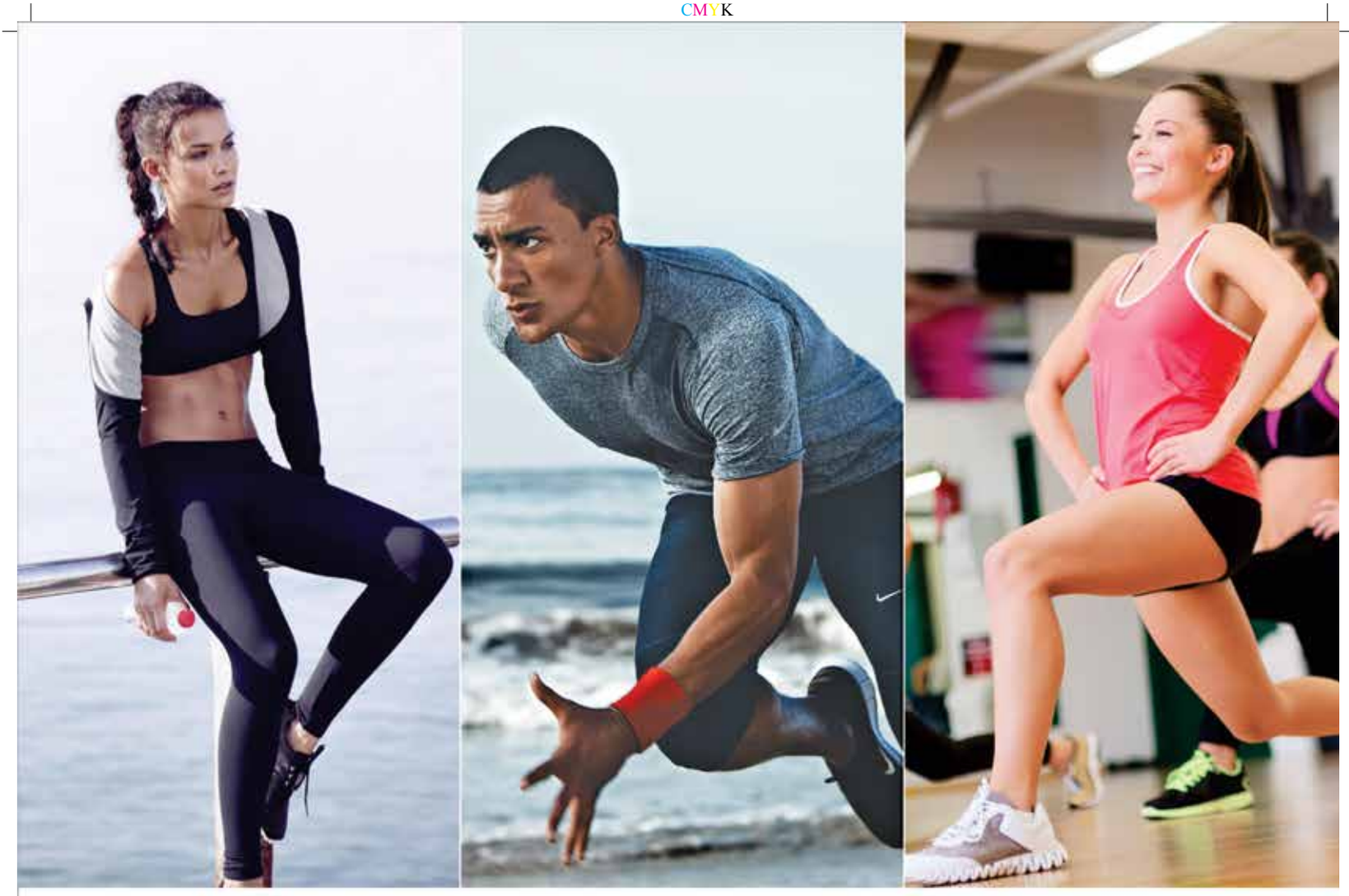

TANTU 2017

ANNUAL JOURNAL OF THE ALUMNI ASSOCIATION

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Editorial

The release of TANTU Annual Journal 2017 on the occasion of fifth **TANTU** seminar **"Performance Textiles: Athleisure and Active Sportswear"** organised by the north India section of alumni association of textile technocrats from Calcutta University, is an indication of growing commitment of the textile and apparel professionals in the industry at large. With so many seminars being organized and publications released every year, TANTU has already created a niche by organizing seminars in thrust areas supporting government's Make in India mission.

The performance sports apparel market is exploding by all means and expected to generate revenue of $184.6 billion by 2020, growing at a CAGR of 4.3% during 2015-2020. According to research by Morgan Stanley, the **athleisure** sector has seen a huge increase of 42% over the last seven years and is now worth over $270 bn globally – not only that, but **athleisure** is also predicted to grow another 30% by 2020, especially in Asia and the US. According to The NPD Group, US activewear apparel sales totalled US $ 45.9 billion in 2016, up 11% from last year and far outperforming the traditional apparel sector overall. According to Euromonitor report, from 2015 to 2016, the Indian sportswear market grew 22%, outpacing the segment's global increase of 7%. By 2020, it is expected to grow an additional 12% CAGR with sales expected to reach US $ 8 billion. By 2018 Asia Pacific would emerge as the largest sports apparel market. While most of the international brands are already present in India, Indian start-up brands have already made their mark.

The brave heart garment entrepreneurs from India are known for their never say die attitude but generally reactive in approach and follower of international trends and practices. It is heartening to see that in **athleisure** and activewear segment, Indian entrepreneurs may be leading the pack. This seminar will probably mark the arrival of India's home grown brands in **athleisure** and activewear segment with as many as eight brands are associated with TANTU seminar time. While the healthy competition will elevate the standard, it will create a competitive supply chain to take the international brands head-on. While the seminar will have live discussion, we have tried to cover this domain through number of articles addressing raw material, sourcing, and market.

This TANTU magazine contains very interesting mix of articles, in textile and apparel space. On behalf of TANTU, I would like to extend my heartfelt thanks to all those who financially and otherwise supported in our efforts to bring together like minded professionals, nurture young minds and keeping this industry alive and relevant. Last but not the least the inspiration and support of our spouses and children notwithstanding the agony and tolerance for all the late comings and meetings.

DR. PRABIR JANA, Editor-in-Chief
PRASANTA SARKAR, Assistant Editor

Developments of Fibres for Active Sportswear

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INTRODUCTION

An increase in participation in active sports all over the world has been observed in recent times. Professional sports people are much more conscious of the sportswear and demand more specific function to be performed by the sportswear. As a result new fibres are emerging out for satisfying the stringent needs. Textile materials are used as sportswear in many games. There are many kinds of sportswear such as aerobic clothing, athletic clothing, football clothing, cricket clothing, games shorts, pants, shirts, socks, sweat shirts, tennis clothing etc. The desirable attributes of functional sportswear are as follows[1]:

- Rapid moisture absorption and conveyance
- Optimum heat and moisture regulation
- Good air and water vapour permeability
- Rapid drying to prevent catching cold
- Low water absorption of the layer of clothing just positioned to the skin
- Dimensionally stable even when wet
- Durable
- Easy care
- Lightweight
- Soft and pleasant touch

It is not possible to achieve all of these properties in a fabric made of any single fiber or their blends[2]. The right type of fibre should be in the right place. While fabrics made of natural fibres have the ability to absorb moisture away from the skin, they do not dry fast which have a direct influence on perceived comfort. On the other hand, high-tech synthetic fabrics are lightweight, capable of transporting moisture efficiently, and dry relatively quickly. It has been found that frictional force required for fabric to move against


Dr. Amal Chowdhury

sweating skin is much higher than that for movement against dry skin. This indicates that the wet fabric, due to its clinging tendency, will give an additional stress to the wearer. So, when engaged in active sports, it is essential to remove sweat from the skin. In removing the liquid sweat from the skin, some textile manufacturers claim that moisture absorbency of the fibre is important and hence cotton or viscose is a necessary component for the sportswear, which is next to skin. While others say that fibres in these garments should not absorb moisture, so that moisture or perspiration is wicked away from the skin

to outer layers of clothing from whence it can evaporate into atmosphere. However, a lot will depend on the degree of activity contemplated. In fact, the synthetics should be preferred in clothing of active sports because they do not retain moisture and this has the advantage of keeping garments lighter than the cotton when it is wet. Most of the modern textile materials use the basic idea of capillary action for sweat absorption and fast drying. However, cellulosic fibres like cotton, viscose are regarded as notorious fibres when it comes to wicking property through capillary action. Although, several trials[3] have shown improvement in wicking properties of cellulosic fibres after treating with hydrophobic finishes, the durability and other aspects of comfort of these fabrics still remains questionable. The quest for search of new type of fibres to cater to the various needs of sportswear throws uphill challenges to the scientists, which leads to the innovation of new fibres. Finally, these fibres have become today's breakthrough materials in commercial applications, which opened up new horizons in the field of sportswear as discussed below.

POLYESTER COOLMAX:

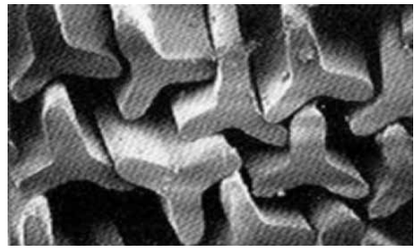
Polyester coolmax[4] has been claimed to improve comfort of wearer through rapid removal of perspiration by capillary. Coolmax is a four-channel modified polyester fibre. It offers improved wicking capability and moisture vapour permeability. It dries significantly more quickly than many other fabrics used in sportswear[5]. Coolmax and thermostat polyester fibers are used in two fold garments; the former wicks the moisture away from the skin and the latter maintains warmth.

TRIACTOR:

Toyoba Co Ltd has developed Triactor[6], which is a perspiration absorbing as well as quick drying polyester filament as shown in figure 1. In this case, the shape and size of cross-section of fibre has been manipulated by using suitable design of spinneret to exploit the advantages as regards transportation of moisture. Polyester is hydrophobic and does not absorb moisture but changing the filaments to Y shaped cross section brings about a large in its wick ability. The fibres with this type of cross-section offer large surface which augments quick transportation of moisture by capillary action. The hydrophobic nature coupled with large surface of polyester filaments enable quick drying and refreshing.

There are many other fibres, which have good sweat absorption and fast drying property. Most of them are either nylon or polyester.

Figure 1 - Structural model of Triactor



LUMIACE:

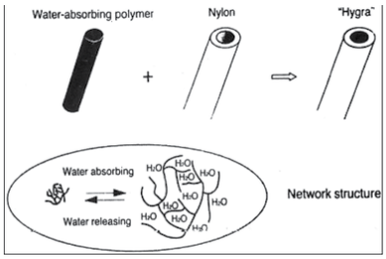
Advent of micro denier polyester also opens up a new concept as regards transportation of moisture i.e. wicking perspiration away from the skin. The use of superfine or microfibre yarn enables production of dense fabrics leading to capillary action that gives the best wicking property[8,9]. Lumiace[7], a micro denier fibre, is a product from Unitika. It is a collection of polyester filaments having different fineness (0.5 - 2.0 denier per filament) and irregular cross sections. Hygra - Lumiace combination in knitted fabric is very popular in top Japanese athletes.

HYGRA:

Unitika Limited has launched Hygra, (figure 2) which is a sheath core type filament yarn composed of fibre made from water absorbing polymer and nylon8. The water-absorbing polymer has a special network structure that absorbs 35 times its own weight of water. Moreover, it offers quick releasing property that the conventional water-absorbing polymer can not do. On the other hand, nylon in the

core gives tensile strength and dimensional stability. Hygra also exhibits superior antistatic properties even under low wet conditions. The main apparel applications include sportswear like athletic wear, skiwear, golf wear etc.

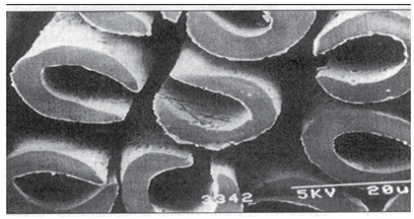
Figure 2 - Hygra sheath core type fibre and its way of functioning



KILLAT N:

It is a polyamide fibre. These fibres are strong enough from durability point of view and used for swimwear and cycling clothing or as reinforcing fibre in blends used for sports socks[5]. These fibres higher moisture absorption rates and better wicking ability than polyesters but dry more slowly. To overcome this drawback, Kanebo Ltd has launched Killat N9, a nylon hollow filament. The hollow portion is about 33 per cent of the cross section of the fibre. The hollowness confers good water absorbency and warmth retentive property. The manufacturing technology of Killat N is very interesting. The yarn is spun as bicomponent filament yarn with soluble polyester copolymer as the core portion and nylon as the skin portion. Subsequently, it is undergone alkali weight loss treatment which dissolves the soluble polyester copolymer of the bicomponent filament. This results in formation of a large hollow portion which is shown in figure 3.

Figure 3 - Killat N hollow nylon fibre



HYDROFILIA:

Hydrofilia[5] is a modified polyamide fibre. It is a polyamide block copolymer containing 85 per cent nylon 6 and 15 per cent polyethylene oxide diamine which provides significantly improved water absorbency, up to the levels associated with cellulosic fibres. Polyamide microfibres such as Tactel Micro, Microfine, Supplex and Microfibre, are used in fabric to produce superior wind protection, a soft feel and good moisture vapour transmission.

DRYARN:

It is the fibre from Aquafil. It is a completely recyclable polypropylene microfiber. These fibres have very low moisture absorbency but excellent wicking ability[5] which enables it to dry fast. It has good moisture management property due to its hydrophobic nature. As polypropylene does not wet out, its thermal insulation is retained during and after strenuous activity which keeping the wearer warm in cold weather and cold in warm weather. Further the density of the fibre is less than unity, making it the lightest fibre. This is why fabrics from Dryarn[10] is very lightweight and comfortable and used in different sports fabrics. Dryarn is also resistant to bacterial attacks as the bacteria can not settle on smooth surface of the fibre. This evades unpleasant odour associated with decomposition of bacteria.

LYCRA:

Lycra, a truly synthetic fibre of long chain polymer composed of at least 85% segmented polyurethane, finds wide range of end uses such as swimwear, active sportswear, floor gymnastics because of its comfort. These fibres are frequently used in small quantities in garments to increase stretch and support. For example knitted sportswear contains 3-10 per cent of elastomeric fibres. It will not affect the thermo-physiological comfort of garments that contain them. Adding Lycra to a fabric gives it stretch and recovery, particularly in gymnastics and swimwear where body skin flexing and stretching are inevitable[11].

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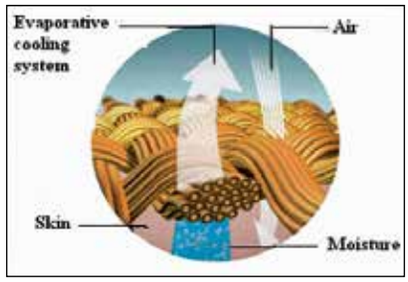
ROICA AND LEOFEEL:

Roica is a polyether type spandex made by dry spinning method and Leofeel is a soft nylon-66 yarn developed by Asahi Chemical[12]. The combination of Roica and Leofeel in mixed knitted tricot fabric gives a soft touch and excellent stretch. It is mainly used in swimwear.Various other fibres like Elite from Nylstar Co, Linel Ac from Fillattice Co, Elastil and Sens from Miroglio etc also have good stretchability and are effectively used in swimwear[13].

THERMOLITE:

The clothes made of the Thermolite range fibers are efficient and comfortable. Sportsmen can use them during any weather and for any sport. Thermoliteis[5] a lightweight, hollow fibre offering more warmth and better moisture control than any other fibre of the same thickness. The secret of the Thermolite range lies in the fact that the hollow fibers capture the air for better insulation. Further, because of increased surface area, it evaporates moisture quickly. On an average, the clothing dries 20% faster than other insulating clothing and 50% faster than the cotton[14]. Their structure and way of working as regards evaporation of moisture is shown in figure 4.

Figure 4 - Structure and way of functioning of Thermolite



Conclusion

With the help of the latest technology, it is possible to develop new fibres to cater to the needs of different types of active sportswear. In fact, developments in synthetic fibres which are tailor-made have immense potential to open up enormous avenues for their use in sportswear to meet specific requirements. In active sportswear single fibre is seldom used. Mostly, speciality fibres are used in conjunction with normal fibres. Today, there is immense scope to develop new active sportswear by incorporating variants of synthetic fibres judiciously. However, manufacturing of these fibres need a basic understanding of the principle based on which the fibres are supposed to perform. Last but not the least, in economic front, export of these fibres and sportswear made of them may provide immense earnings in future.

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The Technological Innovation and Shift in Business Practices

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Introduction

Top growth driver today is innovation and to be competitive in the global marketplace, organizations need to be driving more innovation in their products and services. They need to innovate rapidly and they need to do it cost-effectively. This is the need of today.

Even during the recession, CEOs were mainly focused on growth, and they expected technology to be the main enabler of innovation. In fact, most CEOs were looking to use technology to gain both efficiencies and differentiation simultaneously.

A survey conducted by *PwC in 2011 found that 80 percent of CEOs believed innovation drives efficiencies and leads to competitive advantage. For most of them, technology is one way of capturing both. Close to 70 percent of CEOs surveyed were investing in IT to reduce costs and to become more efficient, while 54 percent were also funnelling funds toward growth initiatives that leverage emerging technologies such as mobile devices and social media.

[***PricewaterhouseCoopers** (doing business as **PwC**) is a multinational professional services network headquartered in London, United Kingdom. It is the second largest professional services firm in the world]

Even the best technology can't deliver success without focus on business strategy and goals. It is important to have a clear vision of where the company is going, as it will define and set the context for the role innovation will play in enabling profitable growth, help determine the type of innovation you want to drive and the way you need to organize to effect change. Innovation can manifest itself

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in multiple ways, whether in a technology change that determines the products and services you deliver, or a business model change that defines the value you deliver. Companies must determine the types of innovation they need—incremental, breakthrough, or radical:

- Incremental innovations make small changes to a company's existing technologies and business models (1st category)
- Breakthrough innovations make significant changes to

either the technology or business model, producing significant growth (2nd category)

- Radical innovations, which take place more rarely, combine technology and business model innovation to create major new industries with exponential growth (3rd category)

The Role of R& D in Industrial Growth

R&D (Research & Development) plays a very important role in the success of a business. R&D contributes to sustainability of business. Many companies do not understand the importance of R&D until it is too late.

It is the R&D function that provides a platform for creativity and innovation to flourish in an organisation. Innovative breakthroughs have happened only because of painstaking efforts of the R&D function. Perseverant efforts are needed when one is in pursuit of research. Every failure in a R&D effort increases the pressure to perform.

R&D helps a business to have a competitive edge over its competitors. It is the R&D function that develops plans much ahead other functions. The R&D function needs to have a clear foresight about future problems that need solutions. R&D (in its development role) can act as a catalyst for speeding up the growth of organisation by way of introducing breakthrough products in the market.

R&D is very relevant in today's competitive scenario when customers are hankering after new products and new technologies. The firm that can successfully leverage its R&D efforts by translating the efforts in building new products will find itself ahead of its competitors. Expenses on R&D can be considered not as expenditure but as an investment.

The Role of Ind. on R&D efforts can take a while to materialise. But once success is achieved, the financial returns can be quite high. Pharmaceutical companies, chemical companies, automotive companies, lubricant companies invest massive amounts of capital expenditure and revenue expenditure for this reason. These companies strive to be ahead of others in their learning curve.

Some companies are technology leaders, while others are followers. Some industries prove to be laggards (they are the ones to wake up to the market realities a way bit late).

Let us take the case of mobile phones. Today there are different types of models that are being launched in market are the result of intensive R&D efforts. Apple, Sony, 3M are the companies that are known for their breakthrough technologies - some of these technologies are albeit disruptive because they make the existing technologies redundant.

Many firms have converted problems into opportunities only because of their R&D efforts. These companies eventually became technology leaders as they created a churn in the market

All the modern inventions –laptops, palmtops, music players, iPods, mp3players, automatic washing machines, dishwashers, water filters are all examples of R&D efforts that had a successful outcome. Who would have thought that mosquitoes would provide an opportunity for new product development in the form of mosquito mats, repellent creams, vaporizers etc.

Digital photography has made the conventional technique redundant. Computers have confined the typewriters to the museum. E-mail has rendered the snail mail defunct.

The world moves on only through scientific inventions and discoveries which are result of sustained R&D effort. Only this leads to long term business sustainability. Sometimes R&D efforts are also necessitated to meet the regulatory norms eg: green technologies that

reduce pollution. Hybrid cars, electric cars, catalytic converters in cars are examples of successful R&D efforts

The true test of R&D function lies in time to market. Business exists for the sake of making profits. So, the role of R&D in shortening the time to market becomes extremely important. Unless the R&D efforts in the lab cannot be scaled up within a reasonable time frame, little can be expected in terms of the functional credit to be assigned to R&D.

In India, the problems faced by R&D functions are one too many. It is high time the scenario changed. Germany is known for world class engineering and US is known for its research agenda. India, despite having a talent pool, still lacks in indigenous research.

R&D becomes extremely relevant to make an organization future ready, to equip the business with the wherewithal required for commercialization of lab efforts through large scale production.

R&D function can reasonably predict future technology trends. In an environment filled with resource constraints, R&D efforts in the right direction will enable allocation of scarce resources for the right purpose.

R&D helps a business earn revenues through licensing of technology, technology transfer too. The information technology has developed so much in the last few years that change has become the norm in such sectors. There needs to be greater coordination between academic research and industry research.

Companies tend to focus more on “development” and less on “research” mainly to meet short term operational goals. It must be understood clearly that R&D has a strategic orientation and using the R&D function to meet short term operational goals is anything but a wise more. Some firms use R&D as a cost centre because of the depreciation allowance given by the Income Tax dept. This is indeed sad.

The expenditure in R & D should not be taken as a waste and the team in R & D department should be respected all over the organisation, since it is found members in other functional departments like Production, Sales, Accounts feel that R& D people are doing nothing but taking fat salaries. Organisation should always appreciate and acknowledge the R &D team so that they can innovate new ideas, products beneficial for the company. It is also not necessary that R & D people should be Post-graduates, Doctorates only, anyone with clear vision can do wonders, say for example Steve jobs of Apple, Bill gates of Microsoft and so many others. In fact, that in R&D Team the Scientists should be those who have burnt their fingers!

The Aim

- And all the above are to create new Products to face the competition, to sustain in global market with Brand name.
- To increase market share especially in Export Market and leads to higher growth and profitability.
- To acquire Modern Technique for easy operation with minimal manpower and it should be more viable techno economically.
- To reduce cost at every aspect, say power, maintenance cost (without compromising quality and safety)
- To develop human resources with a view to right man at right place for the right job with expert and skill hands.
- To increase Production without any further investment that reduces costs indirectly with better utilisation of the machineries.
- To increase innovative ideas (KRA) among the employees which leads to constructive thoughts and better out puts. It benefits

both Managements and Employees which leads to career growth.

- Long-time sustain even in recession. Growth must not be held up.
- There should be always Technology development through innovative ideas looking to the business strategy and goals. To set up Quality aspects looking to the International Standard and to act accordingly.
- There should be continuous Trouble shooting and stringent Process Control system so that no wastages, no quality down gradations can happen.

The mode of Implementations

All the innovativeness, R&D activities are to be implemented in the Industries where top CEO to the Grass root level technicians are to be involved. It requires joint efforts otherwise will remain in black & white only.

- The Industries should collaborate/ joint venture with the International Level Researchers. Say RIL collaborated with Du Pont Technology. Like car Manufacturers collaborated with Suzuki, Hero Honda, that will lead the organisation at the top of the Global level.
- Within the Industries self-motivation should be generated. KRA should be given top priority in the Organisations where growth is not limited. This brings growth by small changes, growth in quality, costs reduction, system developments, increases alertness among the employees, increases innovative ideas and reduces frustration among the employees.
- The Expert opinions are to be invited, interactions with the employees are to be developed for maintaining the freshness among the employees.
- The Employees are to be taken part in Quality Circle, visiting Machine Exhibitions, undergo trainings at various stages and the innovativeness will grow. These all come in the 1st and 2nd category of innovations.
- There should be Talent Management.
- In Textile Industries (The Author belongs to this Industry) in India, very few fundamental Research are being done. The fundamental Research are done mostly in Italy, Japan, China, Germany, Belgium, Switzerland etc. where the new and Modern machines with new Technology were developed. The TRA`s have done works mainly on category 1.
- In Textile Industries, whatever the R&D are being done, they are hired/ copied Technology with a view to reduce Cost & Manpower, increase efficiency and quality and to increase Market potentiality.

The case studies

The author being an Industrial expert with sound knowledge in Research & Developments likes to highlight some case studies conducted directly by him which benefited the Industries and fall in the category 1.

(1) We obtained cotton waste from paper industries and lime waste from the ETP of Bhansali Polymers. We made bricks out cotton waste with the lime acting as binder. The main feature here is the utilisation of wastes from industries. We also experimented with cement as binder.

We got bricks which are light and very strong (the breaking strength is 3 time that of mud bricks).

Those made with lime as binder, also are self-cementing i.e. put the bricks one on the top of

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the other without any mortar, the bricks bond very strongly.

The bricks can be made waterproof by applying a coat of paint (which is made from bhilava nut shell liquid, a forest produce). Because of the compact structure the bricks are also fire resistant. This is just innovative idea to reuse cotton waste (which is just a waste) and to reuse.

(2) Reuse, reduce and recycle is the Industrial Slogan today.

The POY and PTY waste used to be help in producing the pillow and soft toys. Now there is breakthrough Innovation that POY wastages are recycled in producing again POY with similar characters.

Similarly, PET (Polyethylene Terephthalate) bottles are also recycled and shirt buttons, bottles are manufactured.

(3) The effect of Humidification and yarn properties: This Project was carried out to prove that with modern technic of Humidification, with better distribution & circulation of air, the cotton yarn quality can be improved. The Management implemented it and Export quality improved.

(4) Technoeconomic of High Speed Texturisation Machine. The Project was carried out and proved that higher the Machine speed, higher is the economic Benefit although the Power and maintenance costs go high. It was implemented by several Industries including RIL.

(5) Developed modified cross-section POY through continuous polymerization and direct spinning process. (In RIL, Mauda, Nagpur and in Patalganga Plant)

- ► Increased the polymer and POY plant output by >35% above the rated capacity through process optimization and minimal equipment modifications.
- ► Converted extruder lines to Direct Melt Spinning through in-house design and execution.
- ► Introduced polymer modification and 0.6 dpf micro denier PFY (first time in India) through in-house development activities. (falls in the category no 2)
- ► Major areas of process and product development were:
  - New Generation 3 (NG3) process and resin development.
  - Cationic dyeable (CD) polymer from PTA route in CP.
  - Dope Dyed POY developed
  - Deep dyeing easy dyeable polymer in BP and CP.
  - Short cut PSF for concrete reinforcement applications.
  - Optically bright polymer.
  - Modified cross-section yarn for anti-crush pile fabrics.
  - Helicoil (3D) permanent crimped bi-component FDY.
  - Full dull POY developed.

    (i) Modifying polymer by increasing cross linking, it increases production by 5%. The polymers are linear and by putting additional chemical “mono penta erithritol” the cross linkage increases and hence production increases.

    (ii) When the melt spun comes out from spinneret it is hot and 5-7 cm area is not quenched (delay quenching). Hence, 2-3% extra draw is possible, speed can be increased from 3000mpm to 3200 mpm. Then normal quenching can be done to stabilise the polymer.
  - Lycra yarn produced (Imported Technology)

All the above products are highly in demand and it was possible only through R&D activities and innovative ideas among the Officers and supported by the CEO.

Conclusions

- The Industrial Growth is possible only by emphasising on R&D Activities. It should be a Nonstop Process.
- The business Practices can be sustained with continuous endeavour to innovativeness.
- The growth should be continuous to stand and to face the Global challenge and encouragements are to be given to all category of the people.
- Various types of Joint Ventures, Collaborations, techno transfer, Exchange are to be adopted to run the business.
- The Textile Industries are facing tremendous challenges because of less Innovations. The Technology is by and large dependent on other counties. TRA`s must be more innovative.
- The sky is the limit for the growth and innovations. It can be encouraged right from the College education.

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Emerging Demand of Sportswear & Athleisure-An Opportunity to Indian Industry

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History of Clothing manufacturing activity could be traced in India in northern part since World War II when a few enthusiastic entrepreneurs jumped in the venture to start supplying garments for defence personnel on emergency delivery schedule. It is more than seven decades, the industry has grown up from a small plant to a big banyan tree, providing employment to a few lakhs people directly and created equally indirect employment. The industry has experienced a lot of ups and down since inception but have been able to overcome. The industry had made a humble beginning in between late 70's and early 80's having an access to the global market. Since then, Indian ready made garment industry has been rapidly moving well registering exponential growth and exporting garments to EU, USA and other countries till early 2000. However the fortune got changed, once India became a signatory of WTO and the industry had to lose the opportunity of quota regime and shift to open market economy to capture the market. A lot of challenge and opportunity have come during the last one & half decade but industry as a whole was not very successful to tap the full potential. Indian industry was not in right mood to take a call to move out of manufacturing traditional garments to special feature product for specific end uses. Sportswear is one such unique product which had a growing market potential in domestic market but there was no serious move to make a venture. The first sportswear brand (Power brand) was launched in Mumbai in early 80's by a reputed company to tap market potential but failed

CHANDAN SAHA

to outreach the consumers' expectation. In the mid 80's, a few small and medium size clothing manufacturing units made serious attempts to manufacture sports wear mainly Jogging suit, Shorts, T-shirts specially for Tennis, Badminton, & Polo games etc. These units had got a big success initially but it was short term as quality, cost and design etc. were not matching with the imported brand. However, a few are still continuing, despite facing stiff challenges. India has been importing the sportswear from

EU and USA since beginning in absence of established brand of any domestic manufacturers.

With the passage of time there was a sudden change in people life style and improved health consciousness mainly in metro cities, there was a sudden upsurge in demand of sportswear mainly Jogging suit and sports T-shirt in late 80's and there was a big gap in demand and supply. There was a wave of awareness among the youths specially involved in sports & games, desperately searching for quality and affordable sports wear and it was in early 90's the world renowned branded product manufacturers namely Reebok and Adidas had made an access to Indian market and made serious initiatives to popularize their products by organizing sports event & camps and distributing sportswear and sports footwear to the youth. This had enabled the manufacturers to make an inroad in the Indian market. Since then, these imported brands have been dominating the market but the domestic manufacturers have been able to make a dent to capture a small share. It is reported that till date, only four imported brands like Reebok, Adidas, Nike and Puma are having 80% of the share and the domestic manufacturers are having the rest. In the last one decade, sports activity has got an importance in common people's life as Indians have been able to have a big access in international sports circuit. Besides, structured initiatives are also made to popularize traditional games in the country. Sports activity got popular in rural area in a big way in the last decade. Market analyst indicates a huge surge in demand for sportswear and Athleisure in the coming years as a big no. of youths are opting sports as a career and Govt. is encouraging the sports activity throughout the country. Till date, the consumers are using mostly branded products as there is hardly any option but there is no doubt, the preference may get a big shift, once affordable quality products are available from domestic players specially in rural and semi urban areas. It is expected that the domestic players will make serious attempts to make strategic plan to tap the huge potential.

Features of Sportswear:

Sportswear, the darling of American Fashion came into its own during 1920. It has largely embraced by American woman because her need of clothing separates to wear for an increasingly life style and re-creative activities. It is reported that part of the evolution of sportswear was triggered by 19th century, with the developments in female active wear for specific purposes. Initially Sportswear was the moniker used by fashion industry to describe the informal, interchangeable, separates typically worn for spectators of sports. It started out as a fashion industry, term describing informal and interchangeable separates. Sportswear originally described as Active wear clothing is made especially for sports. In the 70's & 80's it has become a mainstream clothing varying degrees of formality for everyday style. Sportswear is typically designed to be lightweight not to encumber to the wearer. Sportswear should be loose enough so as not to restrict movement of body parts. Some sports have very specific requirements, hence; designing of sportswear is very important to cater the needs. Standardised sportswear may also function as a uniform. Sportswear is usually identified by colour & design of both sides in any sports /games.

Experts outlined the importance of technical features of Sportswear to make it comfortable & convenient to the sports personnel and sports wear manufacturers have to comply with the features to cater the needs and also to retain the market share. These are heat transportation properties, Microclimate in clothing and Stress compatibility. It is reported that sportswear design must consider the thermal insulation needs of the wearer. In hot situations sportswear should allow the wearer to stay cool; while in cold situations sportswear should help the wearer to stay warm. Sportswear should also

be able to transfer sweat away from the skin, using moisture transferring fabric. It should be light weight and having capacity to create passage for air movement within the garment.

Features of Athleisure:

With the passage of time, life style and health consciousness among the working people especially in urban areas has grown up in a big way but acute time shortage has become a constraint. So there was an urge to bring out an innovative product to fulfill the need of consumers. Athleisure is a new buzz word, echoed recently in fashion design world and the innovative thoughts/ideas have taken a shape in bringing out the new designed outfit. Experts opine that Athleisure, a derivative of sportswear has come out as an innovation to build a bridge between need and time management. Athleisure is arguably a more versatile type of apparel. It could be seen as an improvement of sportswear. It stems from people demanding need for everyday comfort especially for those aiming to squeeze in workout. Athleisure also represents a bigger and likely permanent change in fashion. Athleisure is a unique clothing, designed for workouts and other athletic activities. Athleisure can be considered as a fashion industry movement, enabled by improved textile materials which allow it to be more versatile, comfortable and fashionable. It encompasses a wide range of items like Yoga pants, Leggings, Zip front or hooded sweat shirt, Blazer and Varsity Jacket etc. Yoga pants consist of a huge part of Athleisure. It is more functional since it looks just as good in the gym as it does anywhere else. It has been identified as being sporty and stylish. It is reported that the athleisure trend grew out of woman wearing yoga pants and slowly it has been designed to wear in multiple occasions without having any change, which meant greater convenience.

Materials & Technology:

Both Sportswear and Athleisure are new generation well designed product. Innovation and consistently improvement in design, comfort and quality are the key elements to meet the requisite features of consumers. These products are unique in nature as these products provide additional facility to have comfort and retain its shape even after stressed to an extent. To manufacture such product, traditional technology and materials will not suffice to bring out as appropriate. Hence, innovation in technology and materials both are important in absolute terms. Although these technologies are expensive but it has been able to make more energy efficient thus scaling down the cost. Research has led to new fibers developed specifically for odour reduction, sweat- wicking, strechability to conform to the body shape, more breathability to allow air inside the garment, while other parts can have a greater tension perhaps as a way to aid posture. Moisture wicking fabric, a class of hi-tech fabric that provides moisture control for an athlete's skin and this helps to move perspiration away from the body to the fabric's outer surface where it can evaporate. Moisture wicking means that material is absorbent in nature and this can leave a barrier of wet fabric on your skin. Dry wicking material is the newest variation of moisture wicking. It has smart two tier fabric that breaks the surface tension of sweat and propels it through hydrophobic layer into a natural wicking outer layer where it is assisted by evaporative cooling, leaving your skin absolutely dry. This enables the sports person body to perform better. This also keeps the sportswear chemically free, prevent odors because a bacteria microclimate can not grow on dry skin. Expanding interest in wearable technological devices and fitness application has also paved its way into the athleisure and sportswear market.

Market Potential & Opportunity:

The global sports apparel market has witnessed significant growth owing to growing health awareness and

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increasing fitness activities such as Aerobics, Swimming, Brisk walking, Yoga etc. including growing inclination to sports & game among the youth and senior citizens. The market is further got enlarged by consistently increasing participation of women in sports and fitness activities. It is reported that North America is the largest revenue generating region in the global sports apparel market. However, Asia-Pacific would be the leading revenue generating region by 2020, owing to increasing disposable income and improving living standards in the emerging countries such as China and India. Market analyst indicated that Asia pacific play an integral role in the global sportswear market, accounting 38% of global sportswear absolute value growth from 2011-16. China leads the region accounting 46% of market share in 2016 but India and Vietnam indicate a considerable scope for future growth surging an interest in health & fitness combined with rising disposal incomes will ensure sportswear growth exceeds overall industry growth by 2021 across the region. However, availability of inferior quality and unbranded products restricted the growth. The report analyses that the sports apparel market is growing based on end users, mode of sale and geography etc. Favourable demographics and rising inclination towards trendy sports apparel have boosted the growth of the market.

Global Sports apparel market is expected to garner US$184.6bn by 2020 registering a CAGR of 6% during the forecast period 2015-2020. Market analyst also predicted a big jump in demand of Sports and Fitness clothing in 2024 and it may reach a value of US$ 232 driven by rising health consciousness and increasing trend in participation of sports and fitness activities. In 2016, the global athleisure sector is valued at over $83bn, while US market reported a 16% increase to US$44bn. and a 30% growth is also predicted in Asia and US by 2020. It is reported that Indian sportswear industry was worth $1.18bn in 2013 and from 2015-16 Indian sportswear market grew 22% outpacing the segment, global market increases only 7%. It is expected to grow by an additional 12% CAGR with the market demand of worth US$8bn. It is reported that growth rate of Athleisure is not very significant in comparison to sports wear.

Table-1
Demand growth of Athlesiure in India (in CAGR%)

Year	CAGR
2009	0.28
2011	0.40
2013	0.56
2015	0.85
2017	1.30

Athleisure is a new innovation of sportswear, serves the purposes beyond the sports activity. In India it is still in incipient stage, it will take time to get popularize among people as environment & culture at working place as well as social function are quite different from western countries. Hence growth rate at this juncture it appears a slow move, however it is expected to grow in the next decade.

Table-2
Market share of Sport goods and Sportswear Manufacturers in the Global market in 2013-14.)

Manufacturer's name	% of share
Nike	27.80
Adidas	19.95
V.F. Corporal	7.0
PUMA	40.87

Table-3
Global Athletic Apparel market Share of various company in 2015

Company's name	% of share in Global market
Adidas	11.6
Nike	10.8
V.F. Corp	4.6
Under Armour	3.1
Gildan	2.4
Columbia	2.3
Hanse brands	2.0
Puma	1.7
Quick Silver	1.5
Billabong	1.1
Others	58.9

Table-4
Global Sports Apparel Market 2011-18

Sl.No.	Year	Value(in US $ Bn.)
1.	2011	132
2.	2012	135
3.	2013	141
4.	2014	146
5.	2015	152
6.	2016	158
7.	2017	165(E)
8.	2018	171(P)

Source: Global Market Study Report on 2017.

Important Issues to be addressed:

1) Facility to evaluate quality of product conforming to the international standard.
2) Ensure availability and selection of appropriate raw materials.
3) Adoption of appropriate technology in manufacturing.
4) Design of the product for various sports activities and multipurpose activities in case of Athleisure.
5) Trained manpower with special skill.
6) Innovation in product development for specific use and demography based.

Conclusion:

It is evident from various study reports that there will be a growing demand of such products in India as well as in global market in next one decade as life style both in urban and rural areas has been rapidly changing since last two decades and growing health consciousness & fitness movement among youth have made a big call. It is reported that there will be a big no. of Gym & Fitness centers coming up at different clubs, housing societies and work places etc. As a rule of the game, one has to wear sports wear or athleisure to do exercise conveniently. Union Govt. has made several initiatives to popularize Yoga among the people to stay fit. India has made a visible presence in international sports circuit in last one decade and now there is a huge attraction among youth to join in sports. Various schools and institutions have included sports as an integral part of academic curriculum. Various Sports institutions have initiated big efforts in organizing games and sports to make a talent search as well as popularize the game among youth. So, it is expected to experience a huge surge in demand of Sportswear and Athleisure in the coming years. As imported brands are price sensitive and not always so convenient to get as per requirement, so; it is an opportunity to domestic players to keep a watchful eye and make strategic plan to capture the market. Govt. of India, Ministry of Textiles has made an initiative to promote Sports textiles under Technical Textiles scheme and a Center of Excellency has also been established to extend requisite services. This will be a good proposition to both existing & new generation entrepreneurs to make venture in this field and reap the benefit.

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The contents of the article are sourced from various study reports and statistics & data are compiled. The undersigned had undertaken a study on Sportswear in '84, while working in SASMIRA Mumbai. Japan had done a huge research works on Sportswear in late 70's to early 80's and developed new fiber and produced innovative product. JTRO had campaigned to promote manufacturing of Sportswear in India in late 80's.

Activewear and Athleisure: Product, Trends and Future

INDU SHARMA

These two categories refer to attire or clothes designed for the purpose of transitioning from exercise wear to casual wear.

Their rapid growth reflects interest in a healthier lifestyle. The categories span high-tech, performance-enhancing fitness garments for professional athletes, apparel and workout gear for individuals and wearing, practical choices for those who enjoy the outdoor active lifestyle that just involves regular walking.

Brands and Retailer from Nike, Adidas, Lululemon and Athleta to Designer Brands like Calvin Klein to Betsey Johnson are all designing with a purpose outfitting that active lifestyle with new fiber technologies and specialist fabrics. In short Product, Trends and Future in these categories are and will continue to be driven by technology in fabric and design.

It's not clothing; it's a lifestyle

It is Clothing You Don't Actually only Wear To Work Out.

So, whether or not you are a gym junkie, you are likely to dress like one if activewear and athleisure is your choice of apparel.

Activewear evolution reflects shifting paradigm in popular fashion. And Athleisure aspect has taken the boring out and made workout clothing a statement of wealth, luxury and active lifestyle. It's a category that's most popular amongst fashion trend setters willing to invest big bucks to stay ahead with premium design and innovation

So what's driving the growth? First, the expectations for

Indu Sharma

women's bodies has shifted significantly. From super-thin bodies of the 90's, the focus now is on toned and fit bodies. More than ever people today want to look healthy and live a healthy lifestyle. Needless to say, the transformation of social landscape has had a huge impact on this "looking good" category. From influencers to their followers, people are recording and posting pictures of themselves twenty-four-seven. So whether you are a person who exercises or not,

perception is everything. When you wear clothing meant for working out, it makes you look attractive, feel healthy and fit, even if you aren't.

Till quiet recently, your workout clothes were not fashionable enough to be worn post a workout session. But today sales of yoga pants are up and denim are down. Trendy workout clothes now are all day, every day cool quotient. We live in an age where activewear is not actually worn for sweaty workouts, but as a fashion statement.

Decoding Fitness Fabric

Your workout clothes do more than make you look good: wearing the right material can also optimize your exercise routine. Smart and high-performance fabrics and interactive textiles are a growing market thanks to largely a fitness oriented lifestyle.

Performance fabrics are engineered for a wide variety of uses where the performance, not style, of the fabric is the major parameter offering an unrestricted range of moves, breathability, wicking and quick drying properties. These fabrics are commonly used for all activewear, clothing for outdoor activities and protective gear.

Some key fabrics used in activewear are:

Spandex: Also known by the brand name Lycra. It puts the stretch in workout wear and feels smooth on the skin, and is used in fitted garments.

Polyester: Commonly used in workout fabrics and one that you see on most labels. A plastic cloth, it's durable, wrinkle-resistant, lightweight, breathable, and non-absorbent. It allows the moisture from your skin to evaporate instead of being drawn into the material. Polyester wicks faster than cotton and feels stretchy and smooth.

Nylon: This synthetic fabric is soft as silk, mildew resistant, and dries quickly. It's also breathable and wicks sweat from your skin to the fabric's surface, where it can evaporate. It is used for making the all kinds of clothing from Tops and Bottoms to women's stockings, etc

Tencel: Similar to bamboo, TENCEL is made from wood pulp. TENCEL contains tiny fibrils, or small hairs, that give the fabric sweat-wicking properties and a luxurious texture. Textiles made from TENCEL are known to be softer than silk and cooler than linen. It's is biodegradable, breathable, and wrinkle resistant and largel used in form-fitting items

Patented Performance Fabrics

Coolmax a technical fabric developed in 1986 by DuPont Textiles and Interiors (Invista) was originally designed to be worn under the uniforms of soldiers and other officers. The fabric employs specially-engineered polyester fibres to improve "breathability." It's a 'wickaway' fabric that draws moisture away from the skin in order to maintain the appropriate body temperature.

Supplex was created to offer consumers the feels and benefits of cotton without its its shortcomings like creasing, shrinkage, and colour fastness. It combines the traditional appeal of cotton with the performance benefits of modern fiber technology. Supplex is a fabric that feels like cotton but is breathable, holds its shape, dries fast, and is colour fast.

X-Static is a silver-coated textile fiber that enhances products with permanent and nature anti-odor, anti-static and thermodynamic properties. Silver is antimicrobial that prevents bacterial and fungal growth. X-Static is permanent and resistant to washing and its performance does not diminish over time.

Performance Technology

Wicking and moisture transfer: a process of moving moisture away from the body to the surface of a fabric enabling it to dry faster. This can be achieved through topical finish, fabric content or through the fabric construction.

Reflective: a technology where materials capable of reflecting light are used as a safety feature to helps protect the runner from traffic in low visibility conditions.

Thermo-regulation: a technology that helps regulate body temperature by keeping you warmer in cold weather and cooler in warm weather.

Finally Activewear vs athleisure — what's the difference?

Activewear is "clothing designed to be worn for sports, exercise and outdoor activities". It's what you wear to the gym, to your yoga class, or your morning run. It's typically light-weight, sweat-wicking and form-fitting, to allow you to move freely. Its primary aim is functionality. Activewear clothes are clothes which serve the purpose of an active life mixed with a casual social life.

Athleisure was born out of compromise. It lies at the intersection of activewear and traditional sportswear that was meant as recreational wear designed for daytime or leisure activity but later adapted for more formal occasions. When celebrities and influencers from super models to singing sensations, took activewear from the gym to the streets of London, Los Angeles and New York, yoga pants became the staple of every college and working girl's wardrobe, transitioning into casualwear.

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Performance – A key for success

K.K. GOSWAMI

Abstract

Textile Industry's a part is rural, cottage and unorganised which includes carpet industry. The industry whether unorganised or organised, textile or other, performance is the key for success with sustainability hence measurement and management of same are vital. The paper focused how an academic research work devised performance evaluation technique which is dynamic and unique. The industrial units with fewer resources participated in the project which facilitated establishment of a tool. The findings are encouraging to promote such novel approach.

Keywords: Textile Industry, performance, measurement, dynamic, novel

1.0 Introduction

Indian textile industry involves millions of human resources. The stakeholder consists manufacturers, exporters, artisans/operators, service providers etc. The performance of the industry /sector depends on the performance of all stake holders. Moreover, there are performance metrics control of which in right manner through measurement result performance of the unit of the industry. In deriving performance index over a predicted period to make it dynamic – certain steps are involved; certain tool is required and application of same is proposed. The performance index derived in the novel technique is irrespective of existing way financial & technical evaluation.

Steps involved

2.1 Study of existing established technique

The existing established technique pertain mainly to financial i.e. profit before and after tax, turnover etc. generally on annual basis, whether the unit is in organised or unorganised sector however parallelly measures efficiency & productivity.

K.K. Goswami

2.2 Study of prospect for a new technique.

It is evident from references and cross references that there is no technique which can measure and manage the performance of any unit as a whole in a holistic manner. Therefore question always arise how to develop and improve the performance measurement technique. Therefore research question includes following.

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- To understand the unit as a whole
- To understand the unit in Strengths, Weaknesses, Opportunities, and Threats (SWOT) context.
- To identify the performance metrics in group like
  a) Continuation Desired(CD)
  b) Improvement Needed(IN)
  c) Experimentation Sought(ES)
  d) Challenges for Sustainability (CS)
- To develop a system aimed to come out with list of performance metrics and fit into a system model being developed.

3.0 Methodology

3.1 Identification of performance metrics

- The unit concerned to identify performance metrics(s).

  Involve stake holders to get 3600 way identification.
  Screen and segregate them in appropriate manner
  Finally accepted performance metrics be grouped in four categories: CD, IN, ES, and CS.

3.2 System Model

- A system model to be placed. In accordance a format with exemplary data is reproduced in Table 1.

Table 1: Exemplary Data - Suggested Model for measuring performance of Indian Handmade Carpet Industrial Unit(s)

Performance Measurement Management & Linkage to Financial

Financial Year: 2016-17

Groups/ Code of K.F.	Key factors: Objectives	Elements: Actions	Criteria/Success Indicator	Unit	Weightage	Target/Criteria Values					Achievements	Score		Gap in Performance Index	Regrouped BSC perspective
						Excellent	Very good	Good	Fair	Poor		Raw	Weighted % (Performance Index)		
						5	4	3	2	1					
						100	90	80	70	60					
A	***Continuation desired***	***Ability demonstration***													
	Independent factors														
A14	Control on entire value chain process	Adherence to check list	Compliance	%	10	90	80	70	60	50	80	90	9	1	IBP
A15	Craftsmanship	Skill Management	Upgraded competency	No.	10	90	70	60	55	40	70	90	9	1	IBP
A17	Flexible manufacturing capacity	Outsourcing of weavers	Assured competency	%	10	95	85	75	65	55	83	88	8.8	1.2	IBP
Group Sub total					**30**								**26.8**	**3.2**	
B	***Improvement required***	***Plan Documentation***													
	Independent factors														
B36	Delivery schedule	Strong production planning	Delay in delivery	Timeline (days)	8	10	20	30	40	60	45	75	6	2	IBP
BD32	*Control on manufacturing cost*	Control on raw material cost & wages	Maintenance of competitive cost in consignment	%	8	90	80	70	60	50	61.875	71.875	5.75	2.25	IBP
I.F sub total					16								11.75	4.25	
	Dependent factors														
ABC6	*Government policy / single window* clearance	Data base & awareness	Availing benefits	%	8	90	80	75	65	50	90	100	8	0	F
D.F sub total					8								8	0	
Group sub total					**24**								**19.75**	**4.25**	
C	***Experimentation sought***	***Capacity Exhibition***													
	Independent factors														
C47	Customized product	Successful execution	Ok certification	%	10	95	85	75	65	55	75	80	8	2	C
C51	P-D-C-A	Monitoring action plan	Continuation	%	15	85	75	65	55	45	77	93	14	1	IBP
Group sub total					**25**								**22**	**3**	
D	***Challenge for sustainability expected***	***Strategy Formation***													
	Independent factors														
BD35	*Seller-seller competition*	Control of leakage	Vigilance cleared employee	%	10	80	75	65	60	55	75	90	9	1	L&G
D59	Control of environmental standards	ISO 14000	No. of N.C at given point	No.	11	0	1	2	3	4	2.818	88.18	9.7	1.3	IBP
Group Sub total					**21**								**18.7**	**2.3**	
Grand total					**100**	**COMPOSITE SCORE**							**87.25**	**12.75**	
RATING / SCALE / GRADE													**3.725**	**1.275**	

4.0 Validation

This system model has been validated with existing financial performance data of the unit. The correlation has been positive and encouraging.

5.0 Integration to Balance Score Card (BSC)

B.S.C – A disruptive tool in performance appraisal context which groups metrics into following 4 categories like;

- Financial (F)
- Customer (C)
- Learning & Growth (L&G)
- Internal Business Process (IBP)

The performance metrics in the present BPET have been grouped into categories like;

- KFA: CD – Continuation Desired
- KFB: IN – Improvement Needed
- KFC: ES – Experimentation Sought
- KFD: CS – Challenge for Sustainability Expected

BPET under the present research developed as BPET-I has been regrouped to suit categories pertain to B.S.C denoted as BPET-II. The output/ efficacy of BPET II over BPET I as performance measurement has been compared.

In doing so, statistical coefficient correlation tool for correlating Profit aspect measured traditionally visa in Performance Index (P.I) worked out in BPET (I & II) was used.

6.0 Implication

Further to identified gap in performance measurement especially for handmade carpet industry, it has been possible to provide the industry a handy system to measure and manage the performance in a dynamic manner. The empowerment adopted resulted identification of meaningful performance metrics. The novel idea as presented above to measure PI and its correlation with the gap in financial term that is net profit created positive implications for researchers and the industry – a disruptive way!

7.0 Conclusion

Handmade carpet manufacturing or exporting units at large in particular need to come forward and shaken up themselves to take the advantage of new, novel, niche and dynamic model of performance measurement and management which is disruptive system model.
It is evident that derivation of demographic dividend especially by Indian handmade carpet sector as a case study is possible to contribute Skill India! Make in India! The sector further can attract skill for invention and innovation followed by technological and capital investment.
In summary, the present research work and its output can supplement the vision for the sector to create a globally competitive environment and provide sustainable livelihood opportunities to the units/artisans through innovative products, designs, improvement in product quality, introduction of modern technology and preserving tradition.

8.0 Acknowledgement

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Electrospun Nanofibrous Textiles - The Wonder Material;

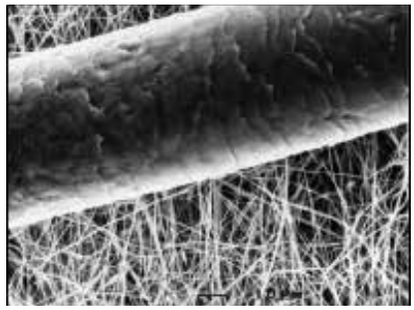
Small in Size but Awesome in Its Functionality

MONTU BASAK

Introduction

The need for ultra-light weight yet strong, structured textile materials for high performance and miniaturized applications has recently been in high demand[1] Nanostructured materials have gained a continuously growing scientific, technological, and industrial interest to provide sustainable solutions to the complex problems of our society[2]. Nanomaterials are attracting the attention of global research community these days primarily because of their enhanced properties required for application in specific areas. Nonwoven fibrous materials have shown better performance capabilities in those specific application areas than conventional woven or knitted fabrics materials. They are better off in terms of their inherent properties like higher surface areas, smaller pore size and better interaction between the fibre and target molecules, especially when they are applied in the field of filtration, separation and adsorption[1]. To optimize the efficiency of those nonwoven fibrous materials, researchers, around the world, designed and fabricated a novel and wonderful material such as nanofibers. A comparison of nano fibre with conventional fibre is shown in the Figure no. 1

Figure 1 - Comparison of Nano fibre with conventional fibre



Nanofibers, due to its inherent properties like diameter in sub-micron size, higher surface area and better porosity when converted into nanofibrous material, find huge applications in high-performing and functional areas in the likes of filter

Montu Basak

medium, adsorbing layers in protective clothing, tissue-engineering, drug-delivery, optical electronics to name a few. These nanofibers or nanofibrous nonwoven materials are made from a very unique technique that is popularly known as electrospinning technique that has emerged as a very powerful technique for producing high strength and highly functional fibrous materials with nano-size structure which otherwise cannot be achieved by conventional textile processing techniques.

Electrospinning - Processing of Electrospun Fibrous Mat

Several techniques have been innovated and

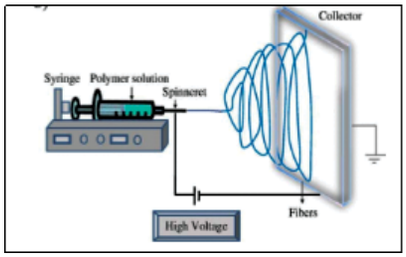
designed to producing small diameter fibres for high-volume production such as fibrillation[4], island-in-sea[5], and novel melt-blowing system[6], or highly accurate methods such as nanolithography[7], and self-assembly[8]. However, their usefulness has not achieved that level of success due to the restriction of narrow material ranges, high costs and low production rates. In comparison, electrospinning is a simple and low cost process, and has an intermediate production rate[10]
Electrospinning is a unique approach using electrostatic forces to produce fine fibres[1]. Electrospinning has proven to be an efficient and simple method to produce continuous nanofibers[11].

The process is based on the uniaxial elongation of a jet, ejected from the surface of a charged polymer solution possessing sufficient molecular entanglements (usually called nanofibers), in the presence of an intense electric field which is applied between the spinneret and a conductive collector[2]. This mechanism is based on the principles of electrostatic repulsion of charges ruled by the well-known Coulomb law. The idea was first patented in the early 20th century[12].

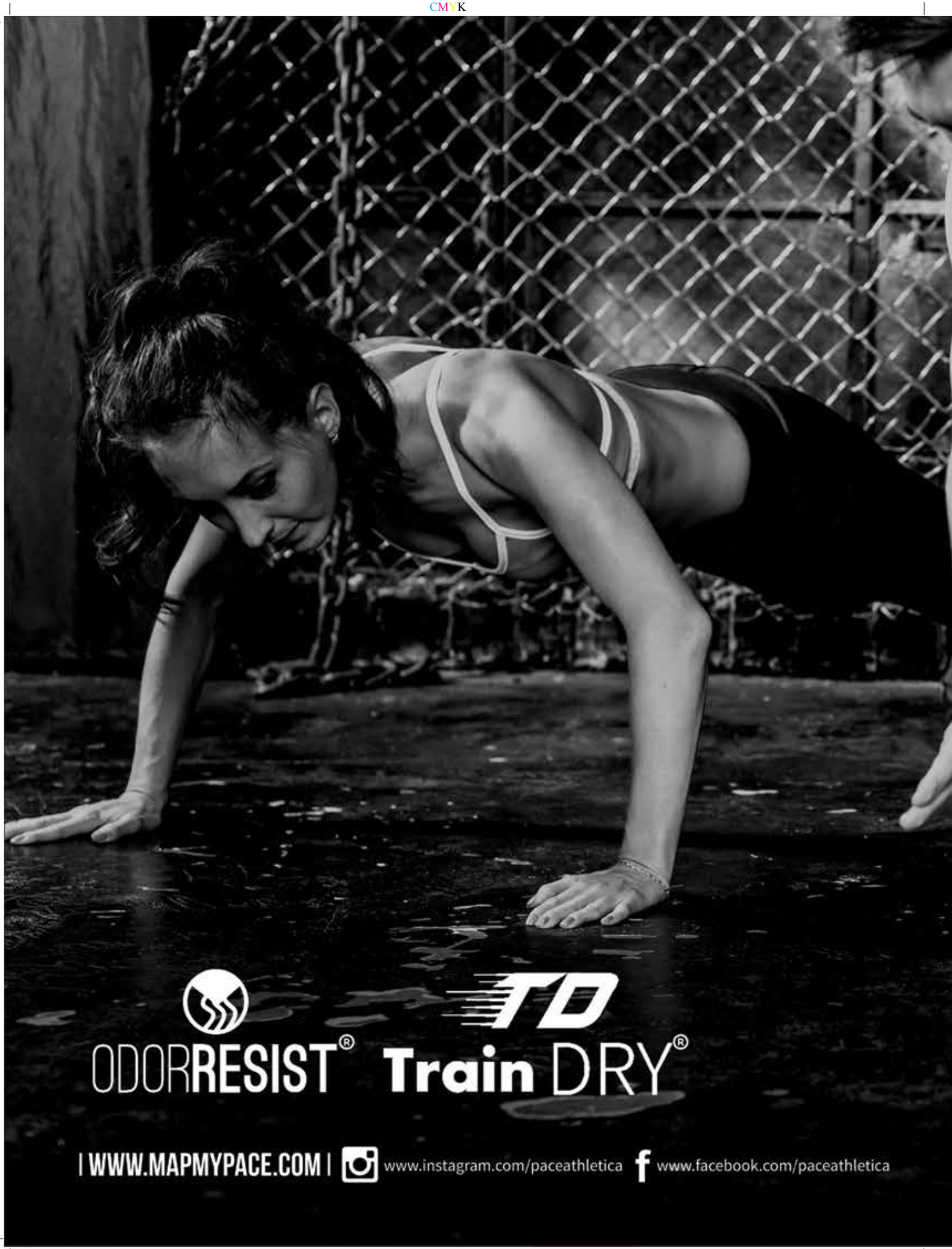
Electrospinning works with both the polymer melts and polymer solutions. Electrospinning can be usefully employed in a wide range of applications requiring submicron scale fibre diameter such as: filtration[13], membrane separation[14], protective clothing and breathable garments[15], wound dressings and scaffolds for tissue engineering[16], and drug delivery[17].

A basic electrospinning setup consists of three elements: an electrical generator (high voltage supply), a jet source (spinneret) and a metal collector (target). The solution is usually electrically charged by the generator and the collector is grounded, but it is also possible to invert the system by electrically charging the collector and grounding the solution[18]. A scheme of an electrospinning apparatus is shown in Figure-2.

Figure 2 - Basic set-up of an electrospinning equipment



A pump pushes the polymer solution through the spinneret (a needle) attached to a syringe at a fixed flow. The high voltage generator, connected by a wire to the metal tip of the needle, supplies the voltage to the solution. A stream of solution (jet) is produced from the tip toward the grounded metal collector on which electrospun nanofibres were collected. Usually, the production rate of a single jet is less than 10 g/hr of nanofibres[12], depending on polymer concentration and process conditions, mainly the flow rate of solution. The fibre-forming process also depends on various factors like operating parameters (applied voltage, working distance between tip and collector, flow-rate of solution, tip diameter), properties of the polymer solution (polymer molecular weight, concentration, relaxation time, viscosity, electrical conductivity, surface tension, and vapour tension of the solvent), and environmental parameters such as temperature, humidity and ventilation[19]. The electrospinning process starts when the voltage generator is turned on. The electrical potential of the droplet surface at the capillary tip is increased to a sufficiently high value that causes the droplet to assume a steady conical shape, known as the Taylor cone, instead of a spherical shape. The electrostatic forces act in opposition to the surface tension of the fluid. The Coulomb repulsion between the charges promotes the formation of the cone. As the electrostatic forces exceed the surface tension, a charged jet of fluid is ejected from the vertex of the cone .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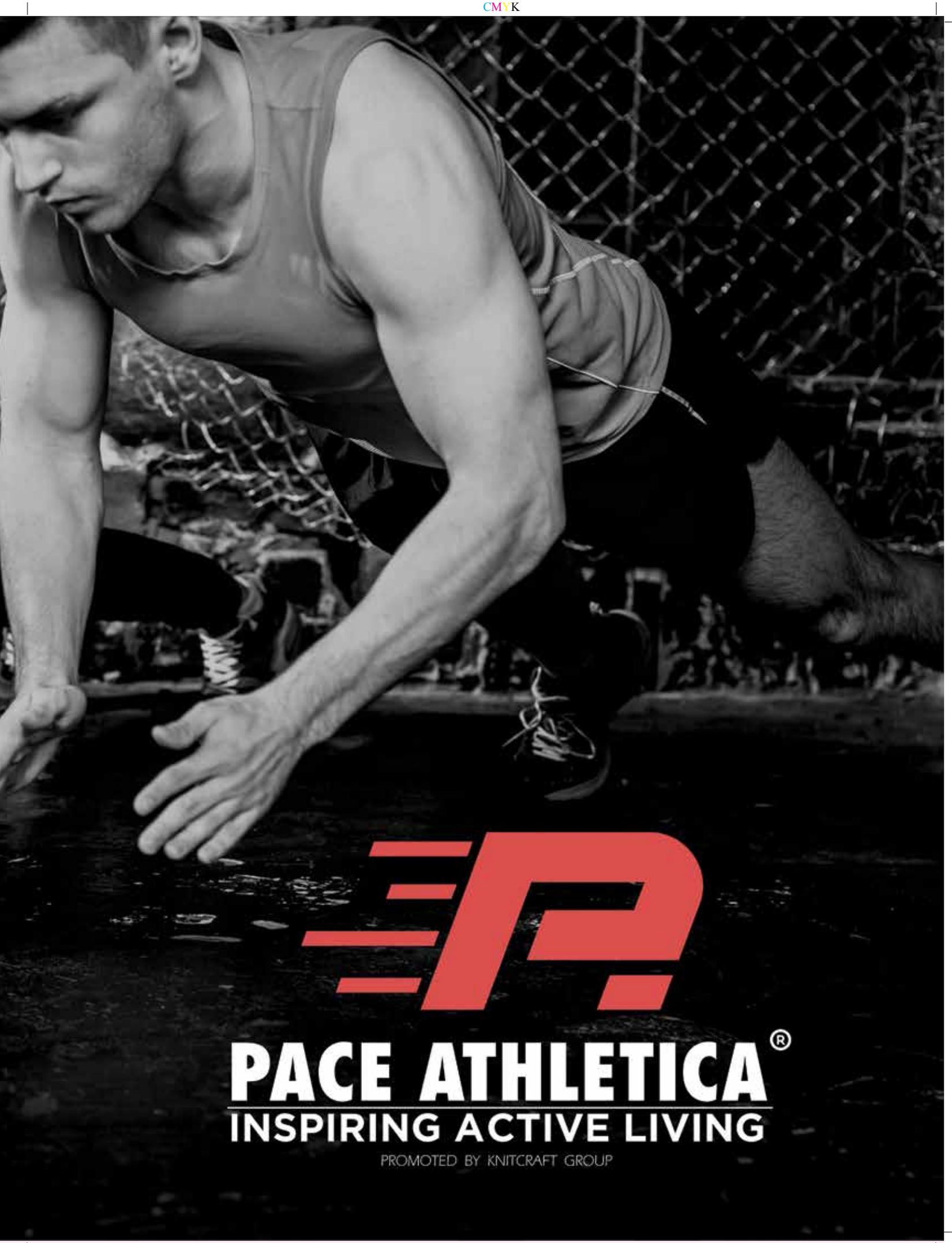
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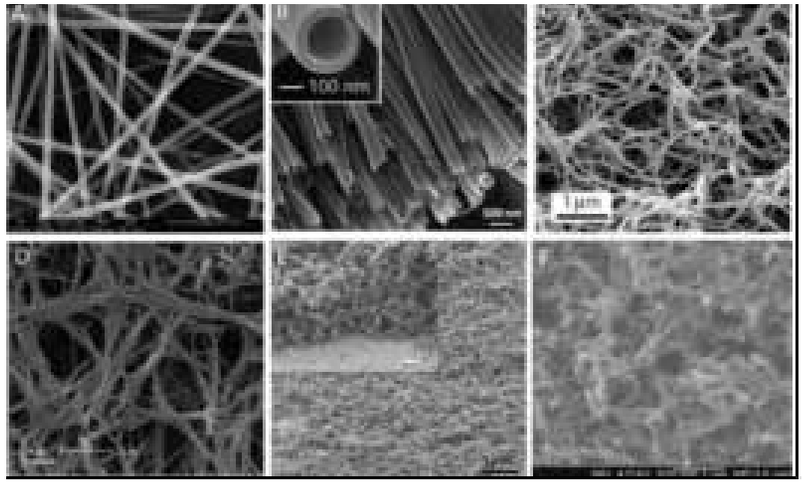
The trajectory of the jet solution begins with a straight segment. The diameter of the jet is one or two orders of magnitude smaller that the inner diameter of the needle from which the jet is generated, and progressively decreases during its journey towards the collector. Finally, the jet completely solidifies into a nanofibres and deposits on the collector as a disordered continuous filament (non-woven fibrous structure).

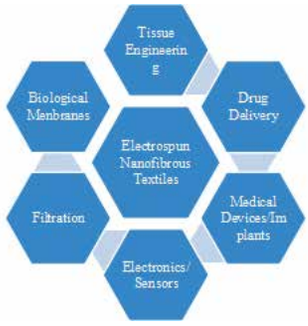
Figure 4 - Scanning electron microscopic (SEM) images of nanofiberous materials1



The Wonder Material; Electrospun Nonwoven Material and Its Versatile Applications

Nanofibrous fibrous materials or scaffolds have shown promise literally in every field, from the simple filtration application to acting as the most complex biomaterials for promoting cell growth and proliferation[21].

Figure 3 - Wonderful applications of Nanofibrous Textile Materials



The scaffold or nanofibrous material, made of synthetic polymers or the natural biopolymers, have desirable qualities such as good physical properties, ease of production, chemical functionality that facilitate cell growth and proliferation. In comparison, natural polymers are mostly preferred and include PCL, polymers of lactic and glycolic acid, collagen, gelatin, silk, cellulose, chitin, and alginate, etc. They have specially shown promise in the clinical tests, particularly when they are converted into nanofibers or into a scaffold. The biodegradability of the nanofibers, as well as the biocompatibility, also have shown promise[22]

The high performance-high value and functional applications of these nanofibrous materials have been discussed in detail in the following sections.

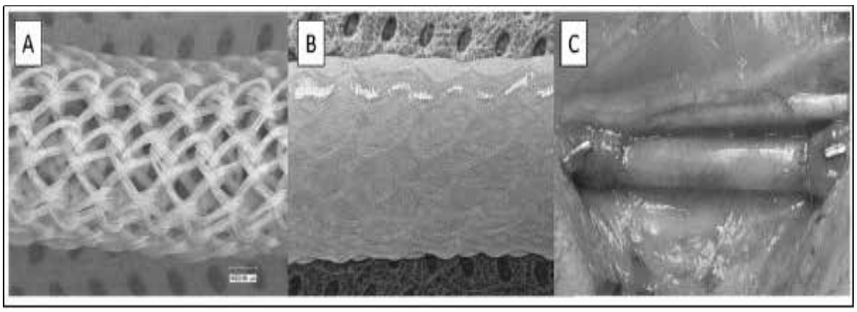
Tissue scaffolds and drug delivery

Nanofibers with high surface area and porosity have enormous scope for applications in engineering mechanically stable and biologically functional tissue scaffolds. The high porosity of the electrospun nanofiber scaffolds provides enough space for the cell accommodation and an easy passage for the nutriant intake and metabolic waste exchange. Mechanical properties like the modulus of elasticity and strain at failure are important for the application of electrospun nanofibers as tissue scaffolds.

Catalytic Nanofiberous Material

Enzyme based catalytic chemical reactions are very important processes because of their high selectivity and mild reaction conditions[2]. Recovery of costly enzyme is very important after each chemical reaction. With that aim in mind, immobilization of enzymes onto the polymeric nanofibrous materials started getting recognition, largely

Figure 5: Images of tissue engineering using nanofibrous scaffolding[24]



due to the easiness of catalyst separation, enzyme stability, and their availability for continuous operations[1].

Filtration

Polymeric nanofibers have been used in air filtration applications for more than a decade[3]. The small fiber diameters cause slip flows at fiber surfaces, causing an increase in the interception and inertial impaction efficiencies of these composite filter media and thus lead to enhanced filtration efficiency at the same pressure drop[4]. The potential for using nanofiber webs as a filtering medium is highly promising.

Air pollution is one of the biggest problem, our country is currently reeling under and needs immediate attention to mitigate its harmful effects on human and animal's life (cardiovascular & respiratory effects[5], indigestion, allergy rhinitis etc) as well as on our mother Earth. Nanofibrous filter media works wonder for capturing smaller particles from air streams and have significantly higher pollutant loading capacity and longer useful lifetime compared to woven or needle-punched nonwoven filter media.

Protective Clothing

Knowing that the essential properties of protective clothing are high moisture vapor transport, increased fabric breathability, and enhanced toxic chemical resistance, electrospun nanofiber membranes have been found to be good candidates for this application[6]. The highly porous, light-weight electrospun membrane surfaces over the conventionally used nonwoven filtration media help in greater moisture vapor transmission in protective clothing[7]

Electronics

Overcoming the limitations of traditional sensing material, nanofibers have shown promising suitability as sensing materials for chemical sensors. Their thin fibers, high-specific surface areas and porous morphology enable swift sensor/analyte interactions that produce faster response/recovery, higher sensitivities, and lower limits of detection[8]. Further researches have also shown other applications of these nanofibrous materials such as photovoltaics/solar cells, energy storage devices etc[27]. Nanofibers also find applications in aerospace and semiconductor industries. Piezoelectric polymers were electrospun and investigated for applicability as a component on the wings of micro-air vehicles. Conductive membrane was produced for coatings using carbon nanotubes by an electrospinning process.

Conclusion

As it is evident from the above brief discussion on the applications of nanofibrous materials, the potential of nanostructured materials in advanced and high-performance applications is unlimited. Researchers are making constant efforts to exploit the high surface area and porosity properties of these nanofibrous materials to develop value added and sophisticated high-tech materials.

In inference, it would not be, at all, an exaggeration if it is said that this unique nanofibrous material, made from electrospinning, is undoubtedly a wonderful innovation of this century and finds its relevance and ever-increasing acceptability in our society.

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Zardozi to E-textile (Electronic-textile) or Smart Textiles: A Terrific Journey

INDU B GROVER, SUMIT MANDAL

Textiles are an integral part of our life. They have survived the time and have greatly evolved with civilization. Aesthetic and style have been important aspects of the clothing. In earlier times, real gold and silver metal threads were used to adorn the clothes like Zardozi. In this fast-changing technical world, textiles and fashion trends have also changed tremendously and trying to accommodate in this modern era. With this, a latest trend emerging in commercial textiles is the e-textiles or smart textiles, also known as wearables. Though, it is not a new thing. Earlier, it was specific to the R&D, industry or for very specific purposes like protective clothing i.e. performance enhancing aspect of smart textiles was majorly the focus of study. But, now-a-days, it is emerging as a cost-effective, fashion trend in commercial textiles i.e. its aesthetic aspect is also being explored.

Electronic textiles are the textile materials (fibers, yarns or fabrics) that enable conductive and digital components (e.g. battery, electronics, etc.) to be embedded into the textile itself [1, 2].They can be broadly categorized into two fields based on their fabrication. First category is based on a simple concept of physics, which involves attaching or embedding basic electrical and/or electronic components like special conducting wires, conventional coin batteries, LED (light emitting diode), integrated circuits, sensors into the clothing. While, the second category involves electronic components directly integrated into the textile substrate. This category consists of conductive or semi conductive textiles i.e. fabrics which can conduct electricity. Conductive textiles are made with weaving metal strands into the

Sumit Mandal

Indu B Grover

construction of textiles. While, a semiconducting textile is made with coating the normal textiles with carbon- or metal-based powders. Conductive fibers consist of non-conductive or less conductive substrates (e.g., cotton, nylon, stainless steel, aramids, etc.), which is then coated or embedded with electrically conductive materials such as carbon, copper, gold, silver. Most research and commercial projects are the hybrids of both the approaches.

With the advancement in every field especially technology, things have become very size- and cost-effective. A simple example of aesthetic textiles can be to glow the clothing using small LEDs (available in many forms PCB, traditional and SMD) sewn by a special kind of conductive thread, and a battery for supplying voltage. It just takes connecting the positive and negative terminals of LED and battery, respectively with the special conductive thread according to the design specification of your imagination and a glowing drama on your clothing is waiting to surprise the crowd.

Things can be taken a little further, thanks to the quantum physics and information technology. A Bluetooth chip can also be accommodated in this circuit and a mobile app can be developed for the smart phone, so the mobile phone can digitally connect to the clothing through Bluetooth, and print (i.e. LED design) on the clothing can be changed with a click on your phone. This seems like a magic, but this is the current trend of fashion textiles. We all aspire to be flexible, part of cool crowd, and big brands cash on this aspiration of consumers.

E-textiles are a nascent, emerging and multi-disciplinary field (textiles, materials, electronics, information systems, chemical, etc.). The integration of technology into ordinary clothing has added multiple dimensions to it. Clothing is now not only comfortable, stylish, functional but has also become smart, intelligent and interactive. It can communicate to the user through touch and movement among others. Based on the level of intelligence, it can be classified into three subgroups [3]:

1. Passive smart textiles: They are only able to sense the environment/ user from mechanical, thermal, chemical, electrical, magnetic or other sources, based on sensors.
2. Active smart textiles: They can both sense and respond to the environment/stimuli. If actuators are integrated into the passive smart textiles to respond to the external stimulus, it results in an active smart textile.
3. Very smart or intelligent textiles: Such smart textiles are not only able to sense, respond but also adapt to the external conditions using controlling units. It means that very smart textiles include sensor, actuators and a microprocessor in which an intelligent agent is installed that can provide service according to the changing environmental condition.

Smart textiles are needed to sense the information about the wearers' body (i.e. biomedical signals, including human gestures) and inform him/her or send the information to the outside world. They should also be able to sense the wearer's outside environment and inform him/her. The most common biomedical signals that can be measured from the human body are body temperature, blood pressure, pulse, respiration, ECG (electrocardiogram), EMG (electromyogram), EEG (electroencephalogram), impedance, movement, blood gas, GSR(Galvanic skin response). While, the sensors measuring the wearers' external environment include temperature, humidity, acoustics, gas, light,

ultraviolet radiation, etc. [4]. For example, a wearable shirt integrated with fiber sensors and electrodes can sense biomedical signals of patient in real-time, and a portable patient unit (i.e. controlling system) can analyze these signals and determine whether the patient is in danger or needs external help. The portable patient unit will alert the patient and also automatically make the emergency call to the hospital in case of alarming medical condition. Patient can be easily located using Geographical Positioning System (GPS) and rescued in case of emergency [5]. Furthermore, e-textiles need not to be wearable only. They have applications in other sectors as well like interior design.

Research and market analysts forecast a huge growth potential for e-textiles in the near future. The applications of e-textiles in the tech-savvy society also seem very promising, e.g., medical and rehabilitation, sports and fitness, home and life style, fashion, industry and military and others. Seeing the huge growth potential and future prospects of e-textiles, big market players from multiple sectors like Adidas, Nike, Levi's and Ralph Lauren from sports & textiles, Material companies like DuPont, Google, Apple, and Samsung from software and technology have already started investing heavily into research and exploring the market.

As e-textiles is an evolving field, and many of its potentials and challenges (manufacturing, durability, comfort) yet need to be explored before its mass production and launch into a full-fledge market. One common question that naturally comes to the mind when we speak of electronics and textiles together is about its washability and durability i.e., will we be able to wash such type of clothing; as e-textiles based clothing involves battery and chips, can it explode or does it has the risk to electrocute. With every sophisticated fashion, it does cost a little special dealing and maintenance. Though all the components of electronic textiles are developed and designed considering its end-use, and theoretically considered safe to use. However, its mass production and usage will uncover the real challenges.

India is not untouched from this new cool emerging trend either. Now, when the information spreads with the speed of light, you might have got this message on Whatsapp as well, 'Let your shirt say what you feel: Hyderabad company creates programmable T-shirt… you type, it displays'. This is India's first company based in Hyderabad 'Broadcast', which has created the first programmable T-shirt and currently producing it on demand. Broadcast company has plans to manufacture it for masses in near future, if product turns out a market success [6].

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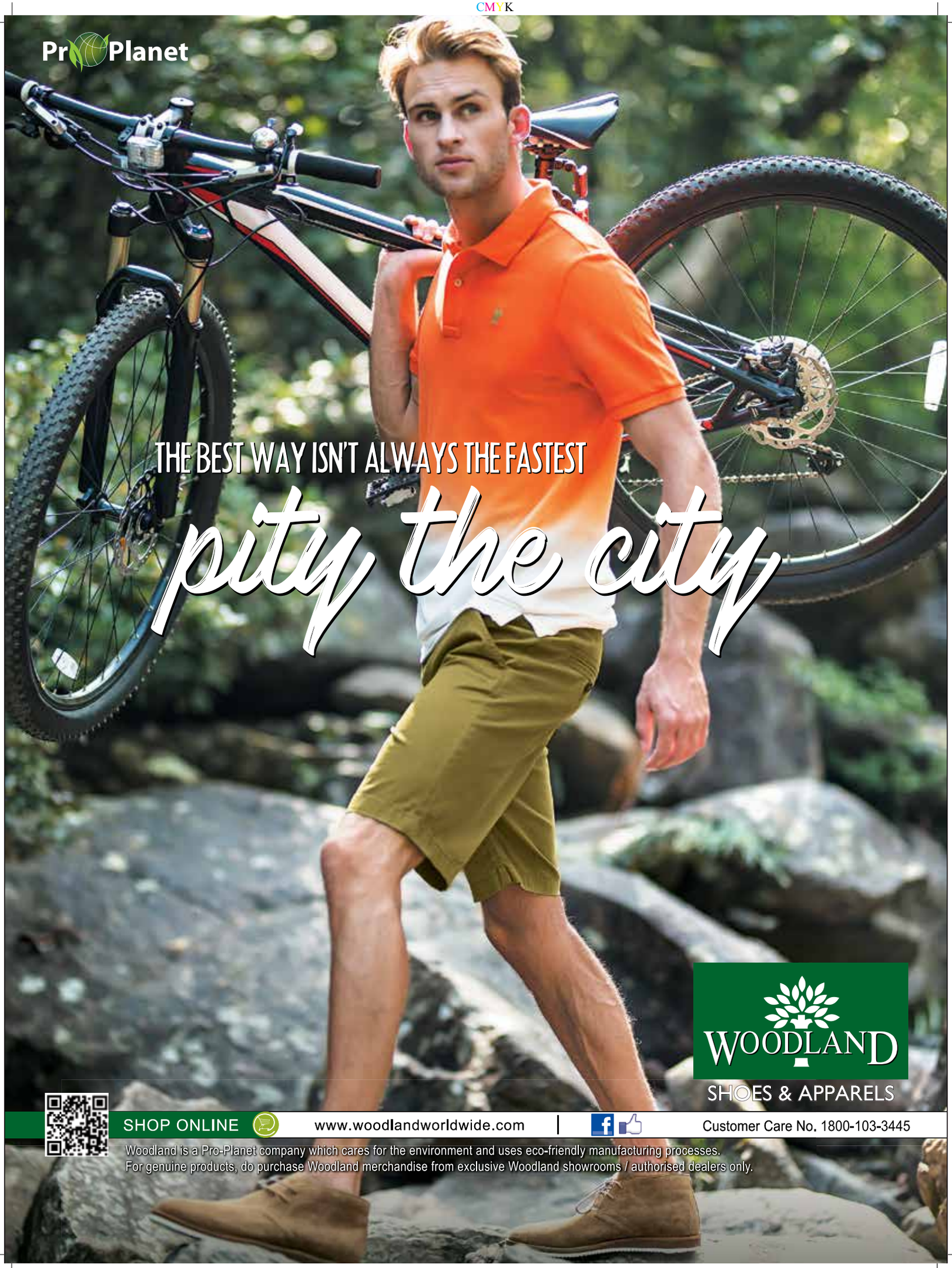
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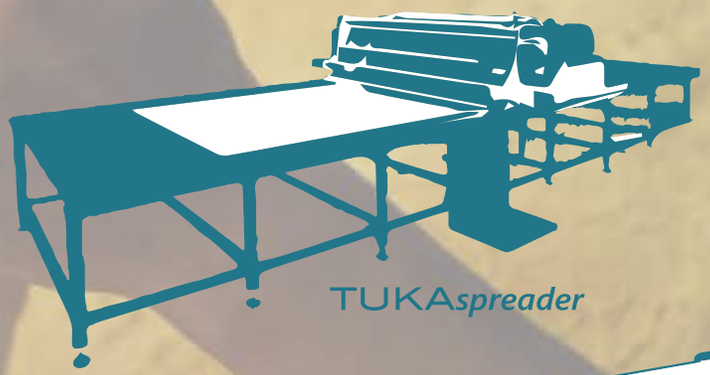

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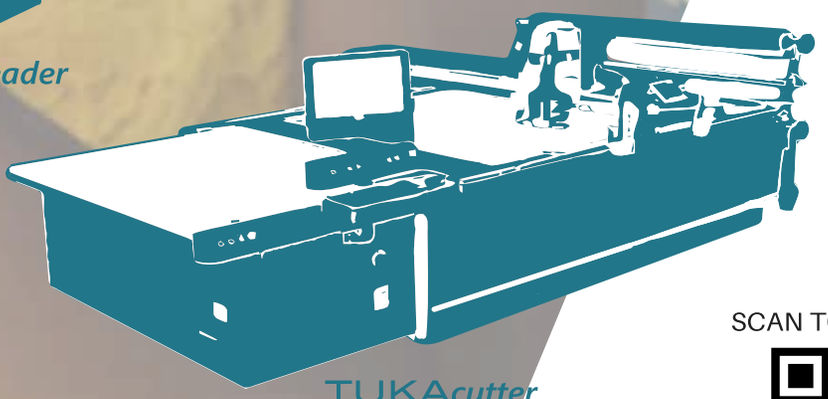

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DR. SANDIP BOSE, DR S. K. CHAKRABARTI, DR. U. S. SARMA

Introduction

Jute is a versatile, natural, biodegradable fibre abundantly available in the eastern part of the Indian subcontinent. Jute had been cultivated in the alluvial Gangetic plains in rotation with paddy for more than 400 years. Jute is the most important natural fibre crop in India after cotton. Being the second most available natural fibre, it is used extensively in the manufacture of different types of packaging material for various agricultural and industrial products. Jute fibre is extracted from the inner bast tissues of the bark of the jute plant's stem. [Kundu, B C. 1956]. Corchorus Capsularis L. (White) and Corchorus olitorius L. (Tossa) are the two species of jute plant that are mostly cultivated for fibres, belonging to the genus Corchorus, family Tiliaceae. The genus includes about 40 species. Jute is grown extensively in Bangladesh, India and China [Atkinson, R R.1965]. India is the world's largest producer of Jute and allied fibres (1.980 million tons), which accounts for about 57% of the world's production (3.460 million tons). The area under Jute and allied fibres cultivation is 0.79 million hectares in the year 2011-2012 in India (FAO, 2012). In Indian context, total jute plant production is about 22-25 million MT and about 17-18% of which is composed of jute fibre and stick (about 4 million MT). The popularity of jute is attributable to its abundant availability and inexpensive nature. The jute fibre is mainly used in the manufacture of coarse fabrics like B-twill bags, hessian, other sacking fabrics, canvas and yarns and twines.

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The use of sanitary napkin (SN) being a basic necessity, yet due to cost it is not always affordable for use in all sections of the society. Thus, cost has been a barrier to reach sanitary napkins to most of the people such as its use is low in India as 83% women cannot afford the product. To address this issue, there is need to develop an indigenous low cost SN from annually renewable natural resources.

The absorbent pulp used in the core of sanitary napkins, baby and adult diaper essentially consists of bleached ligno-cellulose pulp which is largely imported at an approximate cost of 1 US$ per kg. Developing this pulp from annually renewable crop like jute can have important social and economic importance.

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Indian Jute Industries' Research Association in recent past has developed a low cost Sanitary napkin based on 100% jute fibre and stick. No harsh chemical has been used in making such jute based SNs. IJIRA developed low cost SNs has received test certificate from the National Test House, Kolkata and meets the specification as laid down in IS: 5405-1981. A patent in this regard has been filed by IJIRA in recent past (Indian patent application No.201631014268 dated 25.4.2016)

Market potential

In India about 350 million women at the age group of 15-54 years are the potential user of sanitary napkins (SNs). Total demand of SNs in India is about 58,500 million pieces per year but actual consumption is 2659 million pieces i.e.4.5% penetration. Presently 900 million pieces of SNs are produced in India and rest is imported. It is reported that 83% women of the country cannot afford the product due to high price. In addition, it is also observed that inadequate hygiene protection makes adolescent girls (age group 12-18 years) miss five days of school in a month. Around 23% of these girls actually drop out of school thereafter. The Indian market is quite large and as per reports available only 35% of India's actual requirement is manufactured indigenously, as of now.

There are more than 1100 WSHGs in India manufacturing sanitation products for local community. Self-help groups (SHGs) play today a major role in poverty alleviation in rural India. A growing number of people (mostly women) in various parts of India are members of SHGs and actively engage in savings and credit, as well as in other activities (income generation, natural resources management, literacy, child care, manufacturing hygiene products for women, and nutrition, etc.). The SHG system has proven to be very relevant and effective in offering women the possibility to break gradually away from exploitation and isolation. Almost all major donor agencies support SHGs in India in one way or another and many success stories are available, describing how membership in a SHG changed the life of a particular individual or group for the better. Many NGOs are promoting the SHG mechanism and linking it to various other development interventions.

However, the availability of raw materials for manufacturing of gender hygiene products are not regular and there is a definite shortfall in the supply of core wood pulp, conventionally used for manufacturing the sanitary napkins.

Plant Capacity

The average daily production of a pulp manufacturing unit working on two shifts basis is 500 kg dry pulp per day. This would be sufficient to seed twenty five small scale WSHG manufacturing sanitary napkins @ 2000 pieces/day. The monthly production of a unit would be 12.5 MT, with an average 25 days/month working schedule. Thus average plant utilization would be 28%.

Raw Materials

Almost 85% of the jute is cultivated in gangetic plains of India and Bangladesh. So, the availability of the main raw materials for this unit i.e. jute fibre and jute sticks is concentrated in West Bengal, Assam and Andhra Pradesh. As the transportation cost would add to the cost of raw materials, setting up of the unit is preferable in the jute growing areas. Jute fibres and sticks are generated seasonally during the months of July to October and would necessarily require warehouse facility.

The cost of jute stick varies with location, moisture content and time of the year, but is largely in the range of Rs.3/ kg to Rs. 6/kg and is taken as Rs.5/ kg as an average value in this report.

Jute fibre is available throughout the year, although its price remains low during the harvesting and retting season. The price varies to a large extent and would be considered as Rs.30/kg in this report.

The cost of raw material with average daily production of 500 kg dry pulp per day, taking into consideration the moisture loss and material loss (12%) due to processing, would be Rs. 9,800/- per day.

Location

To minimise the carrying cost the pulp production facility should be located at the vicinity of jute growing areas. The jute growing area should be capable to sustain the pulp production unit i.e. have production area over more than 40 hectares of land (assuming production of 2.0-2.5 MT/ hectare).

Process

The process essentially comprises of the following steps:

1. Conversion of Jute sticks to jute dust.
2. Cutting of fibre to desired size.
3. Pulping of jute stick and jute fibres
4. Drying of fibres by mechanical means
5. Drying of fibre by hot air

With this process flow in mind, one has to consider the machineries required to fulfil the process requirements.

Plant and Machinery

1. A guillotine type fibre cutter may be utilised to cut the jute fibres to a size suitable for the pulping machine. The power requirement of such machines may vary from 6.0 kW to 8.5 kW depending on manufacturer. An air compressor would be required to operate with the machine. The cost of such fibre cutter operating at 20 kg / hr rated capacity may cost about Rs. 5,00,000/- to Rs. 7,50,000/-.

   The use of rotary fibre chopper brings down the capital cost and power requirement considerably. However, quality of cut jute and maintenance of such machinery may not be as good as the guillotine type fibre cutter.

. Fibre Chopper

2. The Hammer Mill and Pulveriser are machines required to convert jute stick to jute dust. Ideally two hammer mill and five pulveriser machines working in tandem would be able to meet the production requirement of 280 kg/ day. The power

requirements of such machines are 1.5 kW. The mesh fitted on the hammer mill should be between 8 mm and 11.2 mm while that on the pulveriser should be between 10 to 14. The cost of such hammer mill and pulveriser are around Rs. 40,000/- each.

3. Pulping of the jute fibres and jute stick is carried out simultaneously in admixture with a pulping assistant (patented by IJIRA) in a Hollander beater. High liquor ratio (typically 1:50 to 1:75) is required to obtain good pulp. Typically Hollander beaters are fitted with heavy motors typically (15 kW or even higher) to obtain acceptable pulp quality within a reasonable length of time. Hollander beaters needs to be custom built and cost about Rs.6,00,000/- to Rs. 8,00,000/- lakhs for producing 500kg of pulp of acceptable quality.
4. Hydro-extractor is required to dry the pulp from the Hollander beater to a reasonable extent (about 150%. expression). The hydro-extractor can operate at 1.5 to 2.5 kW power for 5 minutes to dry 5 kg of pulp. The cost of hydro-extractor varies depending upon its capacity and may range from Rs.40,000/- to Rs.2,00,000/-.
5. Tray Dryer/ Hot air convection dryer/ tumble dryer may be used for drying the pulp. Hot air evaporation dryers consisting of a number of chambers through which hot air is circulated. Consecutive chambers operate at different temperatures; fibre passing from the hottest into progressively cooler chambers provides higher drying efficiency. In order to reduce cost of drying use of open trays and atmospheric evaporation to some extent may economise the process. However more drying space would be required.

Infrastructure

The space required for setting up of factory shed is 200 m2 covered area.

The water required = 37500 litres/day

The power required = 60 kW

Total Capital Requirement

Fixed Capital

Land and Building: The factory shed needs to be set up over 1 katah of land. Cost of land may vary from place to place. Typically, areas in Hooghly district are available at Rs. 80,000/- to Rs.1,00,000/- per katah.

Supply of Machinery

The hammer mill and pulveriser are readily available with various suppliers in local market.

Cost of land	Rs. 4,00,000/-.
Cost of Building	Rs.7,00,000/-
Cost of Machinery	Rs.25,00,000/-
Cost of electrical panel etc	Rs.3,00,000/-
Other Miscellaneous cost	Rs.1,00,000/-
Total fixed capital	Rs 40,00,000/-
Cost of Raw Materials	Rs 2,45,000/- per month
Power Cost	Rs.2,00,000/- per month
Salary and wages	Rs.1,00,000/- per month
Total recurring cost/ month	Rs 5,45,000/- per month
Capital cost for Project (with 6 months inventory)	Rs 32,70,000/-
EMI on Capital Invested	Rs. 58,550/- (Loan of 40.0 Lakhs@12.5% p.a. with loan tenure of 10 years)
Total Monthly Expenditure (including cost of capital and repayment term of 10 yr. @ 12.5% pa)	Rs 6,03,550/-
Net cost of Jute pulp	Rs 48.284/kg (without profit)
Selling price @10% profit	Rs.53.11/kg
Competitor product cost	Rs.65.00/kg (imported pulp about 1US$/kg)
Net cost of pulp per napkin	Rs 0.53 (with 12% net profit margin added)

The Hollander beater may be procured from M/s Khalsa Engineering Works 62/D/2, J. N. Mukherjee Road, Ghusury, Howrah – 711107, West Bengal. Phone:033-26555275

The guillotine type fibre cutter is produced by the following manufacturers

1. M/s Prime Instruments, Kolkata ¼ Gopal Chandra Bose Lane Kolkata -0700050 Phone no.983600218, 9433745993
2. GSL Textile India Pvt. Ltd. D-103, Focal Point, Phase V, Ludhiana – 141010 Punjab (India), Ph: 0161-5011257-58

There are lot of manufacturers of hydroextractors and centrifugal dryers. The entrepreneur may choose the manufacturer based on exact requirement and budget.

Project Implementation Assistance

Indian Jute Industries' Research Association, 17 Taratala Road, Kolkata 700088 would aid in setting up such an industry with a nominal fee.

Acknowledgement

IJIRA would like to acknowledge the financial support for this project to National Jute Board, Ministry of Textiles, Government of India.ww

Customized Sportswear Online Brand shop Corporate Promo & Gifts

T10Sports is the preferred name in Customized sportswear, online brand shop, corporate promo and gifting trusted by Indian Premiere League teams - Kings XI Punjab, Delhi Daredevils, Pro Kabaddi League team - UP Yoddha, Delhi dabangg , celebrity cricket League teams - Mumbai Heroes, Bhojpuri dabbangs, Indian Super League Teams - Minerva Punjab FC, Fateh Hyderabad FC , Jsw Bengaluru FC, Pune FC, Sports Federation- Squash Racket Federation of India, Table Tennis Federation of India, for their various custom made sportswear and lifestyle merchandise requirement; our expertise in performance technical fabrics enabled athletes to compete in some of the toughest triathlons and endurance sports – Ironman, Ultraman, Bad water and Campa bay swimming expedition.

We are ISO 9000 certified and accredited by ICC; trusted as cricket uniform manufacturer for Nepal National Cricket team, Bhutan Cricket board and more in the add list.

We have an active e commerce platform; - www.t10sports.com the vertical – online brand shop caters to the brand specific - merchandise listing and procurement. Some of our clients are FMS, SRCC, KXIP, Delhi Daredevils; PwC, UP Yoddha, Neev academy; amongst 50 active Brand shops. With more than 300 styles ranging from performance wear to cotton to winter fabrics and 1000+ non fabric merchandise to select from we give our clients the freedom to select their desired merchandise for online sale to their community via our online platform.

We expertise in performance fabrics and technical sportswear gear ranging from endurance sports like – running to triathlons, wrestling and kabaddi, these specialized sports require specialized trims cuts, and fabric blends for stretch, comfort and stability is given prime importance.

We believe in quality and optimization of resources, we use latest machineries for patterns, color matching, no feel prints, digital print, digital embroidery and other embellishments and final packaging of finished goods.

Being one of the sought out brand for specialized sports apart from cricket, soccer, running and cycling we give due considerations to have the perfect fabrics as per requirement per event, workwear or sports our range of fabrics are – cotton rich fabrics like supima staple cotton, cotton blend, natural fabrics – modal and slub, microfiber, extra light weight micro fiber blended fabrics, bamboo charcoal fabrics, and high density polyimide / spandex fabrics to name a few.

We are the trusted name in corporate promo and gifting some of our clients are GE, Phillips, PwC, Ericsson, Amway, Taj, Pepsi, Pathways World School, The Maple Tree, Heritage School, Fathers School and many more amongst our 1000 + clients in a span of 5 years since inception of the Brand T10Sports under a 2 decade seasoned firm - Jade Knits.

For more please scan – (official video & testimony).

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Lining-up

FASHION IN FABRIC

Like Never Before...

THE RMP MISSION & VISION

To become the leading supplier of fabrics in India for the apparel industry by setting the fashion trends across global brands.

RMP INFRASTRUCTURE

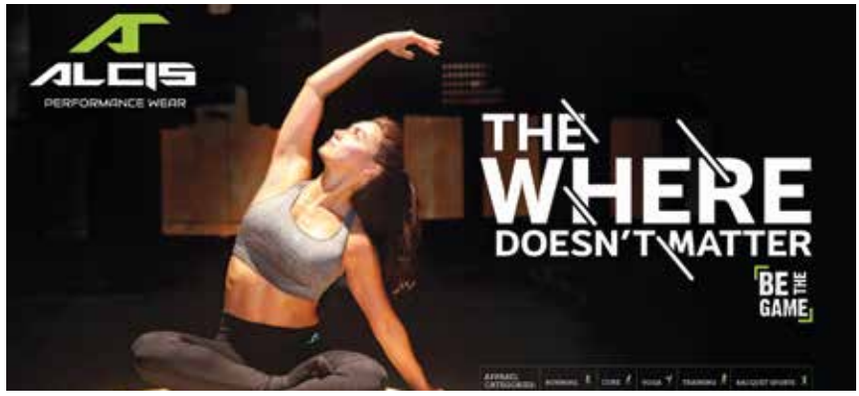
Our In – House infrastructure, conductive work environment, commitment to quality, production capability

OUR INITIATIVE

RMP has always given special preference toward it's Social and Quality initiatives

ALCIS SPORTS: The Game Changer for Indian Sports' Wear

A look at how emerging sports' wear brand — an all Indian endeavor — Alcis Sports, will revolutionize India's sports' wear market.



The Indian sports' wear market is booming. With the outdoor landscape, having evolved in the last decade, the sports' wear market grew at 22 per cent between 2015 and 2016. Alcis Sports is an all-Indian brand of sports' wear and 'athleisure' clothing which seeks to address this growing demand for affordable and high-performance sports' apparels in the local market.

The brand is owned by Paragon Apparels, India's largest integrated sports' wear manufacturer with an installed capacity to manufacture 15000 pieces a day. The company has an impressive list of international clients like Benetton, Adidas, Superdry, Reebok, Kappa and Hummel as well as Indian labels like Reliance, Waste2Wear and Fransa to name a few. Now, for the very first time, Paragon Apparels is venturing into direct retail in the Indian market through its flagship brand – Alcis Sports.

Alcis Sports has been created to celebrate the power to compete. Its core philosophy 'Challenger Spirit' powers Alcis' strategy to question the status quo with the domestic sports' wear market. When it comes to sports, an apparel is more than mere clothing — these separates are like tools that enable an athlete, yoga practitioner or sports' practitioner to reach their zenith. In India, most sports' wear with the technology to enable high performance in the sports' arena have tended to be big global brands. Their products, which offer product innovation and performance features, are beyond the reach of this burgeoning segment of sports' enthusiasts in the country.

The Wonder Tee, for instance, is the world's most light-weight T-shirt made from premium quality polyester. It is made from ten pet bottles, making it a recycled product par excellence. This T-shirt features all the innovations of the Alcis Sports such as Anti Statix, Stretch X, Drytech, Light X, Airventx, 360-degree Reflective and Neu-Dri to name a few. Super-absorbent, resistant to static charge, light-weight and with light reflecting trimmings on all four sides, it is by far the most quality sports' apparel in its class. Retailed through stores and online platforms like Jabong, this product is

made more appealing at an affordable price-point, for Indian consumers across segments.

Alcis Sports is also the only Indian sports' wear brand to have a separate line of yoga apparel. With the Modi government, having promoted this ancient Indian discipline in a big way, more Indians are practicing yoga than ever before. Alcis Sports yoga wear is made from more natural fabrics like bamboo fiber, which mimics many benefits of polyester, and stretch lycra cotton. These garments have innovative design features which prevent lowers and tees from rolling away from the body during inversions and certain postures.

Alcis Product Feature

Every Alcis garment is distinguished by technological innovation. Therefore, our sportswear garments offer unparalleled comfort:

RECYCLED (Recyclable Polyester)

It's a "Green" polyester& environment friendly textile. A really high quality fabric that's breathable, lightweight & hard-wearing.

ANTI-STATIX (Static Charge Resistivity)

This technology is helpful for runners who run long distances. Friction caused by the garment rubbing against your body results in irritation in the nipples. Antistatic finish takes care of this problem and allows you to run in ease.

STRETCH-X (Active stretch garment)

ALCIS STRETCH X technology gives extra stretch to the garment by adding extensive Lycra at the yarn level. The stretching of the fabric ensures that it does not hinder the natural movement of the fitness/sport action. It actually moves in the same direction when you do a curl.

DRYTECH + (Whilst Wicking)

ALCISDRYTECH + technology keeps you cool and dry, and allows the garment to breathe whilst wicking moisture away from the body. In addition, the quick dry properties created by the natural microclimate of the garment help reduce post exercise chill, making the burnout last longer.

AIRVENTX (Enhanced Wicking)

This technology helps you stay dry even during intensive exercise. The garment does not cling to your body, thereby helping you perform better. Compared to a normal t-shirt, an Alcis t-shirt ensures comfort, while also aiding your running effort.

N-9 PURE SILVER™

It is a revolutionary, globally patented, particulate silver-based technology that neutralizes odor-causing bacteria on contact, keeping articles fresher for longer. This breakthrough technology delivers outstanding performance, combined with impeccable environmental credentials.

ANTI-MICROBIAL

Antimicrobial technology neutralizes body odor and protects from odor causing microbes, delivering unparalleled, long lasting freshness.

ANTI-ODOR

N9 Pure Silver is a revolutionary technology that neutralizes odor causing bacteria on contact, keeping active wear fresh longer.

NEUDRI™

NeuDri™ additional soil release, softening, and anti-static properties ensure that garments are not only comfortable, but also agile and functional. It facilitates evaporation, leaving the wearer dry, comfortable, and confident.

Dynamic Drying and Soft Touch are the other features which make Alcis garments such a pleasure to use and have.

Soon to be unveiled – the face of Alcis. Bold, non-conformist and a challenger of conventions, our brand ambassador is a role-model for a breakaway generation.

Comfort Characterstics of BI Layered Knitted Summer Wear Accessories

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Introduction

Comfort is defined as "the absence of displeasure or discomfort" or "a neutral state compared to the more active state of pleasure". Extensive research has been carried out in order to develop thermal comfort behavior of knitted fabrics as knitting technology meets the rapidly-changing demands of fashion and usage as knitted fabrics not only possess stretch and provide freedom of movement, but they also have good handle and easily transmit vapor from the body. That's why knitted fabrics are commonly preferred for sportswear, casual wear and underwear.

Comfort properties are very much affected by the type of yarn used. In Bi-layered structures different combinations of the yarn type are to be brought into use. The main consideration is on the yarn type like natural/ synthetic and yarn spinning systems like ring/ rotor. Combinations which are to be used for preparation of the fabric are carded/ combed ring/rotor yarn in face (outer) layer & polyester spun/polyester filament in back (inner). Natural fibers like cotton, silk are generally known to be hydrophilic while the synthetic fibers like polyester, nylon are hydrophobic. Bi-layered fabrics consist of two layers of fabrics which have the ability to complement and maximize the essential comfort properties. Presence of more numbers of layers can reduce pressure, temperature; shear and friction developed on body and also enhance the moisture absorbency and moisture vapor transport property. The present study attempts to objectively evaluate the comfort properties of bi layered knitted fabrics and designing of summer accessories.

Materials and Methods:

Six single jersey bi-layered fabrics were prepared on flat bed knitting machine with plating technique by using the cotton yarn in face (outer) layer & polyester filament in back (inner) layer. The variables chosen for the production of single jersey bi-layered structure are yarn type, yarn spinning system and fibre denier. The construction details of samples are given as shown in table 2.

K.N Chatterjee

Method

Physical properties like thickness, GSM, CPI (courses per inch) and WPI (wales per inch) and liquid transfer properties like drying time, drying rate, vertical wicking and drop absorbency was measured as per standard procedure laid down in BS, ASTM and AATCC Handbooks.

Table 1. Knitted structure types

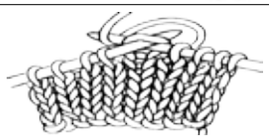
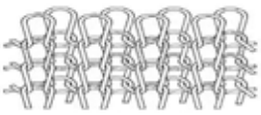
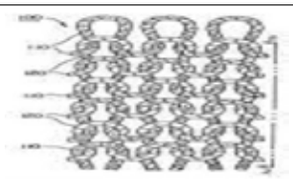
Type of knitted structure	Description	Fabric structure
Single Jersey	The simplest and the most widely used fabric, having V-shaped loop appearance on technical face side and show semi-circular loops on the technical back side. Knitted on single cylinder circular knitting machine.	
Rib	Reversible and balanced structure due to 1*1, 2*2, 3*3 ribs, having the same appearance at face and back side. Knitted on Circular Rib Knitting Machine having two sets of needle-cylinder needles and dial needles.	
Purl	Reversible in appearance. Each wale consists of face and reverse loops. Knitted on purl knitting machine having double ended needles	
Interlock	It is made by the interlocking of two rib structures. Reversible structure. Knitted on Circular Interlock Knitting Machine having long and short dial and cylinder needles.	
Bi-layered	Bi-layered fabrics consist of two layers of fabrics which have the ability to complement and maximize the essential comfort properties. Presence of more numbers of layers can reduce pressure, temperature; shear and friction developed on body and also enhance the moisture absorbency and moisture vapor transport property.	

Table 2- Sample details

Sample code	Inner	Outer	Yarn type (carded/ combed)	Yarn spinning system (Ring/Rotor)	Fibre fineness (denier)
PET-C1	PET	C	Combed	Rotor	1.2
PET-C2	PET	C	Combed	Rotor	2
PET-C3	PET	C	Carded	Rotor	1.4
PET-C4	PET	C	Combed	Rotor	1.4
PET-C5	PET	C	Carded	Rotor	2.0
PET-C6	PET	C	Combed	Ring	1.4

Note: PET – Polyester, C - Cotton

Results and Discussions

The moisture content % which is ranges between 62-69. PET-C4 fabric sample has the highest & PET-C5 has the lowest value. Wickability of PET-6 was observed to be the highest & PET-C2 showed the lowest value. Spreading time of PET-C4 was observed to be highest and PET-C2 has the lowest. Spreading speed of PET-C2 was observed to be highest and PET-C6 has the lowest. Higher the value of spreading speed, better will be drying capability of fabric. PET-C6 has the highest & PET-C5 has the lowest water evaporation rate. The fabric fibre denier, air permeability decreases & water absorbency increases. The thickness and GSM of fabric increases with the increase in diameter as well as hairiness of yarn. The thickness and GSM of fabric increase with the increase in yarn diameter.

Conclusions

In this study, objective evaluations were conducted in order to determine the effect of yarn type (carded/ combed),yarn spinning system(rotor/ring) and fibre denier on comfort properties of Bi layered fabrics. Bi layered fabrics using combination of finer fibres and ring combed yarns showed higher values of air permeability, vertical wicking and lower values of drying time, thereby exhibiting their effectiveness of rapid dissipation of generated sweat in summers compared to their rotor and carded yarn counterparts. The former structures were thus chosen for designing summer wear accessories particularly wristbands intended to be worn during brisk walking or light physical activities. Wear ratings suggested that the designed accessories were otherwise acceptable aesthetically and in terms of comfort. However, the subjects had suggested some alterations in the selection of colours and sundries for the designed accessories.

Thermoplastic Technology for Sew Free Garment Manufacturing



H&H is specialise in thermoplastic technology for sew free production. H&H uses adhesive and waterproof technology for manufacturing of apparels, bags, shoes, material for medicals, tents and gloves etc. including waterproof seam sealing, sew free pocket adhesive, zipper bonding, front zip sealing, fabric joining, line bonding, overlay taping. Also include adhesive backing for woven label and embroidery.

Technical textiles field such as Pro-Tech and Sport-Tech, H&H is bridging the gap from inspiration to execution with the help of Trims suppliers by contributing our technology making smart Hot air machines, smart bonding press, smart automation for specific application. Reliability is ensured by us in terms of deliverables accuracy such as Heat and pressure for the application.

In this technique heat and pressure are applied to the seams of the fabric to fuse them together by using a mediator or with ultrasonic method to the suitable fabrics. Also in this technique by using an external layer of protection film with help of heat and pressure on sewed seams ensures protection seams.

The thermoplastic bonding process proves beneficial to the garment industry in many ways not only because of its durability but, also the quality. thermoplastic bonding is beneficial in the manufacturing mainly because it gives sealed edges and seams. Also since there are no stitch holes and no penetration into the fabric, it also makes the product aesthetically appealing. It can be also used to tackle problems like thickness variation of the fabric also it avoids puckering. Also, high level of accuracy is needed from the operator in the process of welding because once the process is completed, it is difficult to alter or repair the garment

In 2016 November UNIK (designer, developer and manufacturer's dream) powered by H&H opened in Bangalore, India with partner investors SAKHO and RCG. It is an Innovation and Incubation centre for design and development, logo making, job work, garment production specially in field of seam protection and bonded (stitch-less garments) seam.

H&H ASIA GROUP LTD company was established in 1993, and hence we have over 24 years of experience for thermoplastic technology on seam sealing and adhesive film applications.

Real Time Shop Floor Control System in the Apparel Manufacturing Sector

PRASANTA SARKAR

The real-time system is an IT enabled system that can provide necessary information to its users as sooner as things are rolled on. In the shop floor, the real-time system is used for production and inventory tracking and control. The radio frequency identification (RFID) technology is one of the few technologies used in real-time shop floor production control system in the apparel manufacturing.

In a garment manufacturing unit, we have managers and industrial engineers to manage the shop floor. But they don't have the latest technology or reliable tool to capture the production data on real-time to provide standard time produced by employees, actual working hours of the employees, lost time data, bottleneck identification and improved shop floor visibility.

Apparel manufacturing companies those are aware about the real-time system and who feel the accurate and real-time data is important for managing and improving the processes, are using this kind of systems.

In this article, I will walk you through the basics of a real-time shop floor control system and its benefits in the garment manufacturing sector.

Why Real-time System?

The garment manufacturing sector is labour intensive. And you know that labours are the costliest resource in making garments. To maximize the utilization of the shop floor employees, production managers and line supervisors need information on real-time. Managers can take the decision quickly if they are informed with correct data on the real-time basis. Having

Prasanta Sarkar

the real-time production control system implemented, factory management does not need to wait or call anybody for the daily production status. They can check the shop floor reports and data from anywhere with internet connectivity.

Following are some pointers that is possible through such systems. This system -

- Captures real-time production information from each workstation, each section, each line and each process.

- Provides data on who is doing what task on the shop floor
- Provides workers' idle time, lost time and actual bundle work time data
- Calculate the true labour cost of garment production
- Calculate workers actual earnings and make up amount that a factory needs to pay to their workers
- Identifies bottleneck operations on the floor and shows in which workstation the bottleneck operations can be done within line to meet day's target
- Records bundle working time for each bundle
- Helps in line balancing by providing minute by minute production data and inventory details
- Records the reasons of low production in a line or in a specific operation
- Keeps factory informed in many other ways

Application of the real-time production control system in garment manufacturing

This system can be used in all processes in the apparel manufacturing - from sample development to packing of the garment. In the bulk production, the order status can be tracked on real-time from cutting room production to washing to packing of the garments. The real-time system is also used in the statistical quality control (SQC). You can track who had made the defects and in which operations defect generations are more.

System Components

Let me briefly show you the primary components of a RFID based real-time production control system. I am referring to our shop floor production control system to explain the system components. The hardware components include Host server, SQL server (Database server), Network manager, Controller, operator terminal, RFID reader, RFID tags, Bundle sticker printer (barcode printer), and LCD TV screen. Host server, SQL server, Network manager, and controller are connected to the LAN (via ethernet cable). The operator terminals are connected to the controller through a network cable.

Operator terminals are installed on the workstations where the factory desires to capture data. The RFID reader is attached to each operator terminal. The terminal is used to enter employee transaction information like scanning bundles (garment pieces), sign-on and sign-out time on the workstation, lost time records etc. Operators can view their production data, earning and efficiency information on the terminal display. Depending on operator inquiry terminal shows information on real-time. The same terminal can be used as sewing terminal, SQC terminal, Group incentive terminal and shared terminal.

RFID tags are used as bundle tags like a bundle ticket. When a bundle tag is scanned to the operator terminal, system records who did that bundle, when the scanning is done, on which operation of the OB is scanned etc. The RFID tags

Figure 1: Real-time production and performance display on TV screens

Figure 2: Operator Terminal and RFID Tag reader

Figure 3: RFID Tag and Tag Attached to a Bundle

can be used different ways like employee tags (for employee sign-on), supervisor tags (for lost time request approval) and operation tag (to change operation when an operator do multiple operation in a same workstation). RFID tags are available at various frequency level.

LCD screens are used for displaying key information on the floor. LCD screens are normally hanged on the wall at the end of the line. In a LCD screen reports like number of attendances/absent employees, line output, line target, line performance, and hourly production report, are shown.

System Workflow

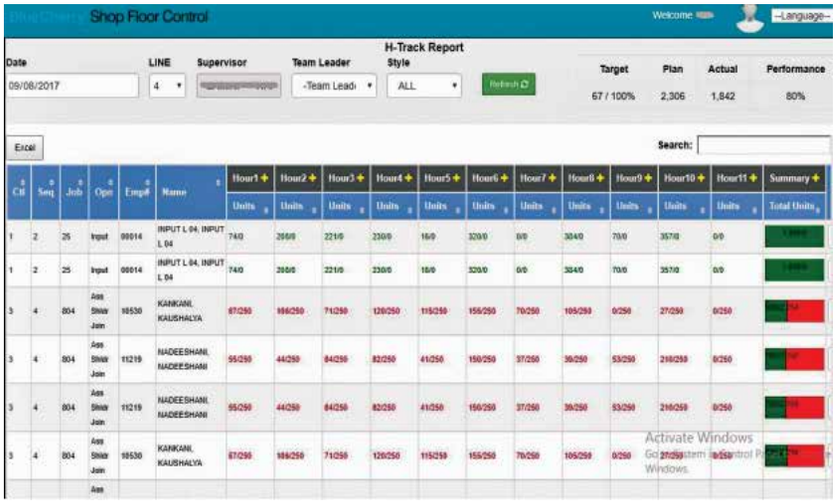
After the system installation, followings are main activities to be performed by the factory to make it a successful implementation. I have tried to list the activities in a sequence for an operation cycle.

Data preparation: Initially user needs to enter data into the system like shift timing details, employee master, operation and style master, and operation bulletin. Normally, industrial engineering department takes care of data entry activities. Data masters can be imported from excel file or can be added from system menus.

Bundle tag preparation: Bundle tags are prepared by scanning each tag on the RFID tag writer. Depending on the lay plan and cut bundle details, bundle list is made on the system allocating unique number for each bundle. The RFID tag carries the unique bundle number. After bundle tags are prepared, each bundle tag is labelled with a sticker to identify the bundle number.

Attaching Bundle tag to each bundle or to individual pieces (in case factory follows single pieces bundle system). Multiple RFID tags may be required to against each bundle depending on the production system. For example, when garment is processes on different sections at the same time (like part sections of a shirt

Figure 4: Hourly Report



making line – collar, cuff, back and front parts of a bundle can be stitched at same time). Operators receive the RFID tags with the bundles (cuttings).

Operator terminal setup: Each operator terminal is set-up with a unique terminal id (like each computer device needs a unique IP address) and operation number. Operators login to their terminals when they work on the line.

Scanning bundle tags: When operators work on the bundle they scan bundle tag (RFID Tag) to the RFID reader attached to the terminal. Operators need to scan bundle tags as they start working the bundle.

Report reviewing and report inquiry: As soon as operators scan bundle tags and complete their first bundle, LCD screens start displaying production details and the display is automatically get updated. Line supervisor see the reports to manage their lines. The operator's terminal also shows many useful information to operators.

Reports and data analysis: The system captures all transactions made on the floor. Data based action is taken by the line supervisor after viewing the reports.

Reporting and data analysis

The system captures and records all the transactions made on terminals by employees and supervisors. Line supervisors' comments and managers' comments on low production and idle lines are fed using tabs or mobile application. System is already equipped Business Intelligence (BI) tools, common production and WIP reports.

Users can further develop custom reports and analyze the data as required. Here are few examples of common production reports.

- Hourly production report
- Line balancing chart
- Lost time data - lost hours
- KPI Dashboard
- Operator skill matrix
- Line and employee performance
- Business Intelligence tools
- Production display screen on the shop floor

Conclusion

The wages of the workers will never reduce in future. To be competitive in the business and increase the bottom line, you need to find a way to reduce your manufacturing cost. As per industry experts and consultants, reduction in the manufacturing cost is possible through improving floor performance, workers performance and increasing resource utilization. To achieve these goals, you need a reliable technology with business intelligence tool that can provide information to your team for quick action.

Reference

www.onlineclothingstudy.com

www.cgsinc.com

Seminar Report

The fourth TANTU seminar on The Technical Textiles: The next Big Opportunity was held on 25th September 2016 at India International Centre, New Delhi. There was interesting gathering of industry experts, academicians, professionals and Govt. officials from all over India discussing on medical and protective textiles. Dr. Prabir Jana, President, TANTU and seminar chairman in his brief welcome address, set up the right tone by giving a overview of the seminar theme and pointed out that though India has lots of nonwoven roll goods manufacturer but, there are few good professional organisations to convert these into final product. And to value add in the supply chain India needs more such manufacturers of technical textile products.

Dr. Amalesh Mukhopadhyay, Advisor, Dept. of Science & Technology explained the Govt. approach and scope of technical textile's market in India. Mr. Dilip Gyanchandani, COO, F2F, steered the session on "Wellness and Medical Textiles" with four panel members. Dr. P.J. Singh, Managing Director, Tynor Orthotics, mentioned

Dr. Prabir Jana, President, TANTU welcoming the delegates

that bio textile is key issue to make the success, Mr Krishna K. Behati, Director Technical, Shubh Swasan India Pvt. Ltd. emphasized that the comfort level and related parameters should be given equal importance (if not more) for wearable technical textile products and there must be passion for excellence. Dr R Chattapadhyay from Textile technology department, IIT, Delhi called for educating students across the country in the arena of technical textile which are highly science based products, more participation of industry in research and assured uncompromised institutional support to make a great success. Mr. Subhamoy Banerjee, Senior Marketing Manager, Freudenberg Performance Material who emphasized that three aspects marketing, markets and technology are key for the success of technical textiles. There was an excellent coverage of medical and SoundTex products from Freudenberg range and its uses. He has extended an open offer to support any collaborative product development initiative

Mr. Bhaskar from Mann Filter explained the need for air purification in current scenario and demonstrated the superior products from MANN FILTER range designed for room and automobiles.

Mr Deepak Mohindra, Editor-in-Chief of Stitch world, presided over a rather large panel of 5 members on "Safety and Protective Wear". Dr. Mrinal Talukdar, Director Technical, Kusumgar Corporate, emphasized the need for more organised mills for making technical fabrics in India. India still imports 90% of taffeta, used for making basic products like umbrella. Mr. Anurag Singhal, Managing Director, Sai Synergy LLP, emphasized the need for adding the fashion element to the protective gear to increase its acceptability and expected more professionals from design institutes to join technical

◀ *Release of TANTU annual magazine (from L to R: Paresh Das, Mr. Sibaji Dasgupta, Mr. Subhamoy Banerjee, Mr. Bhaskar and Mr. Chandan Saha)*

◀ *Wellness & medical textiles panel discussion (from L to R: Dr. Rabi Chattopadhyay, Mr. Krishna Kumar Baheti, Mr. Dilip Gianchandani, Dr. P J Singh and Mr. Subhamoy Banerjee)*

◀ *Safety & protective gear panel discussion (from L to R: Mr. Gaurav Kumar, Dr. Mrinal Talukdar, Mr. Deepak Mohindra, Dr. Mukesh Sinha, Mr. Anurag Singhal, and Dr. Arindam Basu)*

textile industry to explore their career. Dr. Arindam Basu, Director General, NITRA, mentioned the breakthrough steps taken by Government in making the norms mandatory for use of protective wear in workplace. The experts present in the seminar welcome the move and expressed that it will help expanding the market for protective gear. Mr. Gaurav Kumar, Marketing Director, Excel Global from his long experience of working in South Asian countries felt that India is still not ready with quality manufacturers of protective gears. He also mentioned that the typical practice of using contract labour for manufacturing in northern India may not go very well with protective wear manufacturers. Dr. Mukesh Sinha, Scientist E (Dy. Director), Defence Research Development Organisation acknowledged that unrealistic stringency norms and specifications in protective gear for defence use is currently a hindrance and DRDO is working towards removing such hurdles with collaborative support from industry. Mr Krishna K. Behati, Director Technical, ShubhSwasan India Pvt. Ltd. emphasized that the comfort parameters should be given equal importance (if not more) along with functional parameters for protective wear for defence personnel. He gave an example where a light weight sleeping bag was designed and developed for defence with stringent performance criteria.

Freudenbeg Performance Materials, part of 7 billion EUR Group has associated with the seminar as Gold Partner. Freudenberg is a Germany-based company offering its customers technically challenging product solutions and services. Mann+Hummel, a 3 billion EUR Global Leader from Germany in all filtration-related products and the Oerlikon Group from Switzerland, offering Surface Solutions, Manmade Fibers, Drive Systems and Vacuum were the Silver Partners of the seminar.

The seminar generated good discussion with the participants and the panelists regarding the role of academia and industry in support and success of this sector. The biggest take away from this seminar was the pledge taken by industry experts and sponsors to work on collaborative projects with academicians and help students in their research endeavour.

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Seminar on "Technical Textiles: The Next Big Opportunity"
India International Centre, New Delhi
16th September 2017
Tentative Seminar Schedule

Registration **9:30 AM – 10:00 AM**

Inaugural Session **10:00 AM – 10:25 AM**

Welcome Speech by Dr. Prabir Jana, President, TANTU

Launching of Annual Souvenir of TANTU 2017

Keynote Address by Mr. Ram Sareen, Head Coach, Tukatech, USA

Panel Discussion 1 **10:25 AM – 11:45 AM**

THEME: ATHLEISURE AND ACTIVE SPORTSWEAR: MANUFACTURING CHALLENGES

Panelist:

- Roshan Baid, Managing Director, Alcis, India
- Deepankar Sekhri, Production Process Manager, Decathlon India
- Indu Sharma, Director Production, Activewear, Delta Galil, USA Inc.
- Bhupinder Singh, Chief Product Officer, Wildcraft, India
- Sanchit Khurana, Founder, Pace Athletica, India

Tea Break **11:45 AM – 12:00 Noon**

Presentation by Gold Sponsor **12:00 Noon – 12:20 PM**

Presentation by: Ms. Savannah Crawford, Chief Collaborator, Tukatech, USA

Panel Discussion 2 **12:20 PM – 13:35 PM**

THEME: ATHLEISURE AND ACTIVE SPORTSWEAR: MARKETS & OPPORTUNITIES

Panelist:

- Anurag Jaichand, Head Technology & Innovation, Woodlands, India
- Mohit Singhal, Managing Director, Aurro, India
- Bijesh Todi, Managing Director, T10 Sports, India
- Deepak Singh, Director, Shiv Naresh Sports, India

Presentation by Silver Sponsors **13:35 PM – 14:15 PM**

Presentation by: Shayama Prasad Goswami and Pulak Bhattacharya, Kesoram Rayon

Presentation by: Anshuman Dash, H&H Asia

Vote of Thanks

Sanjib Sinha, General Secretary, TANTU **14:15 PM- 14:25 PM**

Networking Lunch **14:25 PM – onwards**

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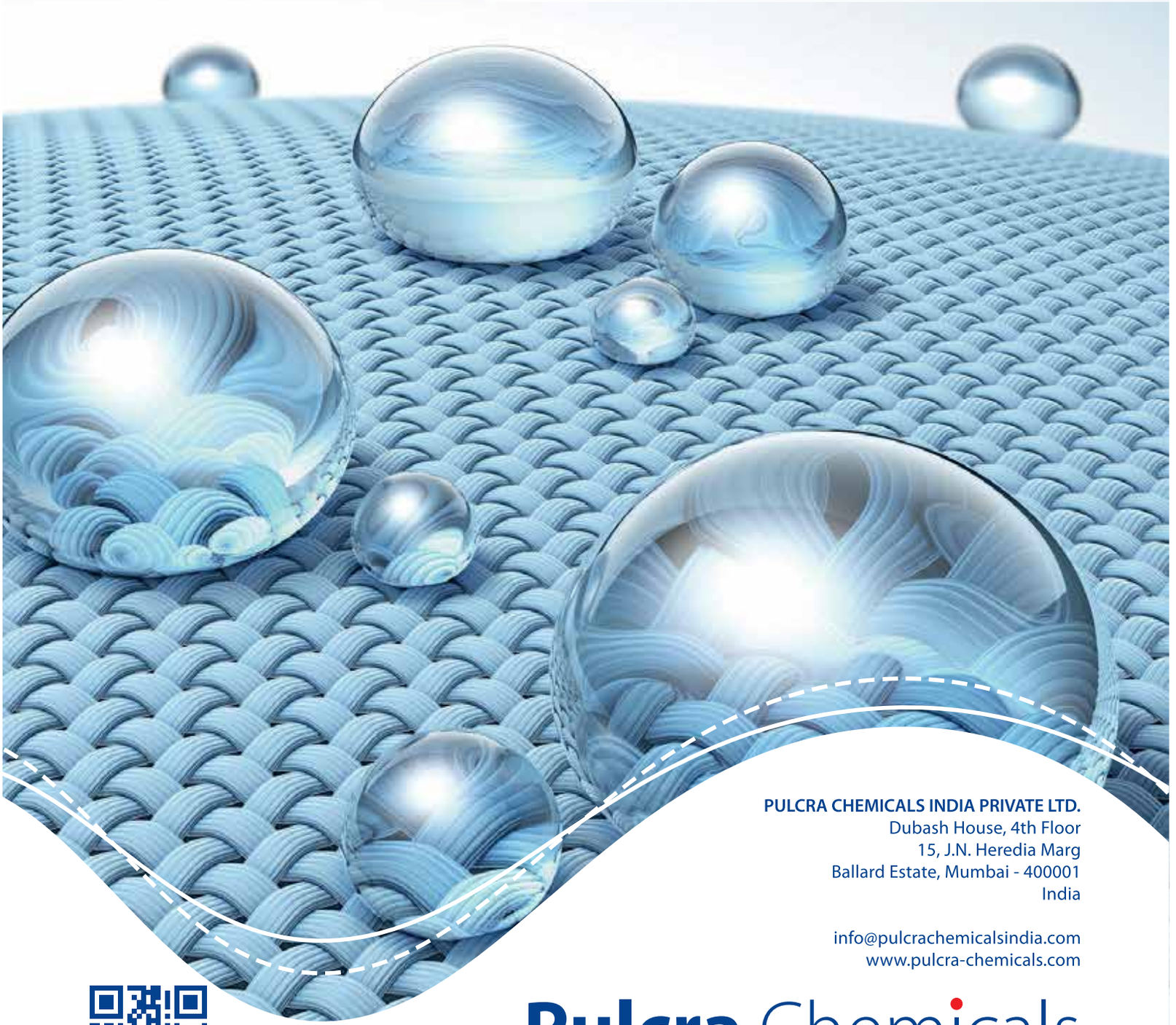

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