics before planning global lead
- Unlocking hidden value in global trade management
- How marketing principles can give you effective complete advantage?
- Sustainability environment and clean technology
- Effective textile education and adopting changing scenario
- Legal issues such as contract management
- Legal response to the challenging world of credit risk and the fault
- How to safeguard your interest in foreign courts
- Skilled labour shortage world wide
- Gaining access to the critical south east station market
- Defense textile in major opportunity
- Application of IT in textile sector
- Garment Market Trade & Investment
- Competitiveness in Indian Apparel Export

In order to make a truly International Conference and Global Reference Conference on Textile Industry we have combined various International Issues, various markets, economical situations, banking, highly technical issues, research, latest developments, IT in textile etc.

For participation & information Contact:

The Textile Association (India)
Tel.: +91-24461145, Fax: +91-22-24474971
E-mail: taicnt@gmail.com

Textreasure

When everything seems to be going against you, remember that the airplane takes off against the wind, not with it.

-Henry Ford

Celebrating One year of Success, Innovation & Pride

On the 4th of July 2014, the re-established Saurer group celebrated its first birthday with utmost enthusiasm and pride. In just over 12 months the Group has successfully marked its presence in the textile industry, building upon its 160 years of rich history serving at different stages of the textile value chain. The Group, driven by its "Passion for Innovation", "Passion for Customers" and "Passion for Quality" business model, and inspired by a dedicated workforce, has been able to achieve significantly during the course of the year and seeks to strive for excellence in all its future endeavors.

Saurer, with a significant presence in the Indian market through a few Joint Ventures and Subsidiaries, saw major celebrations across all its regional offices. Cakes and cheerful employees marked their presence as Birthday songs echoed throughout the adorned office workspace. Some glimpses from the various Indian Offices:

Saurer's Birthday Celebrations at our offices in Mumbai, Ahmedabad, Coimbatore and Guntur

This Birthday not only highlights the completion of a successful year for the Saurer Group, but positions its foundation for a promising future. Through continued commitment to producing quality engineered textile solutions with a customer centric approach, Saurer seeks to develop its long tradition of setting standards and establish itself as the leader of Textile Industry.

Glimpses of Saurer India Birthday Celebrations

AHMEDABAD

COIMBATORE

GUNTUR

MUMBAI

CONGRATULATION!!!

The New Age Fabric is All Set to Create a Stir in the Fashion Market

LIVA to collaborate with some of the behemoths of the fashion industry for the season

Mumbai, 14th May: LIVA, the new age fabric made with natural fibres from Pulp &Fibre Business of Aditya Birla Group announced its association with AND, Global Desi, Allen Solly and Van Heusen - some of the biggest players in the fashion industry. These brands have created exclusive collection using LIVA in their SS 14 offerings, ranging from Maxis to work-dresses to casual tops.

Using LIVA in any garment or fabric enhances the fluidity quotient of the silhouettes. So fluid that you move it moves. The collections from all four brands (Van Heusen, Allen Solly, And & Global Desi) offer new cuts & styles interpreted with the fluidity of LIVA for the new age fashion consumer this summer !

With these associations, the company aims to create awareness and preference for LIVA amongst consumers. LIVA is a fluid fabric made with natural fibres that imparts gentle drape to the garments. This new category creation is a mutually beneficial exercise for LIVA, as well as for the partnering brands. The partner brands get superior quality fabric which can be translated into a better design for the end-consumers, making the partner brands deliver best-in-industry garments. The cellulosic fibres usage is just 3 % in overall fibre basket which the company hopes to increase it to 6% in coming years.

Fibre is the starting point of the textile value chain with the end-customer at the other end. LIVA effectively implementing the 'pull-strategy' by hooking the customers with flowy silhouettes and liquid drapes that it imparts to the garments, which by virtue dictate the buying trends for the end-consumer.

Birla Cellulose promotes the concept of green fashion and is entirely focused on creating a sustainable leadership with the help of innovations in processes and product.

Excited about the associations, Mr. Manohar Samuel, President (Marketing & Business Development), Pulp &Fibre Business, Aditya Birla Group says, "We are thrilled with thesecollaborations. LIVA being a new age fabric with its natural flow and softness will really enhance the offerings in the segment by providing a collection that befits its customers. Our aim is to reach out to new age customers and give them designs and fabrics that they can't resist. We hope that these associations will help us garner more partners who seek to target the evolved, new-age consumer using LIVA as an anchor."

With classy and comfortable pieces that can be combined to create a unique look, the soft cascading drapes of LIVA truly stands out this summer!

About LIVA

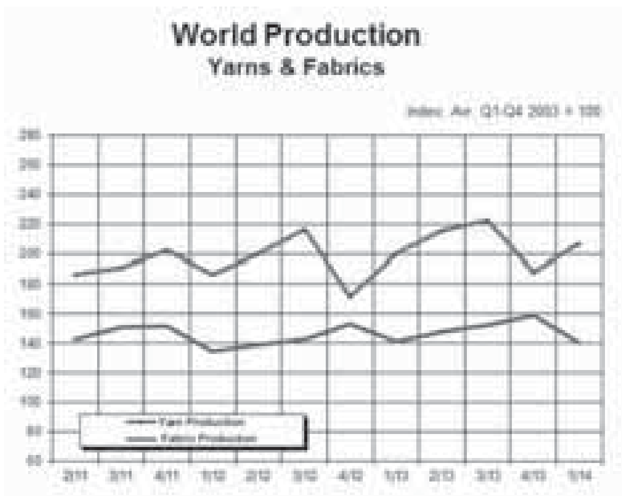
LIVA is a new age fabric made with natural fibres from Pulp &Fibre Business of Aditya Birla Group. It's is a fluid fabric that gives a glamorous drape, soft, has shine and is extremely comfortable. LIVA is made from natural fibers/cellulosic that is derived from wood pulp. Hence, it gives a beautiful flow to the garments and enhances ease of movement. It takes the shape of the body and hence gives you perfect look. It doesn't tug out like other stiff fabrics. It is extremely soft and has a great feeling on the skin. It also has a natural shine that makes it look dressy unlike other fabrics. And finally since it is natural, it has great breathability and it is extremely comfortable to wear.

World Yarn Output up but Fabric Output down in Q1/2014

Estimates for Q2/2014 for Global Yarn and Fabric Output are Positive

Global yarn production increased in Q1/2014 compared to the last quarter in 2013 due to higher output in Asia, North America, and Europe, and despite a drop in South America. On an annual basis yarn production increased as well even though output levels were lower in South and North America. Worldwide yarn stocks decreased slightly in comparison to the previous quarter as a result of lower inventories in South America and Europe. Year-on-year global stocks jumped with higher stock levels in Asia and Europe and despite lower ones in South America. Yarn orders in Europe and Brazil were up in Q1/2014. Compared to last year's quarter yarn orders were lower in Europe and in Brazil.

Global fabric production was down in Q1/2014 as a consequence of lower fabric production in Asia with South America and Europe recording higher output levels. Year-on-year world fabric production decreased slightly with Asia's output having shrunk and Europe's and South America's having grown. Worldwide fabric stocks were lower in Q1/2014 with South and North America recording lower stock levels and despite higher ones in Asia and Europe. On an annual basis fabric stocks fell as well as a result of decreasing stocks in South America and despite higher stocks in Asia, North America and Europe. Fabric orders rose in Q1/2014 both in Europe and Brazil. Also in comparison to last year's first quarter fabric orders were up in Europe and Brazil.



Estimates for yarn production for Q2/2014 are positive in Asia and North America, unchanged in South America but negative in Europe. Estimates for fabric production for Q2/2014 are positive in Asia and Europe and unchanged in South America.

The outlook for yarn production for Q3/2014 is positive in Asia and unchanged in Europe. The outlook for fabric production for Q3/2014 is positive in Asia and Europe.

In comparison to the last quarter in 2013 global yarn production increased in Q1/2014 by +10.0% due to higher output levels in Asia (+11.0%), North America (+3.2%) and Europe (+0.5%) and in spite of a drop in South America (-8.2%). In comparison to Q1/2013 global yarn output had increased as well (+3.3%) with production in Asia and Europe up by +4.0% and +3.0%, respectively, while a decline was recorded in South and North America (-16.8% and -1.7%, respectively).

In comparison with the previous quarter world fabric production fell in Q1/2014 by -11.6% as a result of a reduction in Asia (-14.3%) and despite higher output levels in South America (+11.0%) and Europe (+2.9%). Year-on-year fabric production worldwide decreased slightly by -0.6% which could be attributed to a decrease in Asia (-1.2%) that could not be offset by increases in Europe (+4.0%) and South America (+1.0%).

Global yarn inventories fell slightly (-0.8%) in Q1/2014 as a result of reduced stocks in South America (-8.0%) and Europe (-0.6%) while stocks in Asia were unchanged. On an annual basis, global yarn stocks jumped by +11.1% due to higher inventory levels in Asia (+14.4%) and Europe (+6.9%).

Global fabric stocks in Q1/2014 fell by -1.0%. In South America they declined by -4.1%, while Europe and Asia recorded increases of +2.0% and +0.1%, respectively. In comparison to last year's quarter global fabric stocks decreased as well as result of lower tocks in South America (-11.8%) and despite higher inventories in Europe (+2.2%), North America (+0.9%) and Asia (+0.4%).

In Q1/2014 yarn orders jumped by +21.8% in Brazil and by +1.0% in Europe. Compared to last year's quarter yarn orders were down in Europe (-4.2%) and in Brazil (-0.5%).

In Q1/2014 fabric orders increased both in Brazil and Europe by +6.9% and +5.1%, respectively. Also on an annual basis fabric orders rose by +13.5% in Brazil and by +6.6% in Europe.

AATCC Seeks to Revise Dry Cleaning Test Methods

Research Triangle Park, N.C., USA - July 21, 2014 - AATCC, the Association of Textile, Apparel & Materials Professionals, is seeking participation in the revision of AATCC test methods related to dry cleaning.

The current perchloroethylene solvent used in several AATCC test methods has been identified as potentially dangerous and is being phased out of use in some regions. AATCC research committee RA43 plans to update the following test methods to include more environmentally friendly solvents:

Test Method 86-2011 Drycleaning: Durability of Applied Designs and Finishes

Test Method 132-2013 Colorfastness to Drycleaning

Test Method 158-2011 Dimensional Changes on Drycleaning in Perchloroethylene

To participate in these activities, contact Committee Chair Joseph J. Nilsen at+1.215.737.2405by October 1, 2014.

About AATCC: AATCC, the Association of Textile, Apparel & Materials Professionals, is the world's leading not-for-profit association, serving textile professionals since 1921. AATCC, headquartered in Research Triangle Park, NC, USA, provides test method development, quality control materials, and professional networking for members around the world.

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AATCC Wins 2014 Tabbie Award for Feature Article in AATCC Review

RESEARCH TRIANGLE PARK, N.C., USA, Wednesday, July 23, 2014-AATCC has won yet another Tabbie award for an in-depth feature article, published in the March/April 2013 issue ofAATCC Review, written by the association's former Features Editor, Glenna Musante.

The annual Tabbie Awards are sponsored by Trade Association Business Publications International (TABPI).Nearly 500 editorial and design entries from around the globe were entered in the 2014 contest.

Glenna Musante

"A Matter of Fiber Veracity," won an Honorable Mention and represents the Association's 16th award for writing or publication design.

Jack Daniels, AATCC's Executive Vice-president, says, "We are extremely pleased to haveAATCCReview be recognized again with another Feature Article Tabbie Award. AATCC officers, volunteers, and staff involved with the Association's publications strive to bring useable and timely information to our members. This recognition is again, tangible evidence of the value we aim to provide our many members and library subscribers through this key AATCC publication."

As well as publishing original features on major topics of interest to professionals in the textile, apparel, and related industries,AATCC Review also contains technical articles, and AATCC news and information.

Launched in January 2014, theAATCC Journal of Research, a sister publication, is exclusively for peer-reviewed research papers.

To read the award-winning article, visit:http://www.aatcc.org/media/Read/documents/A2Rev313-Fiber_Veracity.pdf

Product Cum Catalogue Show in Ludhiana

Overwhelming response to ITAMMA's 13th Product Cum Catalogue Show

ITAMMA successfully organized its 13th Product -Cum -Catalogue Show on 1st June, 2014 at the newly opened Radisson Blu, Hotel in Ludhiana. The show was inaugurated by Mr. Rajiv Garg, Managing Director of Garg Arcylics.

Mr. Rajiv Garg, Managing Director, Garg Arcylics Pvt. Ltd, inaugurating the 13th Product Cum Catalogue Show

The trade show received an overwhelming response with 64 exhibitors participating, and over 500 visitors attending the show. The 13th Product -Cum- Catalogue Show conducted by Indian Textile Accessories & Machinery Manufacturers' Association (ITAMMA), provided an ideal platform to the textile user industry of Ludhiana to interact with the suppliers (Manufacturers, Dealers and Traders) of textile machines and accessories. During the show the visitors of the Textile Industry of Ludhiana got an opportunity to observe the quality products of Machines & Accessories from the field of Spinning, Weaving & Wet Processing.

Over the years, Ludhiana has grown as a leading hub for Textile Manufacturing, and occupies a vital position in the industrial scenario of Punjab. It has become the principal producers of woolen and acrylic knitwear, and also uses cotton and blended fiber to produce hosiery, knitwear and various ready - made garments. Keeping this mind, ITAMMA decided to conduct the Product-Cum- Catalogue Show in Ludhiana, which also attracted visitors from neighbouring Himachal Pradesh and Jammu & Kashmir.

Texttreasure

There is no greater evidence of superior intelligence than to be surprised at nothing.

- Josh Billings

Mr. Diven Dembla, President, ITAMMA, presented memento to Mr. Rajiv Garg, Managing Director, Garg Arcylics

Prior to the show a press conference was organized on May 31, 2014 at the Radisson Blu Hotel where Mr. Diven Dembla, President of ITAMMA, addressed the media, detailing the purpose of the Product- Cum-Catalogue Show organized at Ludhiana and the benefits expected for the Textile Industry of Ludhiana, as well as to the member exhibitors of ITAMMA.

The show was co - sponsored by the India - ITME Society, who were also present to promote the upcoming GTTES 2015 Exhibition being held in Mumbai from 20th to 22nd January, 2014.

Crowd during the show

To coincide with the event a visit to Garg Acrylics in Ludhiana was organized for ITAMMA Exhibitor members. The Participants got to view the operations and functioning of the Spinning and Weaving units of Garg Acrylics, a leading textile manufacturer in North India, having latest machineries vertically integrated with all the operations from the extraction of cotton lint to garment manufacturing.

Single Window Access to Textile Technology, ew Markets & Customers, Engineering Solutions & International Trade

Exhibition Dates	20 - 22nd January 2015
Venue	Bombay Convention & Exhibition Centre, Goregaon, East, Mumbai, India
Objectives	To promote post spinning sectors. Live demo of machineries & accessories, showcase new technology & products. Support modernization, manufacturing & investments in Textile Industry. To create Gateway to regional markets of India To provide access to market opportunities in India & neighboring countries, Indonesia, Bangladesh, Pakistan, Myanmar, Sri Lanka, Vietnam & Cambodia.
Organizer	India International Textile Machinery Exhibitions Society(India ITME Society) 34 years old Industry Body, a pioneer and largest textile machinery exhibition organizer in India.
Booking Process	Online @ www.india-itme.com/GTTES2015 Email : gttes@india-itme.com, itme@india-itme.com
Booking Open from	16th April 2014
Forms closing on	31st July 2014
Allocation of booth	First come first serve till availability of space
Cost	Bare space Indian exhibitor Rs.7500/- per sq. mtr + Govt. taxes as applicable Foreign exhibitor US $ 270/- sq. mtr + Govt. tax as applicable Shell scheme Indian Exhibitor Rs. 8500/- per sq. mtr + Govt. taxes as applicable Foreign exhibitor US $ 300/- per sq. mtr + Govt. taxes as applicable
Chapters	Weaving Machinery Pavilion Processing Machinery Pavilion Nonwoven & Technical Textiles Pavilion Digital Printing Machinery Pavilion Garment, Knitting, & Embroidery Machinery Pavilion Textile Chemical & Dyes Machinery Pavilion Fibre & Yarn Machinery Pavilion Jute Machinery Pavilion Accessories /Spare Parts/Component Pavilion Waste Water Management & Green Technology Pavilion
Event Highlights	Confirmed group buyers from Regional Textile Parks & Industrial Zones. Promoting bulk government procurement & bulk raw material procurement B2B Meetings International trade services Technical staff interaction & recruitments.

Texas Tech Researchers Discover Low-Grade Nonwoven Cotton Picks Up 50 Times Own Weight of Oil

Nonwoven cotton could become the new picker-upper for oil spills.

Texas Tech University researchers recently discovered that low-grade cotton made into an absorbent nonwoven mat can collect up to 50 times its own weight in oil.

The results strengthen the use of cotton as a natural sorbent for oil, said SeshadriRamkumar, professor in the Department of Environmental Toxicology at Texas Tech who led the research. The results were published in the American Chemical Society's journal Industry & Engineering Chemistry Research.

Ramkumar is a creator of Fibertect®, a nonwoven decontamination wipe developed by researchers at Texas Tech capable of cleaning chemical and biological agents. Vinitkumar Singh, a doctoral candidate working under Ramkumar, performed the experiments in this study. This multidisciplinary project involved scientists from Cotton Incorporated and Texas Tech's Departments of Mechanical Engineering and Environmental Toxicology.

"With the 2010 crude oil spill in the Gulf of Mexico, which resulted in the major spill of about 4.9 million barrels of oil, it became apparent that we needed new clean-up technologies that did not add stress to the environment," Ramkumar said. "This incident triggered our interest in developing environmentally sustainable materials for environmental remediation."

In the four-year project, scientists tried to create a fundamental understanding of the effect of fiber structure and basic characteristics of cotton on oil sorption capacity of unprocessed raw cotton. The work also examined the basic mechanisms behind oil sorption by nonwoven cotton webs.

"We believe nonwoven cotton webs as an oil sorbent have tremendous potential for application in real-time oil spill scenarios along with environmental sustainability and commercial acceptability," Ramkumar said. "In this study, we have used low-grade cotton as well as mature cotton, and it was observed that low-grade cotton performs better than regular mature cotton in the oil sorption capacity.Nonwoven cotton batts consisting of immature and finer cotton fibers showed 7 percent higher oil sorption capacity than cotton batts developed using mature and coarser fibers. Cotton batts could be used to clean up oil spills on land as well as any oil-water system."

Ramkumar and his researchers are working with Texas Tech's Office of Technology Commercialization to take this new technology into commercial space within a span of 12 months. Recently, there have been some active interests to evaluate our product for further consideration, he said.

"Our research shows cotton as a high-performance fiber that can be deployed to clean up toxic oil spills," Ramkumar said. "More importantly, the oil sorption by environmentally friendly and natural sorbents like aligned nonwoven cotton made from raw unprocessed cotton and correlation with its characteristics, such as cotton quality, fineness and maturity, are not reported at all to our best knowledge."

Contact:
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Visit http://pubs.acs.org/doi/abs/10.1021/ie5019436

Twinning Arrangement between Institute of Chemical Technology and Ethiopian Textile Industry Development Institute

July 24, 2014, saw the official signing up of the twinning arrangement between **Institute of Chemical Technology (ICT) and Ethiopian Textile Industry Development Institute (ETIDI)**. Present on the occasion were His Excellency, Mr. Tadesse Haile,State Minster to Ministry of Industry of Ethiopia, Mr. Seleshi Lemma, Director General of Ethiopian Textile Industry Development Institute (ETIDI), Mr. FikerTesfu, Director for Finishing Technology Directorate, AtoYitbarekTilahun, Director for Spinning Technology Directorate, ETIDI and Members from the Ethiopian Consulate in India.

The major aim of this twinning program is to prepare, equip and transform Finishing Technology Directorate of the Ethiopian Textile Industries Development Institute to a stage where it will be able to provide competitive support and service to the Ethiopian Textile Processing industry on the basis of International best practice of similar institutes globally so as to realize the national vision and aspirations.

Textile is one of the important commodities that bring considerable export earnings to the Federal Democratic Republic of Ethiopia. It is construed that the trade of manufacture and export of Textile and apparel is one of the promising sectors for the economic and social growth of Ethiopia. Policies of the country point at the strategy of encouraging the export of textiles and apparel. As the country aims at a phenomenal growth of the Textile and apparel sector, it is essential and important to strengthen the national capability in providing adequate skilled and intellectual manpower, technologies and technical advice and support.

The Institute of Chemical Technology, Mumbai (formerly called the UDCT - University Department of Chemical Technology, University of Mumbai) was established on October 1, 1933, with the noble intention of advancing India's knowledge reserves in chemical engineering and technology. The ICT has grown over the years to become a premier Elite University devoted to education, training, research and industrial collaboration in chemical engineering, chemical technology, applied chemistry, pharmacy, biotechnology and bio-processing. The list of achievements of the ICT is voluminous and ever since its inception, the ICT has been a breeding ground for some of India's most gifted minds.

The Department of Fibres andTextiles Processing Technology of ICTis one of the top most schools in the country, having been established in 1933 with a premier objective of generating human resource from Bachelors to Doctoral degree and development of technology for textile wet processing. The department has been recognized for its stellar performance over the years for past 8-decades. Several of its alumni have brought laurels to the nation and have established their own businesses, developed technology and assisted the textiles industry in India and abroad.

Twinning Arrangement refers a professional service to be rendered by ICT through the continuous deployment of textile professionals as well as its own faculty,for a period of three years to ETIDI's Finishing Technology Directorate to build the latter's technical and managerial capability by providing hand holding support to the staff in its endeavor to accomplish the below mentioned duties and responsibilities:

1. Building up the capacity of the staff of the Finishing directorate and participants from the textile processing sector in tandem with the vertical development of textile and garment industries on a sustainable basis.
2. Designing and implementing suitable management system to the directorate to suit the new system requirements for continuous improvement.
3. Developing the capacity of the Finishing directorate to provide consultancy and technical services to textile processing.
4. Designing and preparing courses and curricula in all areas of the textile and garment sector and also enabling staffs of the Finishing directorate to do the same.
5. Providing leadership training to the Finishing directorate staff and corresponding industry personnel.
6. Conducting applied researches that can help to curb problems of the industry.
7. Bridging the gap between the sector's performance and international benchmarks.

On the momentous occasion of signing of agreement, Prof. G D Yadav, honorable Vice Chancellor, ICT, briefed the Ethiopian Delegation about activities of ICT and assured complete co-operation in making this arrangement truly successful. His Excellency, Mr. Tadasse Haile expressed complete confidence in the strengths of ICT and wished all the success to both the highly esteemed bodies, i.e., ICT and ETIDI in the accomplishment of this twinning arrangement.May both the countries be equal beneficiaries in thesame.

Signing ceremony of "Twinning Arrangement" between ETIDI, Ethiopia and ICT, Mumbai, India: Seating (L to R) Mr. Seleshi Lemma, D.G. of ETIDI, Prof. G. D. Yadav, V.C. ICT, H.E. Mr. Tadasse Haile, State Minster to Ministry of Industry of Ethiopia; Standing Prof. R. V. Adivarekar, HoD, Dept. of FTPT(left)& Mr. FikerTesfu for Finishing Technology Directorate, ETIDI.

ICT faculty and Ethiopian delegation while exchanging the signed agreement of "Twinning Arrangement" between ETIDI, Ethiopia and ICT, Mumbai, India.

Jt. Secretary, Textiles, graces 55th Joint Technological Conference hosted by NITRA

The Joint Technological Conference (JTC) is an annual feature of India's premier textiles research associations ATIRA, BTRA, SITRA and NITRA. This is a jointly organized prestigious techno-conference in which delegates from the textile & clothing industry take part. The major technical developments in the field of textile technology, based on the R&D works carried out by four TRAs during the year, are presented and deliberated in the conference.

The 55th edition of this event was hosted by NITRA at PHD House, New Delhi on 10th May 2014. Sh. Sujit Gulati, Jt. Secretary, Ministry of Textiles, inaugurated the occasion as Chief Guest. Also present on occasion were Chairman, NITRA and eminent industrialist Sh. R.L. Nolkha, Director General, NITRA Dr. Arindum Basu, respective Directors of ATIRA, BTRA, and SITRA Dr. A. K. Sharma, Dr. A.N. Desai, and Dr. Prakash Vasudevan. Dr. R. Chattopadhyay and Dr. S.M. Ishtiaque, both Professors, IIT Delhi chaired the two technical sessions. During the daylong conference, twelve technical papers were presented to about 250 industry professionals. TRAs and some reputed companies also participated in the exhibition that was organized for product showcasing and technology manifestation to industry delegates.

Sh. R.L. Nolkha, Chairman, NITRA, in his welcome address mentioned that, TRAs are the flag-bearers of textile research in India since independence and are also acting as implementing agencies for textile ministry. He urged the JS to provide more support to TRAs and create an environment so that TRAs can wholeheartedly concentrate on research works and pass on its fruits to Indian textile industry.

Sh. R.L. Nolkha (R), Chairman, NITRA and Sh.Sujit Gulati, IAS, visit NITRA pavilion

Dr. Arindam Basu, Director General, NITRA while presenting the Combined Report on the Activities and Achievements of TRAs, informed that altogether 50 R&D projects, that are partly funded by the industry, MoT, state governments and other government agencies, are under taken by the four TRAs during last one year. The progress and outcome of most of the projects, whether ongoing or completed, are very satisfactory. While continuing, Dr. Basu mentioned that in order to keep Indian textile industry competitive in the international market in the emerging area of technical textiles, TRAs are working round-the-clock through various Centers of Excellence (CoE) for technical textiles that are established in all TRAs with the financial assistance from MoT.

Dr. Arindam Basu, Director General, NITRA addressing at the 55th JTC

Dr. Basu informed that apart from research, TRAs are also acting on Govt. of India's mega training project, Integrated Skill Development Scheme (ISDS) where MoT has assigned TRAs the task of training a large no. of persons in textile sector in 5 years. Presently, TRAs are conducting customized mass-scale training programs across the country in order to make it a success.

Sh. Sujit Gulati expressed happiness over the activities and achievements of the TRAs and informed that the new ideas emerging in JTCs are very helpful for formulation and implementation of Govt. policies and programs relating to Indian textile and clothing industry. He opined that the area of technical textiles has great potential and textile ministry is making a lot of effort to popularize and bring in investment in technical textiles. He too mentioned about ISDS and appreciated TRAs' role in acting as implementing agencies of such a massive skill development program in order to strengthening the Indian textile industry as well as meeting the Govt. of India's policy objectives. He also advised TRAs to increase international exposure by undertaking overseas training and consultancy projects.

Dr. Arindam Basu, Director General, NITRA presents a memento to Chief Guest Sh. Sujit Gulati, IAS, Jt. Secretary, MoT, GoI

Dr. Prakash Vasudevan, Director, SITRA, while delivering the formal vote of thanks, mentioned that the TRAs have pioneered the act of research and development for the Indian textiles industry for over fifty years now. They have played a lead role in developing the Indian textile industry by conducting needbased research and other supporting activities that help the industry grow and meet the cost and quality standard of a globalized market. Apart from research, result oriented technical consultancy, accurate quality evaluation of material and effective manpower training activities by these TRAs also contribute to the growth of Indian textile & apparel industry to take on the future challenges well prepared.

Dr. M.S. Parmar, Dy. Director, NITRA and Sh. Pranay Sabat of JCT Ltd. presenting a paper

The 55th JTC has been a grand success due to tireless efforts of its coordinator Dr. M.S. Parmar, Dy. Director, NITRA and his team. Sr. NITRA officers Sh. Vivek Agarwal, Asst. Director & Dean, (Management) and Sh. Partha Basu, Public Relation Officer & Faculty, conducted the entire proceedings of the conference.

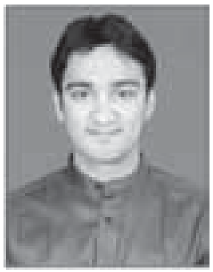
For further information please contact,
Partha Basu, PRO & Faculty
M.: 9871338998
E-mail: parthabasu@nitratextile.org,
parthabasu2@gmail.com

CONGRATULATION!!!

Rieter is one of the most esteemed organizations in the field of Textile Machinery Manufacturing. It has instituted an award for meritorious students carrying out quality research in spinning subjects.

Mr. Akshay Jakhotya of B. Text. (Textile Technology) of DKTE's Textile & Engineering Institute, Ichalkaranji, Kolhapur bagged this prestigious award this year for his project in Spinning, entitled **'Effect of Overall Draft in Spinning Preparation on Ring Spinning Performance'.**

Prof. S.G. Kulkarni, Prof. A.J. Dhavale & Mr. M.S. Kulkarni guided his project.



Mr. Akshay Jakhotya

The recipient of this award Mr. Akshay Jakhotya will get 'Swiss Crystal Trophy' & Visit to Rieter in Switzerland.

On behalf of the DKTE Institute and The Textile Association (India) congratulate him for his grand success.

INDIA

Okhla Garment & Textile Cluster (OGTC)
10th International Conference on Apparel & Home Textiles - ICAHT - 2014

Theme - "COMMITMENT TO EXCELLENCE "
Date : 19th & 20th September, 2014
Venue : India Habitat Centre, New Delhi
Contact : Mr. R.C. Kesar, Conference Chairman
Mr. M.K. Mehra, Conference Advisor
Okhla Garment & Textile Cluster
D-104, Okhla Industrial Area, Phase I,
New Delhi - 110 020 India
Tel.: (91)11- 41609550, Fax (91)11- 26816520
E-mail : ogtc@airtelmail.in, ogtc@ogtc.in,
ogtc@rediffmail.com
Website : www.ogtc.in

TEM TECH - 1st Textile Machinery Exhibition

Date : 11th to 13th October, 2014
Venue : Bhilwara, Rajasthan
Contact : Mr. Sharad Tandon - M.: 9322260941
E-mail : standon@standaonconsulting.com
Mr. Govind Sharma - M.: 9829085976
E-mail : textilemirror7@rediffmail.com
Customer Care - M.: 9849057733
E-mail : temtechbhl@gmail.com

THE TEXTILE ASSOCIATION (INDIA) - Mumbai Unit
organizes Annual Conference
Indian Textiles - The Way Forward

Date : 14th November, 2014
Venue : Hotel The Lalit, Mumbai,
Sahar Airport Road, Andheri (E),
Mumbai - 400 059
Contact : Mr. Haresh B. Parekh, Exhibition Convener-
+91-9167515676
Mr. A.V. Mantri - Hon. Secretary
The Textile Association (India), Mumbai Unit
Amar Villa, Behind Villa Diana, Flat No. 3, 3rd Floor, 86, College Lane, Off Gokhale Road, Near Portuguese Church / Maher Hall, Dadar (W),
Mumbai - 400 028
Tel.: +91-22-24328044, 24307702,
Fax: +91-22-24307708
E-mail : taimumbaiunit@gmail.com,
taimu@mtnl.net.in,
Website : www.textileassociationindia.com

ITMACH - International Textile Machinery & Accessories Exhibition

Date : 10th to 13th December, 2014
Venue : The Exhibition Centre, Helipad Ground,
Gandhinagar, Ahmedabad, Gujarat, India
Contact : Mr. Arvind Semlani - M.: +91-9833977743
Mr. Farid K.S. - M.: +91-9869185102
Tel. : +91-022-22017013/61
E-mail : info@itmach.com,
arvind@textileexcellence.com,
farid@textileexcellence.com

ABROAD

The Textile Association (India) - Vidarbha Unit hosting 70th All India Textile Conference

Date : 17th & 18th January, 2015
Venue : Vasantrao Deshpande Hall, Nagpur, India
Contact : Mr. Hemant Sonare, Hon. Secretary
The Textile Association (India) - Vidarbha Unit
26, Raghuk, Pragati Colony, Near Pragati Hall, Chhatrapati Squre, Wardha Road, Nagpur - 440 015
M.: 9860930380 , 9822573341
E-mail : hemantsonare@gmail.com,
texcellence12@rediffmail.com

1st Global Textile Technology & Engineering Show 2015 FOCUS ASIA
Organized by India ITME Society

Date : 20th to 22nd January, 2015
Venue : Bombay Convention & Exhibition Centre,
Goregaon (E), Mumbai, India
Contact : India ITME Society, 76, Mittal Tower, B Wing,
210, Nariman Point,
Mumbai - 400 021, India
Tel. : +91-22-22020032, 22828138, Fax: +91-22-22851578
E-mail : gttes@india-itme.com, itme@india-itme.com,
Website : www.india-itme.com/GTTES2015

The Textile Association (India) organizes in Association with Thailand Convention & Exhibition Bureau (TCEB) WORLD TEXTILE CONGRESS 2014
Theme: "Global Textile - Opportunities & Challenges in an Integrated World"

Date : 13, 14 & 15th February, 2015
Venue : Bangkok, Thailand
Contact : Mr. Arvind Sinha - National President
The Textile Association (India) - Central Office
Pathare House, Next to State Bank of India, 67,
Ranade Road, Dadar (W),
Mumbai - 400 028 India
Tel. : +91-022-24461145, Fax: +91-022-24474971
M. : +91-9820062612
E-mail : taicnt@gmail.com, lionasinha@gmail.com

ITMA 2015
The Integrated Textile & Garment Manufacturing Technologies Showcase

Date : 12th to 19th November, 2015
Venue : Fiera, Milano Rho, Milan, Italy
Contact : MP Expositions Pte Ltd.
20, Kallang Avenue, 2nd Floor,
Pico Creative Centre, Singapore 339411
Tel. : +65 6393 0241, Fax: +65 6296 2670
E-mail : info@itma.com,
Website : http://www.itma.com

Redg. No. R. N. 11386/57 (Formally Textile Digest)