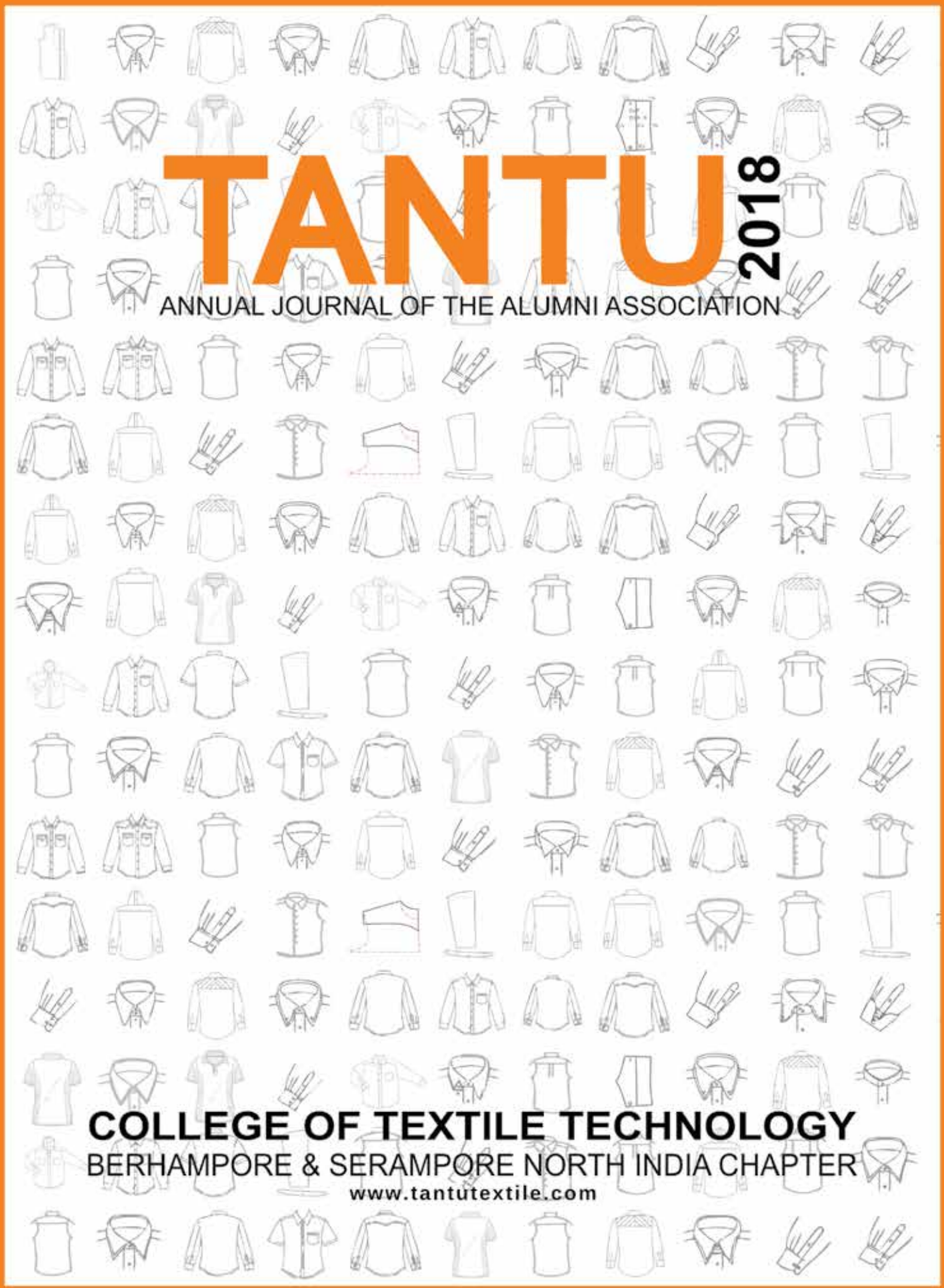

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COLLEGE OF TEXTILE TECHNOLOGY

BERHAMPORE & SERAMPORE NORTH INDIA CHAPTER

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CONTENTS

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Editorial

The release of TANTU Annual Journal 2018 on the occasion of fifth TANTU seminar give us immense pleasure for being able to present a star studded panel discussions as well as curated writings from academicians and industry alike. With so many seminars being organized and publications released every year, TANTU has already created a niche by organizing seminars in thrust areas bringing together technical minds to create awareness, sharing of expertise and expand knowledge base.

This year's seminar topic **"The Art of Shirt Making",** created so much buzz in the market that apart from the technology panel discussions we have to introduce one more panel discussion on "Business of Shirt Making". From 'Rombus', the first indigenously mass-produced quality men's shirt brand in India by Stencil Apparel in NCR, Indian manufacturing came a long way dressing up Indian men with some of the finest shirts. Today, according to Technopak domestic shirt market is estimated at $ 5754 million and Men's shirt is almost 94% of same. Yet, Indian export of Men's shirt is abysmal; most of the world renowned dress shirt brands do not source from India. Along with quality and technology discussions the seminar is also going to address what is stopping Indian manufacturers to capture the lucrative global shirt market, estimated to be $ 50 billion in 2018. Is it quality, productivity, raw material or technology?

We at TANTU are extremely pleased to start TANTU Young Engineer Scholarship Program this year where one student each from both Berhampore and Serampore College in West Bengal will be able to attend the annual TANTU seminar all-expense paid. The objective is to create an eco system for the students to have a fair exposure on industry and capacity building. The initiative will also facilitate the students to interact with the professionals of diverse areas and acquire knowledge on the latest developments, innovations and employment opportunities during the event. This year two students, Pathik Paul and Arnab Kumar De will be attending the seminar.

This year the TANTU annual journal has six write ups from TANTU alumni members on varied topics like Space suits, Nano-fibrous nonwoven fabric - a wonderful solution for personal protection against air pollution, Emerging market scenario of t-shirts in the changed environment, Industry 4.0 - a glimpse of the near future and four write ups from industry experts on different topics like sustainability in every stitch, The new paradigm in PMTS for the RMG sector and Fusing technology solutions.

We at TANTU have also taken steps to increase and enliven our web presence. We need your feedback as well as constructive criticism to improve our service to the industry. We would love to hear you at communications@tantutextile.com.

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

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SPACE SUITS

DR AMAL CHOWDHURY

INTRODUCTION

On the Earth, our atmosphere provides us with the environmental conditions we need to survive. Earth's gravitational attraction holds atmosphere comprising of a mixture of gases like nitrogen, oxygen, carbon dioxide and thick form of water vapour. This atmosphere protects us from various factors. We take for granted the things it provides such as air for breathing, protection from solar radiation, temperature regulation and consistent pressure. For humans to survive in space, these protective conditions have to be synthesized as none of these protective elements are present in space. In other words, there is a need for a system to determine, detect and prevent certain level of radiations, pressures and temperatures encountered by the astronauts to keep him alive in that environment. Such a system is a space suit. It is a complex system of equipment, specially designed to protect and keep a person comfortable in the rough environment of outer space by providing the basic necessities such as oxygen, temperature control, pressurized enclosure, removal of carbon dioxide and protection from sunlight, solar radiation and tiny meteoroids. Thus, space suits re-create the nearly environmental conditions of Earth's atmosphere. So, it may be deemed as a life support system for astronauts working outside earth's atmosphere. Apart from protecting, spacesuits are also used for many important tasks in space. These include aiding in payload deployment, retrieval and servicing of orbiting equipment, external inspection and repair of the orbiter and taking stunning photographs. Moreover, like a small spacecraft, today's spacesuit allows astronauts to work outside of their space vehicles. Therefore, a space suit is almost a spacecraft in itself.

Dr. Amal Chowdhury

The spacesuit completely covers a spacewalker's body. The pieces of the suit interlock so that none of the spacewalker's skin is exposed to space.Astronauts of the space shuttle era have more than one wardrobe for space flight and what they wear depends on the job they are doing. Prior to a mission, crew members are outfitted from a selection of clothing including flight suits, trousers, lined zipper jackets, knit shirts, sleep shorts, soft slippers, and underwear. The materials of every component of the clothing are flame retardant. There are closeable pockets covering the exterior of the garments for storing items such as

pens, pencils, data books, sunglasses, pocketknife and scissors. The latest version of today's space suit is called as extravehicular mobility unit (EMU) which has been developed to be more durable and flexible and is mandatory to wear while working in the open cargo bay of the space shuttle or in space to carry out extravehicular activities (EVA's)."Extravehicular" means outside the vehicle or spacecraft. It is named so to reflect the fact that EMUs are also used as mobility aides when an astronaut takes a space walk outside of an orbiting spacecraft. EMU's are composed of numerous tailor-made components that are produced by a variety of manufacturers and assembled by the National Aeronautics Space Agency (NASA) at their headquarters in Houston. The EMU comprises the spacesuit assembly, the primary life support system (PLSS), the display and control module, and several other crew items designed for spacewalks and emergency life support. It is modular in design which accommodates a variety of interchangeable systems that interconnect easily and securely in single-handed operation for either normal or emergency use. The size of the parts varies from one-eighth inch washers to a 30 inch long water tank. Spacewalkers do not wear custom-made suits. The upper torso, lower torso, arms, and gloves are manufactured in different sizes and can be assembled for each mission in combinations needed to fit men and women astronauts. Moreover, these parts can be resized to fit over 95% of all astronauts. Each set of arms and legs comes in different sizes which can be fine tuned to fit the specific astronaut. The arms allow for as much as one inch adjustment. The legs allow for up to a three inch adjustment. Additionally, a part of lower torso assembly can be made shorter or longer by adjusting the sizing rings in the thigh and leg sections. The arm assembly is also adjustable just like lower torso assembly as sizing rings can make assembly parts of arm longer or shorter.

DESIRABLE QUALITIES OF SPACE SUITS:

- The space walk suits (EMU) have various requirements as outlined below.
- Lighter in weight.
- Flexible in handling.
- Comparable in strength with metals
- Modifiable in size and shape.
- Thermally insulated and resistant.
- Have a pressurized atmosphere.
- Have sufficient oxygen supply.
- Eliminate carbon dioxide.
- Maintain a proper temperature despite of strenuous work and movement.
- Protect from micrometeoroids.
- Protect from radiation to some degree.
- Enable clear vision.
- Allow easy movement of the body inside the spacesuit.
- Enable easy conversation with others such as ground controllers, other astronauts etc.
- Facilitate movement around the outside of the spacecraft.

RAW MATERIALS FOR SPACE SUIT:

Space suits are some of the most complicated and unique pieces of technology in the world today. Due to the sheer complexity of surviving in space there are many components and materials that go into the design of a space suit. The materials used are mentioned below.

- Nylon Tricot
- Spandex
- Urethane coated Nylon
- Neoprene coated Nylon
- Mylar
- Goretex
- Kevlar
- Nomex
- Dacron
- Fiberglass

CONSTRUCTION OF THE EXTRAVEHICULAR MOBILITY UNIT (EMU)

Different parts of a space suit (EMU) are shown in Figure 1.

An Extra Vehicular Mobility Unit (EMU) is designed by the NASA Engineers. It consists of fourteen layers of structures which all contribute in their own way to the survival of the astronaut. The inner layers of the suit do activities like cooling and ventilation. Besides these, an EMU has to housedrink-bag, communication systems, TV camera and lights, etc.Some of the major items are outlined below.

The Liquid Cooling Ventilation Garment

The astronaut produces heat from his/her body, especially when doing strenuous activities. If this heat is not removed, the sweat produced by the astronaut will fog up the helmet and cause the astronaut to become severely dehydrated. To avoid it, a mechanism for removal of heat must be there.The mechanism includes three innermost layers which make up the liquid cooling ventilation garment. Beginning from the inner layers, first layer is made of knitted Nylon tricot over which second layer of Spandex material fabric with plastic tubing is laced.Cool water flows through plastic tubes, which eliminates the excess body heat produced by the astronaut. This water comes from either the astronaut's backpack or an umbilical cord leading to the spacecraft as well as recycled water from the sweat of the astronaut and from the water vapor in the carbon dioxide the astronaut exhales.

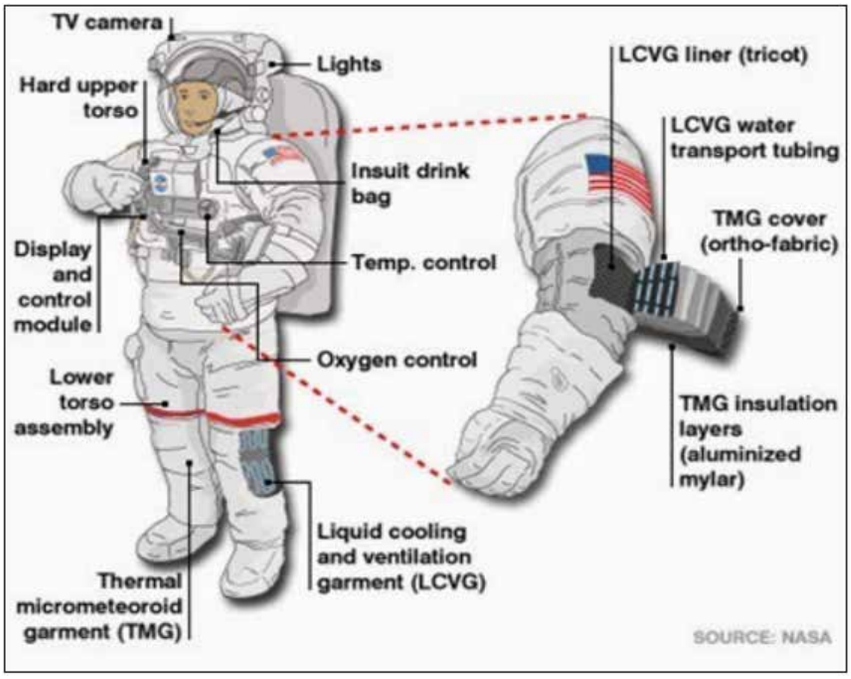

Figure 1 - Different parts of a space suit (EMU)

The Bladder Layer

Above two inner layers is the bladder layer (third layer) which is Urethane-coated nylon fabric and it is considered as the most essential to the astronaut's survival. The bladder layer serves to maintain the proper pressure dynamically to protect the astronaut and it does this by containing the same oxygen that the astronaut will breathe inside of the bladder layer's confined space.Over the third layer, a fourth layer namely the pressure-restraining layer made of Dacron, is laced. These two layers are employed to protect the astronauts from pressures, balancing both internally and externally. These bladders inflate automatically at reduced cabin pressure. However, the degree of inflation of bladder is restricted by some rubberized fabric, in this case, Neoprene-coated fibers which make up the fifth and sixth layers. The restriction placed on the "balloon" portion of the bladder in suit provides pressure on the astronaut inside. The space suit provides air pressure to keep the fluids in the body of an astronaut in a liquid state. Further,without the suit pressing on the abdomen and

the legs, blood would pool in the lower part of the body and cause a person to black out as the spacecraft returns from microgravity to Earth's gravity.

Layers of Mylar Insulation

Next to the sixth layer, there is a series of seven layers of thermal micrometeoroid garment of aluminized Mylar laminated with Dacron. These altogether make thirteen layers of an EMU. This Mylar insulation helps to stabilize the temperature of an astronaut.The final three layers which are exposed to various radiations are made of a blend of Gore-tex, Kevlar and Nomex materials, forming the fourteenth layer of the space suit. This layer is primarily meant to cope with the extremes of the temperature, protect the astronauts from collisions with micrometeoroids and prevent the suit from tearing on exposed surfaces of the spacecraft. Finally, the fabric is covered with reflective outer layers (Mylar or white fabrics) to reflect sunlight. In addition, Mylar also helps to protect the astronaut from various harmful radiations.

ACCESSORIES OF EMU

Almost every aspect of space proves to be an obstacle that the space suit must overcome and as such many parts of the space suit are even more specialized than the layers mentioned above.

Communication Carrier Assembly (CCA)

The CCA is sometimes called the Snoopy Cap. This cap is made up of Teflon and Nylon/Lycra fabrics. The astronaut wears the cap under the helmet. It contains microphones and speakers for use with the radio on the spacesuit. Using the CCA, astronauts can talk with the rest of the crew and hear the caution and warning tones. It allows hands-free radio communications within the suit.

EMU Electrical Harness (EEH)

This is a set of communication wires and bio-instruments that is worn by the astronaut inside the suit. It provides connection to the radio and bio-instruments in the suit's backpack. It allows for communication and for monitoring the astronaut's vital signs (respiration rate, heart rate, temperature etc.)

Maximum Absorption Garment (MAG)

Spacewalking astronauts can spend up to seven hours to accomplish different tasks. During this time, their bodies produce urine. Therefore each spacewalking astronaut wears a large, absorbent diaper to collect urine and feces while in the space unit. It helps in collecting urine produced by the astronaut and its storage during spacewalk. The astronaut disposes the MAG when the spacewalk is over.

Lower Torso Assembly (LTA)

This LTA is a single unit, which includes pants, knee and ankle joints, boots and lower waist. A metal connect ring facilitates its fitting. The LTA has loops to join the tools preventing them from floating away in space4. The outer layer of the boot is made from metal-woven fabric. The boot inner layers are made from Teflon-coated glass-fiber cloth followed by 25 alternating layers of Kapton film to form an efficient, lightweight thermal insulation.

Hard Upper Torso (HUT)

It is a hard fiberglass shell. Fiberglass is used to create a hard upper torso section of the space suit which is strong enough to support the spacesuit's helmet, life support backpack, control module, arms and legs. This is considered as an important assembly from safety point of view.

Arms

Moving with an inflated space suit is tough. To reduce the problem, space suits are equipped with special joints or tapers in the fabric to help the astronauts to bend their hands and arms. Arm unit holds shoulder, upper arm and elbow joint bearings, enabling the astronaut free movement of arms in any direction. The arm units are of various sizes so that they can be fitted to different astronauts.

In-Suit Drink Bag

It is a plastic pouch placed inside the HUT and can hold 32 ounces (1.9 liters) of water and has a small tube something like a straw that is placed next to the astronaut's mouth4.

Gloves

Gloves have wrist bearings for easy movement. They are attached to the arms by quick-connect rings. The lack of gravity in space presents the risk of losing tools or parts during a spacewalk and as such the spacesuit's fingertips are covered with a rubberized material to help the astronaut maintain their grip. Astronauts also wear fine-fabric gloves inside the outer glove units for comfort.The outer gloves have loops on them to tether tools. The extreme cold of space and the sensitivity of extremities to the elements require space suit gloves to have miniature heaters around fingertips 1, 5.

Helmet

Helmets are attached to the spacesuit by a pressure-sealing neck ring.The helmet is made of clear, impact-resistant, durable, polycarbonate plastic, and is attached to the HUT by a quick-connect ring. The helmet is padded in the rear for comfort because the helmet remains fixed rather instead of rotating with astronaut's head. Most helmets have coverings to reflect sunlight.The inside of a helmet is treated with an anti-fog compound before the space walk. Apart from these, it has a purge valve to eliminate carbon dioxide.

Extravehicular Visor Assembly (EVA)

The EVA fits over the helmet. It has the following pieces:

- A metallic-gold-covered visor that filters out sun's harmful rays to reduce glare.
- A clear, impact resistant cover that works in tandem with the helmet for additional thermal protection and protection from impacts that might occur with small space debris.
- Adjustable blinders to block sunlight
- Four head lamps which shine extra light when needed.
- A TV camera

Lithium hydroxide canister

An astronaut breathes out carbon dioxide. In the confined space of spacesuit, carbon dioxide concentration would build up to deadly levels. Therefore, excess carbon dioxide must be removed from the space suit's atmosphere. Space suit uses lithium hydroxide canister to remove carbon dioxide. Lithium hydroxide is used in making the filter which removes carbon dioxide and water vapour during a spacewalk. These canisters are located either in the space suit's life support backpack or in the spacecraft, in which they are accessed through an umbilical cord.

Footholds

In weightlessness condition, it is difficult to move around. If something is pushed by astronaut during work, astronauts fly off in the opposite direction as per Newton's third law. Further the problems become more acute when one tries to turn a wrench, as the operator would then spin in the opposite direction. Therefore, space suits are equipped with footholds and hand restraints to help astronauts in microgravity.

Safety Tethers

An end of several straps is attached to the spacewalker. The other end is connected to the vehicle. The safety tethers keep the astronauts from drifting away into space.

All the above-mentioned fabric-to-hardware connections are made with either mechanical joints or adhesive bonding. Materials used in the construction of spacesuit are selected to prevent fungus or bacteria growth; however, the suit must be cleaned and dried after flight use. The entire suit assembly is rated with a minimum 8-year life expectancy. The nominal operating atmospheric pressure in the suit is 4.3 psi. The maximum total weight of the largest size spacesuit assembly, including the

liquid cooling and ventilation garment, urine collection device, helmet and visor assembly, communications carrier assembly, in-suit drink bag, and biomedical instrumentation subsystem, is around 107 pounds.

CONCLUSION

Space suits must provide comfort and support that the Earth or a spacecraft does, addressing issues like atmosphere, water and protection from radiation. Spacesuits have been modified over the years to be more comfortable for astronauts in negotiating new challenges. Currently, researchers are looking for new materials to build the space suits of the future and we may not be too far from a complete redesign of the modern space suit. With the advent of smart polymer, fibre, Nanocomposite material, shape memory polymer and alloy along with electronics, many improvements are possible in near future. These improvements, taken together, have the potential to revolutionize which suggest that spacesuits of the future may look dramatically different from the current suit. Flexible, lightweight, multi-threat protective materials are needed to provide the durability and protection that will be required in future space suits.

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EMERGING MARKET SCENARIO OF T-SHIRTS IN THE CHANGED ENVIRONMENT

CHANDAN SAHA

Clothing, the basic needs of human being is to cover and to protect the body from nature & external injury in a civilized society. Initially human being used to wear traditional attire but slowly got shifted to modern attire as both human's mood and fashion trend moved in a dynamic way in an open market economy. The trend is experienced quite faster in the recent times as men's wear in various categories got a sea change. 'T' shirt was a new addition in the first half of 1900's and slowly became an attractive wear in apparel category across the consumer segment especially in the developed countries. T-shirt got an access in domestic market initially as especial winter attire and latter it had made an inroad in our wardrobe.

T-shirt is a style of unisex apparel and it is named for it's 'T' shape body and sleeves. It was initially innovated as new apparel with short sleeve and round neck. It reveals in history that innovation of T-shirt could be traced in between 1898 during the Spanish and American war. It was reported that it had become visible, when US Navy army began using the garment for their army men and 'T' shirt came in open market in 1913 in USA. The product had slowly graduated to a regular category of apparel after a few decades. The word 'T' shirt became a part of American English in 1920. T-shirt is commonly popular in Latin American and Mongolian countries and worn by all categories of consumers irrespective of age and sex. Initially it was commonly used by sports person for specific games in India and slowly reached consumers wardrobe in last two decades. Today, it is the fastest growing apparel as it has an acceptance of various segments users for diverse purposes. Market report

Chandan Saha

analysis indicates that till a couple of years back, share of T-shirt is around 8-10% of total apparel market and a major part of the revenue came from unbranded products. It is expected to grow much faster than other apparel products in the coming years.

Various study reports indicated that Global market size of T-shirt across the globe was US$185.1bn in 2016 and it is expected to reach more than US$ 200bn by 2020. India's market is also experiencing a dynamic change in the last decade as life style moves in a rapid changing mode, changing demographic

structure, growing purchase capacity among middle class group and organization's strong attitude to brand building etc. T-shirt was mostly used by the consumers as casual wear till late 90's. It got a boost once the MNCs started using T-shirt as organization/office wear in various promotional activities, campaign for social cause and sports events etc. where company's name or brand name were visible on T-shirt. This had facilitated the multi national company to make their presence visible in the market and used it as a tool to reach consumers. However, majority of such products were commonly outsourced from unknown enterprises, which are usually un-registered and mostly established in tiny and small industry segment. At present domestic market size is estimated to Rs.20000crores (approx.) and it may register a substantial growth in the next decade with the rapid change of life style and growing consciousness of health and body fitness. Of course, traditional T-shirt won't be sufficed to cater the demand hence; it needs to relook on market demand in depth.

Global Apparel market study indicates that China, India and Russia will have a comfortable growth rate in apparel market demand in 2025, whereas; the developed countries will experience a slew in growth. This is perhaps market is slowly reaching a saturated point, but it depicts a different scenario in developing and under developing countries as there is enough room for growth. With the robust growth in economy in the recent years, consumer base in India got widened and consumers demand for clothing got a good start. The market study gives an indication of market size of apparel of various countries and growth rate till 2025.

Table No - 1

Market size of apparel of various countries

Region/ Countries	Year			Growth Rate (%) (CAGR)
	2012	2015	2025	
China	150	237	615	10
EU28	350	350	390	1
US	225	315	385	2
India	45	59	180	12
Japan	110	93	150	2
Russia	40	40	105	8
Brazil	55	56	100	5
Canada	30	25	4	
Australia	25	45	5	
Others		---	510	---

Figures are given above in $US bn.

Source: Global Apparel Market Study Report for 2012-2025 statistics.

It is reported that per capita spending on apparel in developed countries is much higher than Global average spending, whereas it is much less or below global average in developing and under developed countries. Per capita spending in India is also considerably low compared to developed countries and average global spending. So it may not be a surprise, experiencing low spending on T-shirt consumption in India. It reveals from market statistics & data that per capita consumption of T-shirt is hardly around 10% of apparel spending in India, which may get enhanced to 15% in the coming years in the changed environment.

Table No – 2

Per Capita Spending on Apparel in US$

Country	Value in US$
India	37
China	122
Global	163
Brazil	287
Russia	300
EU27	703
USA	725
Japan	885
Canada	887

Source: PCI Analysis 2015 report.

It is reported that developed countries consume nearly 48 percent of the total T-shirts across the globe and Canada, America and UK are the leading users of such product. Asia Pacific region is the up coming market in near future as these countries are registering an impressive growth in the changed environment. India is one of

the fastest growing countries among Asia pacific countries. As per information available it is experienced that a few Developed and developing countries remained the leader of T-shirt consumers across the globe in 2015 as T-shirts are commonly used by consumers of all segments in diverse purposes.

T-SHIRT INDUSTRY AT A GLANCE

T-shirt is a derivative of Shirt and it had been innovated after a few decades of shirt innovation. Shirt was innovated in 1831 in UK and T-shirt was innovated in 1913 in USA It is experienced that T-shirt industry is totally in fragmented in structure. There is no information on estimated units involved in manufacturing T-shirts in India. Manufacturing activity has remained an integral part of apparel industry till date though there is a rapid change in cutting & stitching style and quality of raw materials. There are only a few units fully engaged in manufacturing T-shirts in the country.

At present 'T' shirt industries are mostly concentrated in Tirupur, Ludhiana, Mumbai and Delhi including NCR etc. There was hardly any existence of a unit in organized sector initially, it was in early 90's/ late 80's a few enthusiastic entrepreneurs had made a humble beginning in manufacturing T-shirt. Till late 90,s, organized units were finding it a tough task to establish their brand in absence of strong visible market. The T-shirt industry got a boost only around the year 2000, when various organized sectors and multi national companies started using T-shirt as office wear for diverse categories of staffs as well as various promotional activities were undertaken by big companies for the social cause, where T-shirt was a unique choice to all participants. This has spurted a huge demand in the domestic market. Besides, sports wear also got a big jump during this period as a good no. of MNCs started campaigning of their products by organizing various sports activities and campaign for body fitness. These organizations initiated the process of outsourcing products from domestic vendors, framing quality parameters. This was the beginning of huge activity of manufacturing T-shirt industry in India. In the recent years a few big players made an inroad in the domestic market, launching their products in various segments.

There is no doubt Govt. Reservation Policy was to some extent responsible to create hindrance to growth. The policy got an amendment in 1993, which enable the manufacturers to invest at scalable level. It was after 2000, policy maker took a U turn in the liberalized regime and rules & regulations slowly got modified and later on abolition of reservation policy pave the way for established company to invest in manufacturing of such product without any export obligation. It has also made it easier to the leading domestic manufacturers to invest conveniently in manufacturing of readymade garments including 'T' shirt and place it for domestic consumption. This has resulted in availability of T-shirt at an affordable rate with an assured quality. It is expected that there will be enough room for growth of market for T-shirt as it is worn by both sex and kids.

EMERGING MARKET SCENARIO

It is reported that T-shirt industry is growing faster than any other apparel sector because of market demand in the changed environment. India's market for T-shirt is still on a high growth trajectory and there are huge opportunities to grow at a faster rate. Various studies indicated that growth rate of T-shirt in both categories of consumers will be around 12-13% whereas market of other apparel will grow below 10%. Though per capita consumption of T-shirt is still very low in India but industry is experiencing a

growing demand because of changed life style, improved health consciousness, strict rules & regulations imposed in industrial safety and organization brand building attitude etc.

T-shirt market of India that includes kniT-shirts, Polo shirts, knit tops and other athletic wear etc. and the market is dominated by men & boys' segments. It is reported that 83% of total market share is catered by male consumers. At present consumption ratio of T-shirt in respect of woven shirt in India is 1:2.5 whereas in Japan, USA and EU it is 1.8-2.0. It indicates the low consumption rate of T-shirts in India. It was around Rs.13830crores in 2014 and the market is expected to grow at an impressive growth rate 13% to reach Rs.24940crores in 2019. India's T-shirt market is estimated to reach approximately Rs.61954crores in the next decade with a growth rate of around 12%. Study reveals, T-shirt market is getting widened encompassing variety of Sports shirt, Office wear, Casual wear, Uniform and Industrial wear etc. Besides, there is a growing attitude to use T-shirt among the small and medium category traders and service providers in prominent market to make the company's visibility strong and also to improve outreach.

It is reported that Global market of T-shirt was US$ 185.1bn in 2016 with a CAGR of 6% for the period of 2017-2025 and it is expected to grow at the level of nearly US$300bn by 2025. Looking at the Global consumption of T-shirts per Capita including India, it appears that there are only few countries having a bigger per capita consumption compare to other countries. A few developed countries like India and China may have significant consumption in terms of no. of pieces but per capita consumption remains below average due to big no. of population and seconds users.

Table No - 3

Per capita consumption of various countries

Country	Per Capita consumption (No. of units)
USA	9.8
UK	9.7
China	0.6
Canada	14.1
Global(average)	1.3
India (Estimated*)	0.3
Developing Countries (Average)	0.3

Table No - 4

Consumption of 'T' shirts in various countries

Country	Consumption (in no. of pieces in Million)
US	3150
China	850
UK	625
Canada	506
Australia	1131
India (Estimated*)	400

Source: T-shirt Market Study report on Global trade, Growth, Trends and Insight.

With the expected growth rate of consumption in domestic market and global consumption rate, it appears that India has got ample opportunity to tap the market. Indian manufacturers have to gear up to face the challenges ahead to make an inroad both in domestic and global market.

CONCLUSION

It is experienced that consumers purchase capacity rapidly grows in a developing economy and thus market grows much faster than other countries across the globe. India is no way exceptional. Uses of T-shirt were confined mostly as Casual wear till 90's in India. Consumers life style in the changed environment had got a sea change in per capita consumption last two decades and there is a spurt in growth in consumption of T-shirt and is expected to register an exponential growth in the next decade. T-shirt was an important item of India's clothing export basket till 2004 in quota regime. Market demand of T-shirt was quite strong in various overseas countries. It is also reported that growth rate in men's wear will be much faster than women and kids. Hence, there is strong need for innovation

in design, geometrical structure, materials selection and adoption of updated technology to manufacture the variety of products to improve comfort and stress release etc. Indian manufacturers have to take a U turn from the existing manufacturing facilities to attain the improved features to meet the consumers' desire and for a sustainable growth.

ABOUT THE AUTHOR

Chandan Saha is a Technocrat cum Management professional. He had worked in Industry; Research Institutes nearly a decade and later joined in Govt. of India. Total experience of 38 years in industry and research activities and the recipient of prestigious Er. Sadanand Memorial Award and Fellow of Institution of Engineers India. He has an attachment with various technical and professional institutes and academic institutions at various capacities for more than 30 years. He had made a significant contribution in industry promotion, product innovation, skill development and adopting and practicing modern management tool in MSMEs etc.

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Nano-Fibrous Nonwoven Fabric; A Wonderful Solution for Personal Protection against Air Pollution

MONTU BASAK

ABSTRACT

Air pollution is a major issue that the world is witnessing right now. Its impact on the environment as well as on public health is enormous and is increasing at an alarming rate because of unmindful usage of natural resources, improper combustion of fossil fuel and taking minimal efforts to mitigate the pollution. Several control mechanisms have been explored, developed and used to curb the dangerous effects of air pollution for environmental as well as personal protection. Nano-fibre based nonwoven solutions have been proved functionally as well as aesthetically excellent among the others for providing protection against the polluted air. This article discusses about the characteristics of these nano-fibrous nonwoven fabric as a protecting filter media and their performances for protecting human health against air pollution.

Keywords: Nano, Filtration, Nonwoven, Electro-spun, Textile, Air Pollution, Pollutants, Personal Protective Equipment, Respirator, Filters.

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INTRODUCTION

The history of air pollution, both natural and anthropogenic, has, in some way, reflected the history of human needs. Human-driven activities aimed at providing necessary supports to the basic human needs has led to this grave situation of anthropogenic air pollution, today. Air pollution emissions occur at many stages in product's life cycles. The resulting emissions undergo several types of physical and chemical transformations and contribute to a wide range of health and environmental impacts, such as deterioration of air quality, toxicological stress on human health and ecosystems, photo-oxidant formation (smog), stratospheric ozone (O_3) depletion, climate change, degradation of air resources and its quality, among others. These wide-ranging and deleterious effects of air pollution, especially on human health is currently major issue for the global community. The Global Burden of Disease study has described the worldwide

impact of air pollution with reports of 3.1 million all-cause and all-age deaths being attributable to ambient air pollution in the year 2010. Moreover, ambient air pollution ranked 9th among the modifiable disease risk factors and accounts for 3.1% of global disability-adjusted life years, an index that measures the time spent in the states of reduced health. A recent report published by World Health Organisation (WHO), more than 90 per cent people on Planet Earth breathe dirty air and 1 in 9 deaths around the world are due to conditions caused by air pollution. Out of 6.5 million deaths around the world, 1.6 million occurred only in India due to poor quality of air.

Environmental and air pollution has been described as a greater threat for mankind than communicable diseases. Several research reports have been published all around the world about the serious impacts of air pollution and its significant contribution towards the damage of public health. It acts as an important stimulus for the development and exacerbation of respiratory disease such as asthma, chronic obstructive pulmonary disease and lung cancer (please see the Fig.1). Alongside these affects, long-term exposure to air pollution, which has risen to alarming levels in the past years, likely to cause serious impacts on the cardiovascular activity in human body, brain and mental development in children and adolescents, kidney failure (according to American Society of Nephrology) too, have been reported in various published journals.

Fig. 1: Established outcomes of short-term and long-term exposure to air pollutants (gaseous and particulate)

$PM_{2.5}$ (a particulate matter; described in details in later section) is particularly harmful because its size is very small and can penetrate the human lungs and go into the body circulation system (please see Fig. 4). Along with these solid and gaseous particulate pollutants, even smaller biological pollutants like bacteria, viruses are also causing air pollution, penetrating into human body while breathing, leaving serious impact on people's living quality and posing serious threats to the public life.

AIR POLLUTION; ITS MAIN POLLUTANTS & SOURCES

Due to rapid economic growth and industrialization, air, in the atmosphere, is being maltreated and polluted by various human and industrial activities for fulfilling people's consumerist demand without understanding its future implications. In the process, they contaminated air with particulate matter (PM) and gaseous pollutants like ozone (O_3), nitrogen dioxide (NO_2), volatile organic compounds (including benzene), carbon monoxide (CO), and sulphur dioxide (SO_2) as well as different types of volatile organic compound (VOCs) such as BTX (benzene, toluene and xylene), dichloromethane, and trichloroethylene, etc. The emission of VOCs has harmful impacts like eye & throat irritation, damage to liver, central nervous system and also have carcinogenic effects.

Major sources of air pollution are combustion of fossil fuel and emission from motorised road traffic, power generation, industrial operations, residential heating using oil, coal and wood, etc. Among pollutants, primary pollutants like particulate matter (PM) consists of particles from wide variety of sources that differ in sizes (please refer Fig. 2) and composition. Secondary pollutants like ozone is generated by complex photochemical reactions of nitrogen oxides and volatile organic compounds. PMs are generally classified into three categories; coarse particles (diameter <10 and ≥2.5 μm, PM_{10}), fine particles (diameter

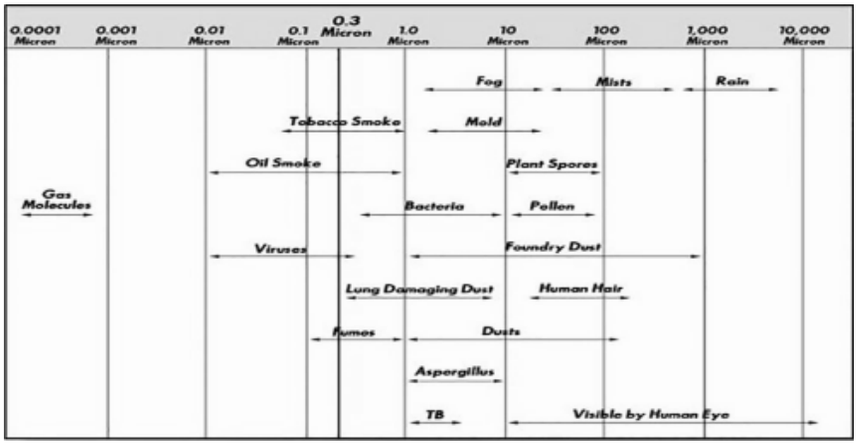

Fig. 2: Comparative size chart of different particulate matters in the air

Fig. 3: Size comparison of PM 2.5 and PM 10 against the average diameter of a human hair (~70 µ m) and fine beach sand (~90 µ m) (Source: Guaita et al., 2011).

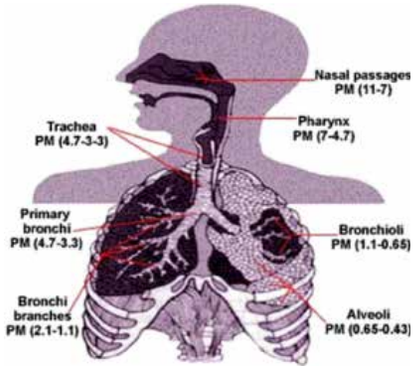

Fig. 4: Deposition potential for particles of varying sizes in micron (µm) (Source: Londahl et al., 2006)

<2.5 and ≥0.1 µm, $PM_{2.5}$) and ultrafine particles (<0.1 µm) (Fig.3).

Depending on the sizes and their distribution in the atmosphere, different control mechanisms and devices are developed and deployed to curb the menace of air pollution and have been discussed in details in the following sections.

CONTROL MECHANISM AND DEVICES

The particulate matter in air has become a serious environmental issue which calls for immediate attention by the researchers around the world and devise new and newer efficient technologies that can mitigate its serious impacts on the environment as well as on public health. Most people live, work and enjoy their leisure activities in densely populated environments, which increase their exposure to many types of pollutants and pathogens. It reduces the well-being of the population and has a powerful economic impact due to reduced quality of life, absenteeism due to sickness and reduced productivity in the work place. Therefore, the necessity for clean and quality air has now become a must, not only for quality life for the public but also for large number of industrial processes that provide and fulfil many basic and essential needs for human life. Certain industrial operations extremely rely on clean air of exceptional quality. Besides these needs, the stringent regulations in place by the Government bodies for controlling fine particle emission have also necessitated the requirement to control and manage the quality of air.

Therefore, to remove the airborne PMs in air stream and to provide protection against them, filtration of air has been recognized as an essential control mechanism. Filtration has been used in diverse applications such as cleaning the exhaust air stream in many industrial, nuclear and hazardous material processes as well as providing respiratory protection for human health and clean rooms. Filtration is also an absolute need for the medical and biological fields also where they rely on highly purified sterile air.

Filter devices are designed and developed based on the principle of this filtration mechanism, which is generally deployed for providing clean air for people's breathing. Various types of fibrous

filters (mechanical and electret) and nano-fibre based filtration membrane are used in different applications for cleaning air, especially giving protection against human respiratory activities. Respiratory protective devices (RPD) are generally used to protect people from respiratory hazards, such as particulate matters in the inhalation air including chemical, biological and radioactive materials. Filtering Facepiece Respirators (FFR) are the examples of such respiratory protective devices that protect human respiratory tract from air borne particulate exposure.

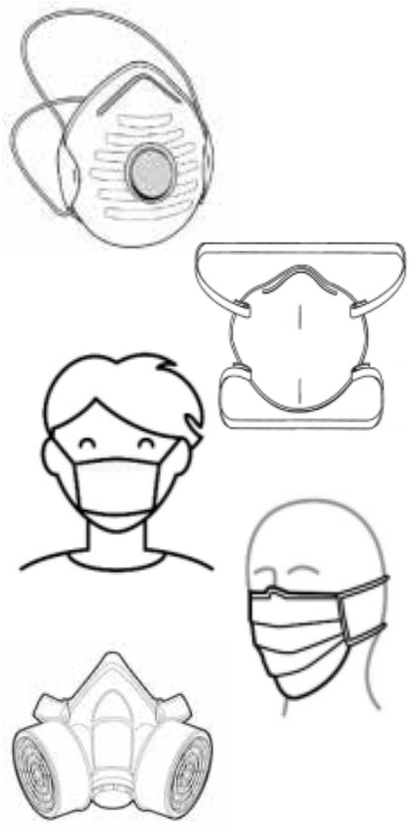

Fig. 5: Different Types of Filtering Face-piece Respirators (FFR) used for human protection

National Institute of Occupational Safety and Health (NIOSH) certify these FFRs into the following nine categories:

- N-type: N95, N99, N100,
- P-type: P95, P99, P100, and
- R-type: R95, R99 & R100

It is to be mentioned here that N (not resistant to oil) means that the respirators cannot be used in an oil droplet environment; R (somewhat resistant to oil) and P (strongly resistant to oil) mean these respirators can be used for protection against nonoily and oily aerosols respectively. Numerical designations 95, 99 and 100 show the filter's minimum filtration efficiency with 95%, 99% and 99.97% respectively.

In the same line, the European Standard (EN 149:2001) have classified FFRs into three categories as below:

- FFR 1: Minimum filtration efficiency as 80%
- FFR 2: Minimum filtration efficiency as 94%
- FFR 3: Minimum filtration efficiency as 99%

NANO-FIBROUS NONWOVEN AND RESPIRATORY PROTECTION AGAINST AIR POLLUTION:

Conventional micron-sized nonwoven fibrous and sub-micron electrospun nano-strctured fibrous materials are generally used as filter medium in fabricating different filtering equipment or devices. Conventional fibrous filter media has many limitations that are unable to overcome, owing to its micro sized fibre diameter (several to tens of micron) and resultant large pore size, including relatively low filtration efficiency, bulkiness and low quality factor, especially for filtrating ultra-fine air borne particles.

To optimize the efficiency of those conventional nonwoven fibrous materials, researchers, around the world, designed and fabricated a novel and wonderful material called as nanofibers. A comparison of nano fibre with conventional fibre is shown in the Fig.6

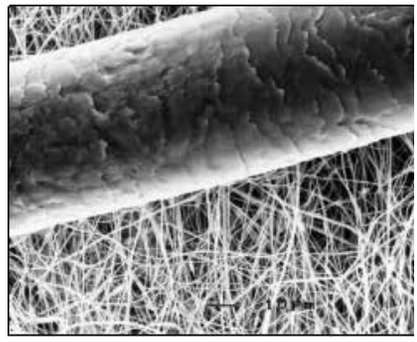

Fig. 6: Comparison of Nano fibre with conventional fibre

These nanofibers 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. Nanofibers, on the

other hand, due to its inherent properties like diameter in sub-micron size, higher surface area with better porosity find huge applications in high-performing and functional areas in the likes of filter medium, adsorbing layers in protective devices, tissue-engineering, drug-delivery, optical electronics to name a few.

Ideally, an air filter used for personal protection should have high air flux with low resistance yet high PM filtration efficiency. Nano-fibre based nonwoven filter media can offer these functionalities with much lighter basis weight due to their significantly reduced fibre diameter (100-800 nano-meter nm) and pore size. Decreasing fibre diameter of the nano-fibres leads to better contact with the pollutants and thereby leading to greater ability to capture submicron particles and ultimately better filtration efficiency for the filter devices the removal of smallest, ultra-fine particulate biological aerosols like bacteria and viruses. Due to these unique characteristics, electrospun nanofiber materials are widely used in human respiratory protective devices. The higher surface area of the nano-fibrous web can provide reactive sites for chemicals and biologicals elements, making it a good candidate for chemical as well as biological protective materials. Sub-micron, nano-pores of the nano-web provides good moisture and vapour transport properties, which can be suitably applied in personal and human protective respiratory wears in fighting with the menace of air pollution.

CONCLUSION AND FUTURE DIRECTION

There are now abundant evidences that air pollution has severe health impact on human body. In light of these evidences, air pollution no doubt has taken a front seat in every discussion relating to climatic change and environmental pollution. Government policies are also in place for violators that violate the ecological rules in nature and contaminates the air. It is the onus of the policy makers who need to make sure this legislation is implemented in reducing the impacts of air pollution on the Mother earth.

Several steps have been taken and various efforts have been exercised to curb this air pollution. Reduction in personal and peer exposure to airborne pollutants can be achieved through simple measures such as:

- Travel by walking, cycling, and public transportation, should be preferred to car or motorbike.
- Avoid inefficient burning of biomass for domestic heating,
- Avoid walking and cycling in streets with high traffic intensity, particularly during rush hour traffic,
- Exercise in parks and gardens, but avoid major traffic roads,
- Limit time spent outdoors during highly polluted periods, especially infants, elderly, and those with cardiorespiratory disorders
- Consider ventilation system with filtration for homes in high pollution areas
- Innovation in design of architectural buildings, offices and apartments so that they can help purifying the atmospheric air and release fresh air to environment.
- Several other devices and equipment that could be designed and put up in densely polluted public places so that they can help clean the atmospheric air.

It is the time now that air pollution needs to be dealt with meticulously with long-term strategic vision for providing a safer, greener environment to our future generation and if we fail to do so, then it's going to present us a big gas chamber full of hazardous and harmful gases that are going to surely affect everyone, irrespective of their status, power and economic strength in developed and developing countries alike.

ABOUT THE AUTHOR

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Design department at NIFT, Kolkata. His research interest involves material innovation in the field of nonwoven & technical textiles and their application in healthcare products. Currently, air pollution and its filtration by high performance nonwoven material are his research focus. Besides, being a person from the Handloom Weaver's family, he feels obliged for the holistic development of the Handloom industry. He is working on a research project for ease operation of the Handlooms.

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REDEFINING THE ART OF SHIRT MAKING FOR METROSEXUAL PROFESSIONAL MEN

K.N. CHATTERJEE, YAMINI JHANJI, SHELLY KHANNA

ABSTRACT

Apparel and accessory industry has been taken by storm and witnessing exponential growth as today's metrosexual professional men like to pamper themselves with the latest trends in apparels and accessories which was earlier considered to be forte of females. The changing tastes and preferences of males have paved the way for designers and manufacturers to experiment with an array of color palettes, themes, prints and motifs for men's wear. The need of the hour is innovation and creation of something trendy yet elegant in the pursuit of fulfilling needs of metrosexual male who like to pop up, mix and match formal and casual look alike. Therefore, shirt making process is being revolutionized as per the target consumer group and still offers huge potential for further refinement. One such concept is the blending of traditional art with the men's formal shirts, kurtas, and shirvaanis by hand block printing, tie and die, batik and hand painting.

Hand crafted articles are hot selling products irrespective of gender owing to their inquisitiveness and cultural, rustic association particularly in country like India which is known for rich culture and heritage. The present paper attempts to redefine the art of shirt making by incorporation of ethnic tinge to men's shirt via technique of hand painting particularly - the art of madhubani painting. Madhubani painting is the traditional style developed in the surrounding villages of madhubani in Mithila region, Bihar. The skill is handed down through generations, & hence the traditional designs & patterns are widely maintained and being used in textiles as well. The beauty of madhubani paintings stay afresh in our spirits however, a lot needs to be done to revive and

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promote this traditional folk art on national and international platform especially if it can be brought to mainstream by incorporation in designing of men's apparels.

Keywords: Shirt, Plaids, Formal, Casual, Heritage, Madhubani, Folk, Culture.

SHIRT MAKING PROCESS-DESIGNING, TAKING MEASUREMENTS & PATTERN MAKING

Shirt making is quite labor intensive and technology driven industry where complete shirt making may take several operations before the shirt is in final stage to be packed and shipped. A lot of research and development therefore goes into shirt making process. The processes involved in shirt making begins with the conceptualization of design by designer taking inspiration from several sources like flora and fauna, prints based on figurative images, plaid fabrics etc. A change in style and design details can render the shirt a casual or formal look. Collar type, neckline, type and length of sleeve, hem shape and length and variation in type of closures are several elements which designers explore in creating new look in men's shirts. Several measurements like collar, chest, sleeve length, half hip measurement, half waist measurement, half bicep, arm hole, yoke and cuff are required for making shirt's patterns (Figure 1).

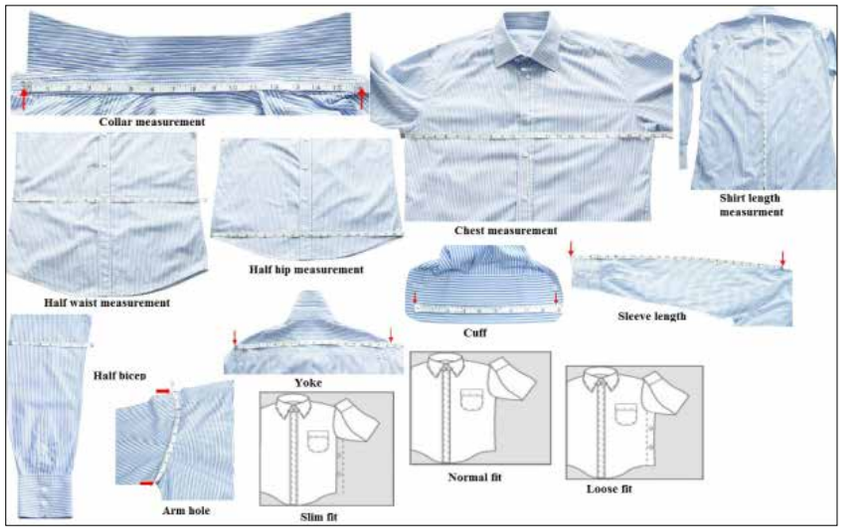


Figure 1 – Various measurements required for shirt construction

Shirt Part / Size	XS	S	M	L	XL	XXL
Collar	14 1/8"	15"	15 3/4"	16 1/2"	17 3/8"	18 1/8"
Shirt length	28 3/4"	29 ½"	29 1/2"	29 1/2"	29 1/2"	29 1/2"
Shoulder width	16 7/8"	17 ¾"	18 1/8"	18 7/8"	19 1/4"	20 1/8"
Sleeve length (Normal)	25 1/4"	25 5/8"	25 5/8"	26"	26 3/8"	26 3/4"
Sleeve length (Extra long)	27 1/8"	27 ½"	27 1/2"	28"	28 3/8"	28 3/4"
Chest	37 3/4"	39 3/8"	41 3/4"	44 7/8"	48"	51 1/8"
Waist	33 7/8"	36 ¼"	39 3/8"	42 1/2"	45 5/8"	48 7/8"
Sleeve width (at armpit)	9 1/2"	9 7/8"	10 1/4"	10 5/8"	11 3/8"	11 3/4"
Cuff	9 1/2"	9 ½"	9 7/8"	9 7/8"	10 1/4"	10 5/8"
Hip width	37"	38 5/8"	41"	44 1/8"	47 1/4"	50 3/8"

Figure 2 - Size chart for Men's slim fit shirt

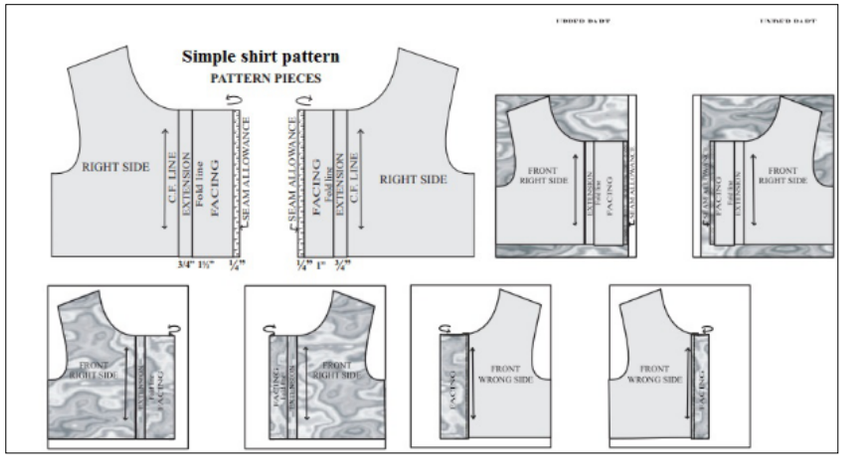


Figure 3 - Shirt pattern with facing & Placket

The measurements can be taken from live models for tailored, customized shirts while standardized size charts are used for taking measurements and making patterns in garment production houses. Figure 2 shows the size chart followed for men's slim fit shirt and Figure 3 shows the placket, facing and pattern for men's shirt. Figure 4 shows the components and design elements of the front and back portion of men's shirt like darts, side pleats, armhole, collars, sleeves and placket.

The first prototype shirt sample made by assembling the cut garment components as per size specifications is sent for approval to client and thereby goes into bulk production. Progressive bundle system is followed in garment manufacturing units for shirt manufacturing so as to ensure all the operations can be meticulously performed fulfilling the quality, quantity and economic parameters as per the deadline set by the clients. In this system, bundles consisting of shirt parts are needed to complete a specific operation. For example, an operation bundle for pocket setting might include shirt fronts and pockets that are to be attached. One operator is expected to perform the same operation on all the pieces in the bundle, retie the bundle, process coupon, and set it aside until it is picked up and moved to the next operation. Under this system of assembling shirt, the sewing room would have a number of sections, each containing versatile operators capable of performing the operations required for a specific component. Figure 5 shows the progressive bundle system followed for shirt making.

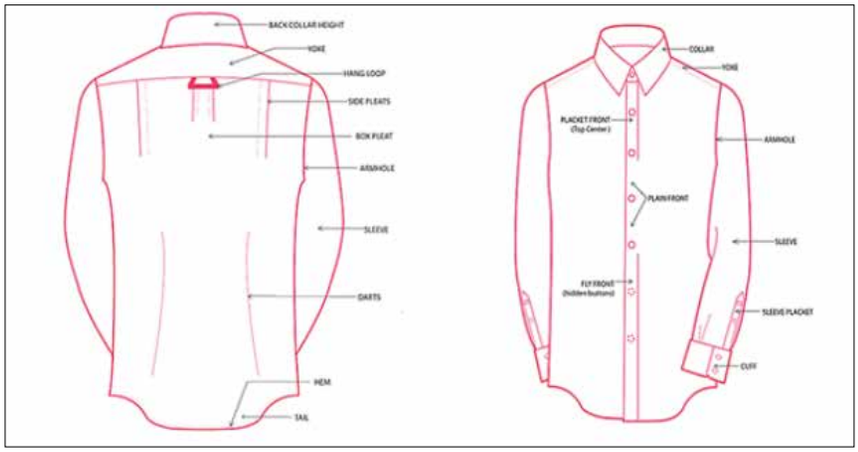


Figure 4- Components of Men's formal shirt

CUFFS	CUFF HEM	BUTTON HEM	
	CUFF R/S	CUTT R/S	
	CUFF TURN / TRIM	CUFF FINISH	
SLEEVES	SLEEVE OPEN	CUFF SETTING	ASSEMBLY II
	SLEEVE PLK ATTACH	CUFF SETTING	
	SLEEVE PCK FINISH (B)	SIDE TOP STITCH	
	SEELVE PCK FINISH (C)	SIDE ATTACH	
COLLAR	COLLAR R/S	SLEEVE T/S	
	COLLAR TURN	SLEEVE ATTACH	
	COLLAR TOP IRON	SLEEVE SETTING	
	COLLAR T/S	COLLAR FINISH	
	PICK A HEM	COLLAR FINISH	ASSEMBLY I
	PICK ATTACH	COLLAR ATTACH	
	PICK CUTTING	COLLAR SETTING	
	POCKET IRON	SHOULDER T/S	
FRONTS	POCKET HEM	SHOULDER ATTACH	
	POCKET MARKING	SHOULDER JOIN SET	FRONT
	POCKET IRON	POCKET ATTACH	
	FRONT BUTTON PLK HEM	BACK YCKE LABEL	
	FRONT KAJA PLK HEM	BACK YCKE T/S	BACKS
	FRONT PLACKET FUSING	BACK YCKE ATTACH	

Figure 5 - Progressive Bundle system for shirt making

Figure 6 –Prints, pocket detailing in shirts to suit the needs of metrosexual men

Figure 7 - Even, uneven plaids fabrics for men's shirts

FABRIC & SUNDRIES SELECTION FOR MEN'S SHIRTS

Woven fabrics constituted of cotton, polyester, PET/C, PET/V, linen, silk fibers are preferred choices for men's shirts with consideration of comfort, drape, fit and aesthetic appeal. Denim, Corduroy fabrics are also preferred for autumn/winter men's collection. White and pastel shades are colors of choice for men's summer wear while warm colors like blacks, blues and browns dominate in winter wear shirts for today's metrosexual males. Plain, even and uneven plaid, camo print fabrics and denims – stone washed etc are conventional fabrics extensively being used for men's shirts (Figures 6 & 7). Two hole, four hole sew through buttons, shank buttons, snap fasteners, velcro, interfacing, lining are generally used trims and notions for men's wear.

VALUE ADDITION TO SHIRTS BY HAND PAINTING TECHNIQUE

Inclination of today's men towards latest trends and no reservations against choosing bright shades with floral, geometrical prints and big motifs has fostered designers and manufacturers to experiment with printed fabrics, tie and die, batik, hand painted fabrics for designing men's wear particularly for fusion of casual and formal look. Value addition to an ordinary, boring looking shirt can be accomplished by surface ornamentation techniques like unconventional use of trims and notions on neckline, sleeves and hemline, hand painting. The placement of ethnic motifs inspired from madhubani, warli and kantha art work renders ethnic, traditional look to a formal white shirt. The following section describes the madhubani technique, motifs used and the implementation of this traditional technique on men's shirt redefining the art of shirt making and rendering trendy, appealing look.

Madhubani painting is a traditional folk art of region of Bihar. Madhubani means a "Forest of Honey".

The wall-paintings or Mural paintings are popularly known as Mithila painting or Madhubani painting. The tradition of Madhubani painting of Bihar has continued unbroken to the present day and has yet evolved with the times. The themes for the paintings are taken from native mythology, legends & history. Madhubani painting is an emblematic expression of day-to-day experiences and beliefs. The attributes characterizing almost all Madhubani paintings are:-

- Use of bold natural and artificial colours.

Figure 8 - Madhubani paintings with motifs inspired from flora, fauna & deities

Figure 9 - Value addition of formal shirts by madhubani painting

- A double line border with simple geometric designs or with ornate floral patterns on it.
- Symbols, lines and patterns supporting the main theme.
- Abstract-like figures, of deities or human.
- The faces of the figures have large bulging eyes and a jolting nose emerging out of the forehead.

INSPIRATION FOR MOTIFS & COLOR CHOICES IN MADHUBANI PAINTINGS

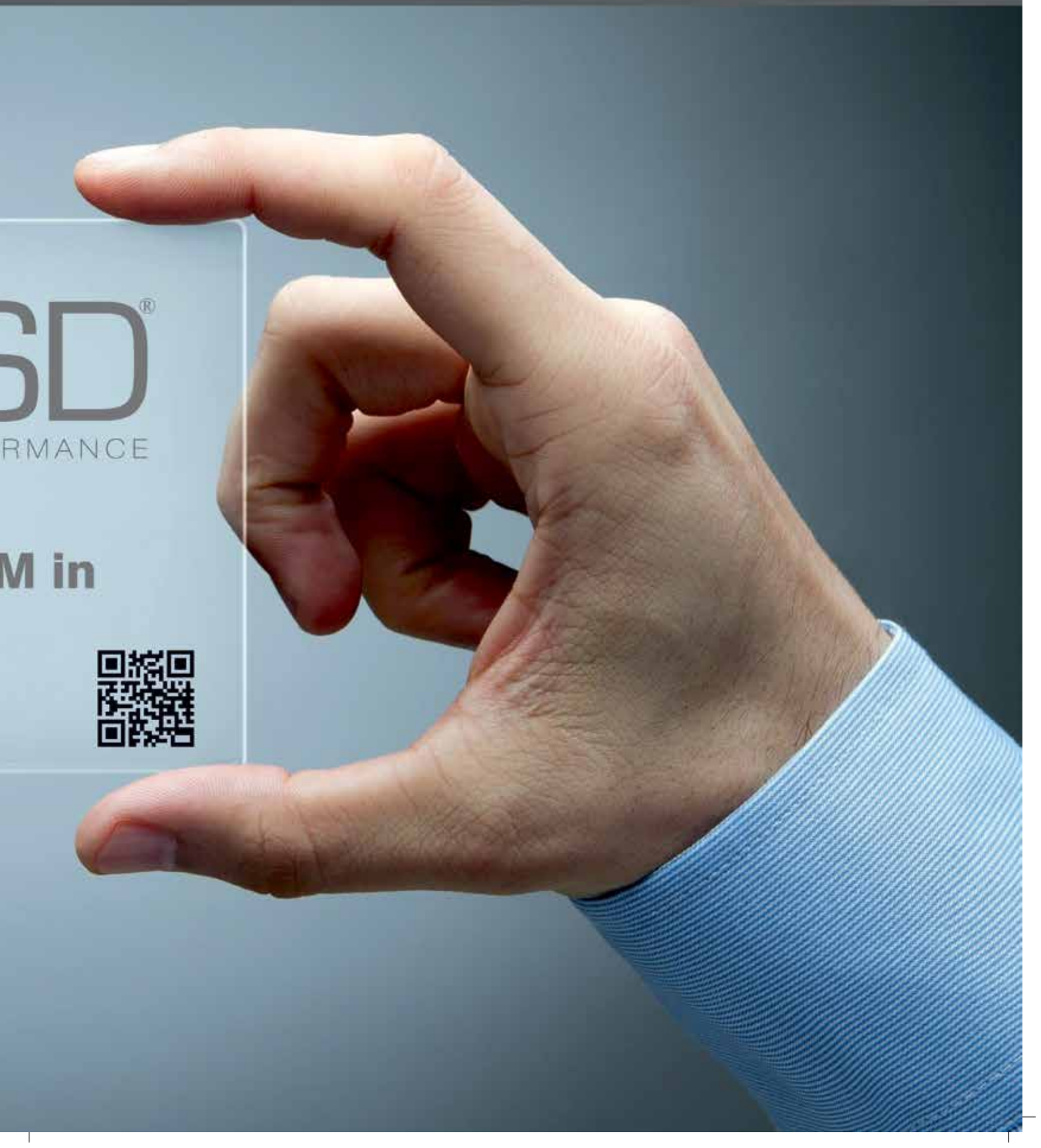
There are images of birds & animals with natural phenomena and human forms including various Gods & Goddesses. The subject matter varies according to the occasion. God –Goddess such as Vishnu-Lakshmi, Shiva-Parvathi, Rama-Sita, Krishna-radha etc. as shown in Figure 8. In other forms, the flora, fauna, myth & legend, social customs m& expressions giving ritualistic symbols are painted. In these paintings include flower (Lotus tree, bamboo forest etc.)

Colours for Madhubani painting are used according to religious symbolism. Initially all vegetable dyes were used for the painting but today artists have access to a variety of poster colours as per the needs. These paints have a narrow range of colours; generally, Gulabi (Pink), Peela (Yellow), Neela (Blue), Sindhoora (Red) & suga Pankhi (Parrot Green). Colours used in Madhubani paintings are usually deep red, green, blue, black etc. Besides deep colour they also apply light yellow, pink & lemon.

Till date the artisan of Madhubani paintings used colours directly from nature. Lamp soot served as a source of black, white from powdered rice, green was made from the leaves of the apple tree and Tilcoat, blue from the seeds of Sikkot and indigo, yellow was drawn from the parts of singar flower or Jasmine flower, bark of peepal was boiled to make a part of saffron colour, red was made from kusum flower and red sandal wood. The brightness and longevity of paintings was ensured by addition of gum with color. However, the use of synthetic color and modern round brushes are replacing the cotton tipped bamboo sticks and stiff twigs that used to serve as brushes still a few years back. Artists skilled in this art at first make rough sketch then detail drawing of subject matter is completed with bold straight and curve lines. Finally, the drawing is filled with different colours whenever it is required. The colours in the paintings are applied flat and the figures are rendered with double outlines with the space in between

TRANSPARENCY W

vith COOPERATION



filled with thin crosshatchings or slanting lines.

The traditional art form is enjoying popularity in women ethnic and fusion wear. Likewise, the inquisitive and beautiful technique is being employed to embellish men's attires as well. Figure 9 shows the strategic placement of bright, colorful madhubani motifs on pockets, bodice of shirts and t-shirts reaffirming the elegance of men's apparel. The effect can be created by one of the innovative printing method i.e. digital printing however the uniqueness and brightness of colors is more fascinating following the conventional hand art technique.

The art form has potential of expansion in different categories of clothing irrespective of age and gender of consumers thus redefining and converting the otherwise simple looking apparel into a masterpiece of traditional ethnic brilliance.

CONCLUSION

Shirt making process is an art demanding skill at the hands of designers, manufacturers and operators involved at each of the manufacturing steps. The industry is undoubtedly technology driven and is a promising profit making venture for garment units. Change in preferences, tastes and liking of today's fashion conscious metro sexual males has paved the way for experimentation in selection of fabrics, sundries, value addition and embellishment techniques for shirts. It is thus possible to modify the look of shirt by hand painting techniques like use of madhubani motifs either throughout the bodice or along pocket, placket, cuff and yoke of men's shirt thereby rendering trendy yet elegant appeal. Madhubani paintings are a blend of aesthetic appeal, rich Indian traditions and heritage. Whole new surge of reviving the traditional Indian craft forms, modern and experimental touch to the art forms prompt implementation of these art forms to men's apparel so that fashion conscious, metro sexual yet heritage loving males can connect to their roots and stay trendy at the same time.

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Industry 4.0 - A glimpse of the near future

SUBHADIP DUTTA

Industry 4.0 is the label given to gradual combination of traditional manufacturing and industrial practices with the increasingly technological world around us.

This includes using large-scale M2M and Internet of Things (IoT) deployments to help manufacturers and consumers alike increased automation, improved communication and monitoring, along with self-diagnosis to provide a truly productive future.

Factories will become increasingly automated and self-monitoring, self analysing and will communicate with each other and their human co-workers, empowering companies with much smoother processes that free up workers for other tasks.

Industry 4.0 is not a new technology, nor it is a business discipline, but in fact a new approach to achieve results that was not possible 10 years ago, thanks to advancements in technology.

Some will also tell you that it's in fact the fourth industrial revolution - but what does that mean?

The first industrial revolution (Industry 1.0) saw Britain move from farming to factory production in the 19th Century. The second (Industry 2.0) spanned the period from the 1850s to World War I and began with the introduction of early electrification of factories and the initiation of mass production. The third industrial revolution (industry 3.0) refers to the change from analogue, mechanical, and electronic technology to digital technology that took place from the late 1950s to the late 1970s.

The fourth, then, is the move towards digitalization. Industry 4.0 will use the Internet of Things and cyber-physical systems such as sensors. Secondly, the advancements in big data and powerful analytics means that systems can scan through huge sets of data and produce insights that can be acted upon quickly.

Subhadip Dutta

A German government memo released way back in 2013 was the first time that 'Industrie 4.0' was mentioned. The high-tech strategy document outlined a plan to almost fully computerise the manufacturing industry without the need for human involvement.

Angela Merkel, the German chancellor, spoke glowingly of the concept in January 2015 at the World Economic Forum in Davos, calling 'Industrie 4.0' the way that we "deal quickly with the fusion of the online world and the world of industrial production."

Some estimates suggest that the component markets of Industry 4.0 are estimated to be worth more than US$4 trillion by 2020 creating millions of jobs globally.

Much of this is down to the thirst for higher productivity and cost reduction by using real-time data. This can also be another area where technologies of the future, such as 5G, will have an effect and make sure the "things" buzz away at optimum efficiency.

Our humble textile industry and apparel manufacturing factories too have geared up to welcome this initiative. Example: Many of us have seen video being circulated in social media about the fully automatized spinning & yarn dyeing unit somewhere in China. This leads to a gamut of opportunity for retailers buying from them to reduce cost & improve price-quality ratio.

ABOUT THE AUTHOR:

Subhadip Dutta is currently working in Decathlon India since 2007. At Decathlon India, he holds the role of process team manager. He holds a B. Tech in textile technology from College of Textile Technology, Serampore, West Bengal.

TANTU YOUNG ENGINEER SCHOLARSHIP

Tantu is launching an innovative scheme to provide scholarship to two final year students of Textile Technology and Apparel discipline (one from each institution only) in a financial year to boost the morale of the students from the financial year 2018.

This is an attempt to provide a seamless passage to the budding professionals to establish strong linkages with the senior professionals as well as with the association by attending the annual seminar. This is one important commitment of Tantu, to be fulfilled from the year 2018. The members of Executive Committee had deliberated in depth & consulted with the senior members of Tantu on the subject and agreed in principle to earmark a fund for this purpose. Tantu will extend financial support to two students to participate in the annual seminar organized by the association.

This year two students, **Pathik Paul** and **Arnab Kumar De** will be attending the seminar.

Know more about **TANTU Young Engineer Scholarship** at

http://www.tantutextile.com/tantu-scholarship.html

Coats: Sustainability in Every Stitch

When purchasing a new pair of jeans, few consider how every stitch will later affect the environment. From the beginning stages of construction to end of life disposal, clothing can have a serious effect on local ecosystems. The challenges that sustainability brings to the apparel industry are being faced in nearly every operation of garment construction.

Coats, a global manufacturer of thread, zips, trims, and interlinings has been working to limit their impact on the environment for years. Matching, and in most cases surpassing, the requirements for global effluent emission standards while encouraging their suppliers to do the same are just a couple of ways the company strives to improve their ecological performance. Reducing and re-using materials wherever possible in the production process is also a major focus for Coats, especially when it comes to water.

Unmanaged water scarcity can threaten ecosystems and communities, representing a material risk to the business if consumption is higher than the local supply. Since 2013, Coats' Vietnam facility has installed programmes to locate and fix any significant leaks in their system and updated dye machines to conserve water, cutting their original annual usage down by enough to fill 22 Olympic size pools. More recently, the Coats team in Honduras opened a new wastewater treatment plant this March to purify water used in manufacturing.

A growing emphasis on sustainability in consumer buying decisions is encouraging brands to release eco-friendly products at a variety of price ranges. Technological advancements in the apparel industry give companies more options to meet the demand for forward-thinking fashion, even if garments are not one hundred percent recycled. Customers have a more transparent view of how their clothes are made, and brands are better able to source and evaluate suppliers.

Coats has made significant strides independently and in collaboration with established retailers to develop products that can be reused, work in concert with new sustainable finishing techniques, and are completely recycled as part of their environmental initiative.

WASTE NOT, WANT NOT

A report released by the Ellen MacArthur Foundation last year indicates that less than one percent of material used to produce clothing is recycled into new garments, creating a loss of over one hundred billion USD of materials each year. In conjunction with a major international retailer to create circular fashion products, Coats ensured two of their most popular thread brands would be up to the task.

Coats Dymax and Coats Epic are compliant by the Cradle to Cradle Products Innovation Institute standards for use in recyclable and reusable apparel.

A LASER FOCUS ON DENIM

Around six billion units of jeans are made annually, using the equivalent of two years of human consumption of water in Paris and electricity in Nepal, as well as 720,000 tons of chemicals according to Fibre2fashion. Thankfully, companies are adapting their methods to reduce water and chemicals in the production process.

Laser technology is another name for sustainable finishing in the denim wash sector, allowing manufacturers to create popular distressed styles, patterns, and even images on fabric. It yields impressive environmental and worker safety benefits, as well as increasing efficiency, but requires different threads than used in chemical washes.

Through extensive testing with denim brands using laser technology, technical solution experts developed threads that are able resist melting in high temperatures: Coats Dual Duty, Coats Dual Duty Supercotton, and Coats Tre Cerchi.

FROM TRASH TO TREASURE

As eco-friendly fashion trends rise, some designers want every aspect of their garments to be sustainably sourced—down to every stitch. While fabrics made from recycled polyester have been used widely apparel for some time, thread made from repurposed plastic is just starting to come onto the market.

Currently, Coats' EcoVerde products are the only globally available, one hundred percent recycled line of premium sewing threads on the market that offers the same level of proven performance as the industry's leading non-recycled threads. Available in both Epic EcoVerde and Gramax EcoVerde, it is made from 100% post-consumer plastic (PET) bottle flakes for use in any type of garment.

timeSSD® - THE NEW PARADIGM IN PMTS FOR THE RMG SECTOR

LASZLO SZABO

INTRODUCTION

It was in 1975 when my 50 m running was measured with a stopwatch, the first time when I have seen that magic tool. At the beginnings of the 90's in Romania the RMG sector was the King, the only industry with tangible cash not only accounting figures on papers. It was one of the main outsourced manufacturing destination for Western Europe. The main cost factor it was cheap labour– and still today is the same – the labour, in fact it's the labour's time. In that time DataS started to develop its shop floor control software with the aim to provide the efficiency and labour cost data, the main requests in that time was from the German capital investor's side. The sewing operation's cycle time was sourced from old books or sometimes gained with the magic tool. During my demo visits to all the companies, small and big ones (from 30 workplaces up to 4.000 operators) asked me if we can provide lists with standard times.

At our first foreign fair presence, IMB Koln / Germany, our booth was next to AJ Consultants, Finland, the moment when I understand why and how the magic tool can be replaced by a solution. AJ was 18 years established player offering the SSD (Standard Sewing Data) solution for the apparel industry. SSD was MTM-2 elements based PMTS. DataS started a partnership with SSD for Romania and East Europe.

REALITY

We introduced SSD in the Romanian market, the Textile faculty from institutes in Romania included it in the curricula, and we implemented few systems over the years. That time for industrial engineers it was a completely new tool, the times provided was under continuous question marks by lack of the background in motion analysis technics. Without convincing support from the manufacturers side and with the high price of the software, the penetration of the SSD it was poor. The manufacturers continued their path, mostly with estimations based on other

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estimated time data from the past. The execution was main focus instead of methods. All the media and industry related events had focussed on competitiveness based on efficiency, but it was only few factories which measured their efficiency on reality basis. The PMTS notion started to be known but the associated costs were never widely accepted by the industry.

THE SPARK

Meanwhile the whole IT and communication domain performed fast and big transformations but also the expectations about the brand and manufacturers relationships suffered important changes. The request for more added value, the time for the goods to be rapidly on the shelf and the continuous pressure on the manufacturers on the price / cost side ignited the spark in us. In 2016 AJ Consultants contacted me regarding the availability of the SSD for acquirement. We acquired the SSD, we kept its accurate motion elements and times database, but we redeveloped it in the Cloud under the **timeSSD®** name.

WHAT IS IT timeSSD® ?

timeSSD® is a time-cost benchmarking, worldwide available apparel manufacturing software solution. First of all, the **timeSSD®** is a tool based on MTM-2 and PMTS concept. It does not provide alone scientific methods or measurement technics as like the car manufacturer does not provide driving licenses and the knowledge behind. **timeSSD®** is dedicated for professionals but is available for everybody. We assume the existence of the necessary knowledge from the user side and the capability of the user to realize the catch: visualize the motions. The use of it isn't it conditioned to any lessons, exams, keys, pre-payments, investments or any other kind of limitations.

AVAILABILITY

The Cloud is everywhere and for everybody, no borders, no limits, just an Internet connection is necessary, where and who does not have it today? As part of the novelty in the PMTS domain we started a public service for all manufacturers and brands from the garment sector, no matter the name, dimension, location and financial capability. Any and all industrial engineers can access it now on a very cost effective level.

COLLABORATION

The motion elements database is available today on 14 languages. The software provides easy and fast tools to help the user in the translation of own texts and descriptions, like for operation lists and instructions. The users are connected in the Cloud to the same motion elements database but develops their own methods and operation lists available only for their user group in a protected data area. On the user's own decision, it can share its method and operation list with a user from another group. Using this feature the manufacturer can involve fully the client into the production process by the internet. The initiative can start from the brand's side, too. This is part of the social manufacturing as a novel manufacturing mode belonging to Industry 4.0. No printings, no e-mails, just a click and the method developed in English is on the Turkish industrial engineer's screen, at thousands of miles distance, in his own language.

TRANSPARENCY

"Trust, but verify" is a Russian proverb applied day by day in the business. A renowned shirt brand it's more expensive because includes a higher added value from the manufacturer side. As a cloth is more expensive the manufacturing risk associated with it is higher. To cover the risk a warranty is required, and the cheapest warranty is the trust. The indispensable part of the trust is the transparency. The **timeSSD®** supports the transparency with

involving the client into the manufacturing in a simple, clear, fast and structured way.

PRICING

The whole concept of **timeSSD®** is as simple as it could be possible with the today's available software and communication tools. Pricing follows the same rule with the "pay per use" concept. You need a benchmark time for a method? Register and edit it immediately with **timeSSD®**, without any administrative procedure, without a contract and without to tell us.

From the beginning you get a free trail for 60 SMV (SAM) which mean you can easily develop the standard methods and operation lists for two completely different shirt styles. As pricing principle, the user pays only for the times of the elements get from the standard element's database. During the edit of a method for 1(one) SMV minute used from the system's database the user pays 0,60 EUR. When the user includes the method in the operation list for 1(one) SMV minute in method it pays 0,12 EUR.

For example, for the first shirt's operation list development, let assume as 25 SMV minutes, the total cost is 18 EUR (25 minutes in methods with 15 EUR cost plus inclusion of the methods in the operation list with 3 EUR cost). But the development of the operation list for the second shirt style will cost around only 6 EUR, as the practice shows. Usually the differences in the operations between two styles are around 15% - 20% it means the new methods to be developed will use around 20% new elements from the system's database (15 EUR x 20% = 3 EUR). The new operation list with 25 SMV minutes will have an additional cost of 3 EUR.

DATA SECURITY

timeSSD® uses Microsoft SQL Servers for data storage. The reliability of the Cloud services provider it was on the first position when we decided for the Microsoft Azure Cloud. To minimize any data damages the data are stored with geo redundancy backup procedures.

CELERITY

timeSSD® provides celerity in all its aspects. One working minute analysis takes between 12 - 20 minutes form the IE side. Based on the share feature the price discussions get a strong and objective background. The user benefits of the immediate data export in Excel for further planning. The third party shop floor control software have a seamless link with the available API.

CONCLUSIONS

The time has become a critical resource even for measurement itself. The value of a minute executed is proportional with the level of the skills required. The skills and the level of the professional approach must be proved for the client continuously. The transparency is part of the social manufacturing process where the client is involved, and its confidence is maintained. The tomorrow's RMG industry players should pay due attention both to the productivity and transparency to keep their competitiveness. Today the **timeSSD®** is the universal accessible cost effective solution dedicated to meet the above demands.

Tukatech: Product Development Tools and Cutting Room Solutions

Tukatech provides best-in-class fashion technology solutions to the apparel industry, in both design and manufacturing. The company's array of CAD 2D and 3D design software products is renowned for its' extensive, yet friendly and easy to use functionality. Its robust, feature-rich software does not intimidate with its' complexity; but rather the beauty is in its simplicity and learnability.

Tukatech empowers users to simplify their processes and be creative while doing so.

Back in 1995, Tukatech Head Coach & Founder, Ram Sareen sought a way to apply technology to the apparel design and manufacturing space by creating a software product that was simple, straightforward and welcoming.

Over two decades later, Tukatech continues to do exactly that with its array of fashion CAD design software and hardware. Tukatech is a recognized name and industry leader when it comes to fashion technology solutions. Our solutions are state-of-the-art and our reputation unparalleled.

Tukatech is an international company with a presence in 6 continents and over 40 countries. We operate as a global company, yet with a family-oriented approach and genuine team mindset. Our team member experts are willing to "go the extra mile" to assist the customer, regardless of duty, department, geographic location or type of issue.

PRODUCT DEVELOPMENT TOOLS

TUKAcad

For decades, TUKAcad systems for pattern-making, grading, and marker-making have given manufacturers power in process engineering

and efficiency. Advanced functionality and process engineering empower accurate pattern building, bespoke grade rules, and marker nesting for every style conceived. Automatically-generated reports provide transparency of information at all stages of product development. Built-in audio/video help for every tool and flexible subscription options make the award-winning TUKAcad suite accessible for designers and manufacturers of ANY size.

SMARTmark

Boost fabric utilization efficiency with SMARTmark, an add-on algorithm module to TUKAmark that beats the human brain every time. The most powerful automated nesting system in the apparel industry, this yield-optimizing solution creates tight markers that reduce material waste. Additional options include a multi-marker queue for a single user, or a unique server-based network for users in multiple locations, including other countries.

Brandix, one of the largest apparel exporters in Asia, tested every auto-nesting algorithm available. Director Dave Ranasinghe found that, "SMARTmark has given us a 1% fabric savings over any known software." Brandix achieves further efficiency utilizing TUKAcutplan. Ranasinghe continues, "The level of customization in TUKAcutplan is very high. It integrates with our ERP and the reports are excellent." Even the most advanced software tools are simple and effective enough to convey important production data to all levels of management.

TUKA3D

TUKA3D is the fashion industry's most advanced 3D apparel virtualization system. Create stunning presentations to showcase life-like digital collections, eliminating the need for multiple iterations of physical samples. Host fit sessions on customized virtual avatars that perform real-time motion simulations, ensuring that the garment fits right the first time. The TUKA3D application for virtual sample-making has helped reduce the amount of time and number of iterations required to approve a sample for production.

TUKAcloud

The web-based digital sample room, TUKAcloud, has given vendors and designers more mobility in the sample approval process with visual data-hosting, simple communication, and flexible collaboration on the web.

At the heart of Tukatech's innovative process-engineering is the ability to re-use digital assets. Many vendors and brands have already begun developing virtual samples in TUKA3D, and even sharing and collaborating about the styles on TUKAcloud. But the designers who come up with new ideas as often as they must have not had a digital tool that meets them where they are. That is, until TUKA3D Designer Edition.

TUKA3D Designer Edition

Finally, the design and development circle is completed with TUKA3D Designer Edition (patent pending), an up-and-coming visualization application that gives designers the independence to show their concepts virtually, without the need to ever touch a pattern. In TUKA3D Designer Edition (DE), designer can use existing 3D samples as digital blank canvases in the Print Visualizer module, in which they can preview their own developments.

In a path-breaking move, Tukatech offers premium technology solution subscriptions starting as low as $29 a month. A breadth of design and development applications integrates into a "New Design Room," where all players (fashion designers, print designers, pattern-makers, and sample-makers) have special digital tools designed with their unique requirements in mind.

A process that is typically done on flat illustrations becomes more powerful (and more accurate) on a to-scale 3D object. Now, the designer can send this digital sew-by to

the vendor with the speed of a digital file, and the realness of a physical sample.

CUTTING ROOM SOLUTIONS

TUKAjet

Clean, simple design and a low noise factor make TUKAjet plotters ideal for any design room. With no operator required, plot patterns and markers 24 hours, non-stop. A full line of high-speed inkjet plotters includes various printable width, speed and pattern-cutting options.

TUKAcut

Accelerate sewn-goods manufacturing with eco-friendly and agile automatic fabric cutting machines. Precisely cut an expansive variety of materials up to 8 cm compressed with a vacuum seal, including knits, wovens, and industrial fabrics. Input marker cut data via USB or through the CAD system network for added flexibility.

Combined Fabrics, three-time recipient of Levi's Supplier of the Year award, implemented Tukatech's state of the art cutting machines to address cost reduction and labor efficiency within its operations.

The latest model of the TUKAcut fabric cutting machines were first installed at Combined Fabrics, the largest supplier of knit garments to Levi's. Before installation, the cutting room had 90 people cutting 50,000 units in a day. Sheikh Tariq Mehmood, Director of Combined Fabrics, explains that the company was already, "very happy users of TUKAcad, TUKA3D, and SMARTmark. Tukatech demonstrated their cutting room expertise by helping us engineer another vendor's cutting system before we even considered adopting TUKAcut for automatic fabric cutting."

Implementation included training personnel for raw material handling, spreading, cutting, and bundling. On the first day of installation, 14 people were able to cut the same number of units (50,000), and within weeks the same configuration increased productivity to between 65,000 and 75,000 units per day.

Mehmood continues, "My suggestion is to listen to Tukatech's expertise. Our expectations for the TUKAcut system were exceeded by far, but they never surprised us with extra hidden expenses." Tukatech is known throughout the apparel industry for their personal customer service and transparent value models.

CUSTOMER-CENTRIC

Tukatech's customer focus is self-evident. Customer satisfaction and feedback is consistently excellent, because first and foremost, they listen to and understand the needs of their customers and then thoughtfully relay to the customer how their systems can improve their processes and potentially grow their production and profits.

Tukatech focuses on the customer long after the sale is complete by maintaining an on-going, supportive, and service-oriented relationship to ensure they are deriving maximum benefit from the technology.

Each Tukatech team member has the knowledge, expertise and willing attitude to assist every customer, whatever it takes.

EDUCATION

TUKAcad is taught at 500 universities and colleges worldwide, and endorsed by notable textbook authors Helen Joseph Armstrong, Dr. Cindy Regan, and many others. Tukatech endeavors to educate, prepare, and empower the future workforce of the apparel industry with the tools and training they need.

Tukatech was the first fashion technology company to do a lot of things. The revolution started in 1995 and is in the DNA of every team member… and they will continue that revolution forever.

Welcome to the connected world of TUKATECH.

To meet your local TUKAteam, email tukateam@tukatech.com or call +91 1242347815

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Fusing Technology Solutions by Martin Group

There was a need of precise and uniform pressure along all the surface of fabric and leather in fusing process. The activity to achieve this started in the 60th from a specific requirement in the field of fusing machines - from here the great intuition of the “pressure lung”. The first machine with this pressure system was developed in 1965, model VARIABIL MEPP 130, serial number 001, and it goes on working until 1996. Fifteen years later, a new kind of fusing machine was developed - the continuous working machines between which the new OPEN TOP and, lately the X series.

The success of this new rolls fusing machine contributes to a remarkable expansion of the company as at a national level, an at an international level. So, to arrive to nowadays and, from small family laboratory, Martin Group becomes a company with a productive unit of 4000 square meters, 80 collaborators with several satellite companies that take care of commercialization and service all over the world.

Martin group manufactures around 30 different fusing machine models with Italian high-tech technology. Features of few models are shown here.

OPTEN TOP SERIES - OT70-100-124-140-160-180

This Model is equipped with back exit belt for retrieving adhesive fabric. It has double heating system with preheating that allows to fuse using temperatures slightly below average. The “sandwich” of these model is excellent for the most delicate fabrics. It has a pressure system with selector of the “OUT” device that allows to thermo-adhesive the most delicate fabrics at zero pressure.

X- Series - X 600-1000-1400-1600 K-EL

Feature of this model includes

- Effective worktop mm. 600-1000-1400-1600
- Upper and lower heating system with 2 independent electronic thermostats (entry zone, preheating + exit zone).
- Heating top with 9 resistive elements which allow the use of lower temperatures or of a shorter manufacturing time. System of resistance choking for a thorough uniformity of the working temperature.
- Pressure range - from 0 to 5 kg/sqcm
- Temperature range - from 0 to 210° C
- Working time adjustment from 5 to 35sec
- Speed from 1 to 10 m per min

OPTEN TOP SERIES - OT70-100-124-140-160-180

X- Series - X 600-1000-1400-1600 K-EL

OLX SEREIES - OLX600 – 900

MEPP

OLX SEREIES - OLX600 – 900

A small production fusing machine which is suitable for fusing jackets, shirts and leather garments. Technical features of this model:

- Pneumatic pressure from 0 to 60 Newton/sqcm,
- Self-belt adjustment, seamless antistatic belts.
- Low electrical absorption 2,3 Kw/h at 230-380V+N,
- upper and lower heating elements,
- heating surface length 700 mm.
- Antistatic graphite scraper blades, 4 internal and external cleaning systems,
- high temperature bearings and Viton pneumatic material,
- 7” Touch Screen control panel.

MEPP

MEPP series machines, the unique product in the market, are equipped with a patented pressure system that give to machine irreplaceable property. In this model, the pressure is not given by two rigid plans (system that don’t give you uniformity). Instead in MEPP model, the pressure is given by a cautciou membrane that swells by the compressed air. This swelled membrane gives a uniform pressure in every square centimetre of the working plane, even when materials with different thickness are feed in the same working cycle.

Machine for various applications, it allows productions with the highest quality.

- Adjustable time, pressure and temperature
- Coverings and paddings with thermical and mechanical high resistance
- Two working plans allow to work in alternated way without dead times

PROPER SELECTION OF INTERLINING

RAJKUMAR RAI

What Is Interlining?

Interlining is a layer of textile used between two outer layers of shell fabric to impart strength/support, stability and shape retention to the outer shell fabric against any distortion due to stress exerted at various stages of production, during wearing/ use or after care treatments.

Difference Between Interlining and Lining

Lining is the layer of textile used under the garment as cover to the raw edges and smooth surface to support outer shell for good drape. It can be woven or knits as needed for a particular application/use.

Why Use Interlining?

- Interlinings are primarily used for imparting strength/support, stability and shape retention.
- When fused to the outer shell fabric it acts as a composite and stabilizes the outer shell against any distortion under stress
- Helps improve aesthetic and hand feel of fused laminate
- Helps retain shape of fused part during use and after care treatment
- Improves longevity of fused part

What Are Different Types Of Interlining Available/In Use

Interlining can be classified into different types based on:

a) Structure of base fabrics – woven, knits or nonwoven

b) Application – non fusible or fusible

Woven Interlining

Primarily woven interlinings were first used 100 years ago to strengthen/support coats, cloaks and gowns or hat. It was mainly 100% cotton fabrics made stiff by starch application and was non-fusible. However, the unpleasant hard touch and

Rajkumar Rai

irregular characteristics during washing led to development of fusible interlinings.

Normal cotton sheeting fabrics were applied with a layer of adhesive that can be fixed to the shell fabric by application of heat or pressure. This formed a composite part of the fused shell part and supported the outer shell for better drape and look.

Woven interlinings are majorly 100% cotton based with thread density of variable count as required for the weight or stiffness needed for a particular use. Now polyx cotton blends are also available to overcome the problems of shrinkage faced

in cotton fabrics together with a variety of warp and weft combination like rayon, texturized poly and wool etc.

Advantages:

The main advantage of woven fabrics is its strength and stability, hence used for all such applications where strength and stability is needed like waistband.

However, this could be a disadvantage at times where flexibility and soft hand feel is required.

Woven is majorly plain weaves, sometimes crepe, herringbone or twill weaves are also offered according to the application need.

In such cases, texturized poly yarns are used for voluminous body, soft and natural hand feel or drape of the fused composite at the same time strength, flexibility and lightweight of fused laminate is achieved without much altering the natural drape or texture of shell fabric.

However, woven is expensive and not suitable for less expensive casual garments hence, it was replaced by knitted fabrics that used a combination of synthetic yarns with rayon and wool for body and volume according to different application intended for.

Knitted Interlinings

The major disadvantage of woven in its flexibility, lightweight and soft handle was duly addressed by knitted fabrics.

Knitted fabrics have a large number of variation in terms of loop structures to impart flexibility/stretch together with body (volume) and strength/stability.

They are kept lightweight and soft hand feel of laminate by using fine bulked (texturized) filaments. It is expensive and hence used in high value garments like blazers and high fashion blouses.

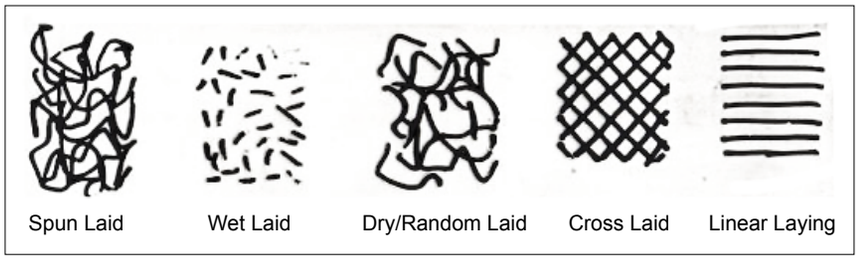
Non-Woven

As the name implies there is no involvement of any yarn for interlacement to make the fabric.

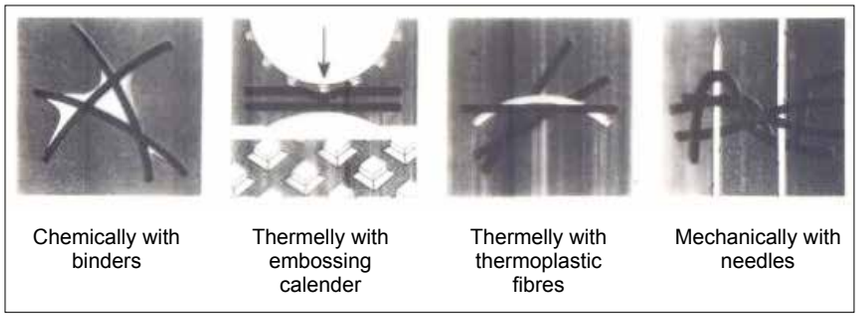
It is made directly from fiber to fabric stage in the process reducing the cost of base fabric. As there is no yarn used in making nonwovens, it lacks in strength needed for apparel use and there are many techniques applied to impart required strength to nonwoven textiles, called Bonding. They are the most versatile product available from 10gsm to 200gsm and above, offering light, soft, flexible or strong for any application one can think of. The basic manufacturing technique is using mostly synthetic fibers to form a layer, which are imparted strength by bonding.

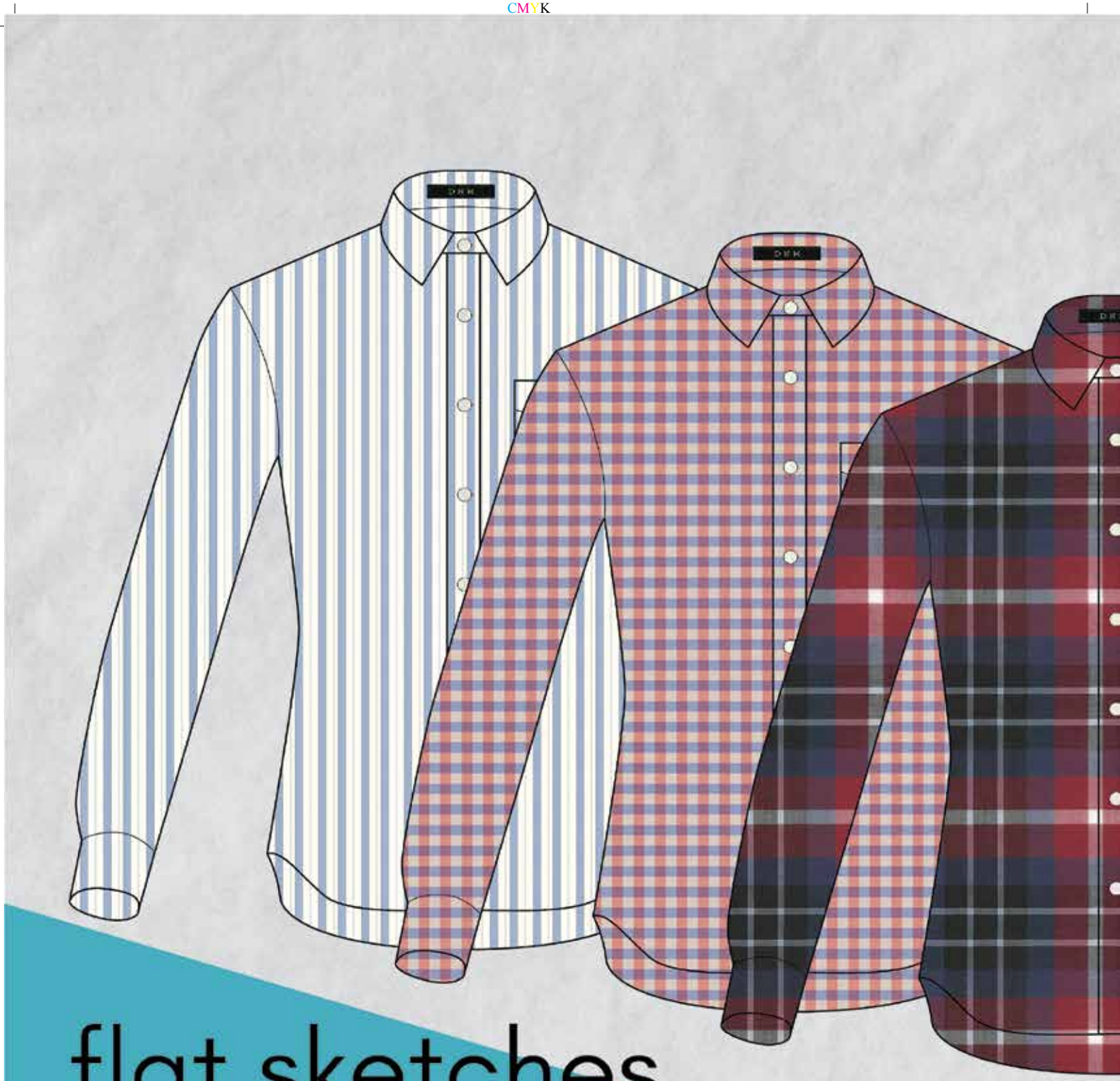
Let us understand the different layering and bonding methods, their use and their advantages and disadvantages.

Layering Method



Bonding Method





flat sketches tell a flat story

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Advantages and Disadvantages

HD-PE-ADHESIVE

Advantages	Disadvantages
Good bond-strength on a wide range of fabics	No steam fusing capability
No reaction to steam no steam-included strike-back	No high frequency fusing capability
Good dry cleanability (A)*	Requires high fusing conditions
Excellent washability (95^{0}C), suitable for garment dyeing, etc.	Heavy contamination of taflon belts

LD-PE-ADHESIVE

Advantages	Disadvantages
Edequate bond-strength for small-area fusing	Hardening of the handel due to surface scatter coating
Low reaction to steam low level of steam-included strike-back	No high frequency fusing capability
Easy to fuse with hard-ires	Adhesive strike-through passible as this, lightweight outer fabrics
Adhesive weakened during dry cleaning can be reactivated by re-pressing	Limited dry cleanability
Very good washability	Heavy contamination of taflon belts.

PA-ADHESIVE

Advantages	Disadvantages
Good bond-strength on a wide range of outer fabics	Bond-strength sometimes inferior on sythetic outer fabrics and fabrics with special finishes
Melting point lowered by steam	Strong reaction to steam, possibly disadvantageous with low melt adhesives
Good dry cleanability to all solvents	Fendency to steam-included strike-back
Good washability (30^0-60^0 C)	Washable only to 40^{0}C with MV adhesives
No contamination of teflon belts on continuous presses	

PES-ADHESIVE

Advantages	Disadvantages
Good bond-strength on synthetics and fabric mixes	Bond-strength sometimes inferior on wool and other nautal fibres
Insensitive to steam low tendency ot steam-induced strike-back	Poor steam fusing capability
Good dry cleanability to perchloroethylene	Not resistant to trichloroenthylene
Very good washability (60^0-95^{0}C)	Contaminates teflon belts on continuous presses

How to select the right interlining for my use?

To help decide on the type of interlining suitable for application/purpose, one has to evaluate exact need, purpose, material area of application, the care instruction and processing details of garment.

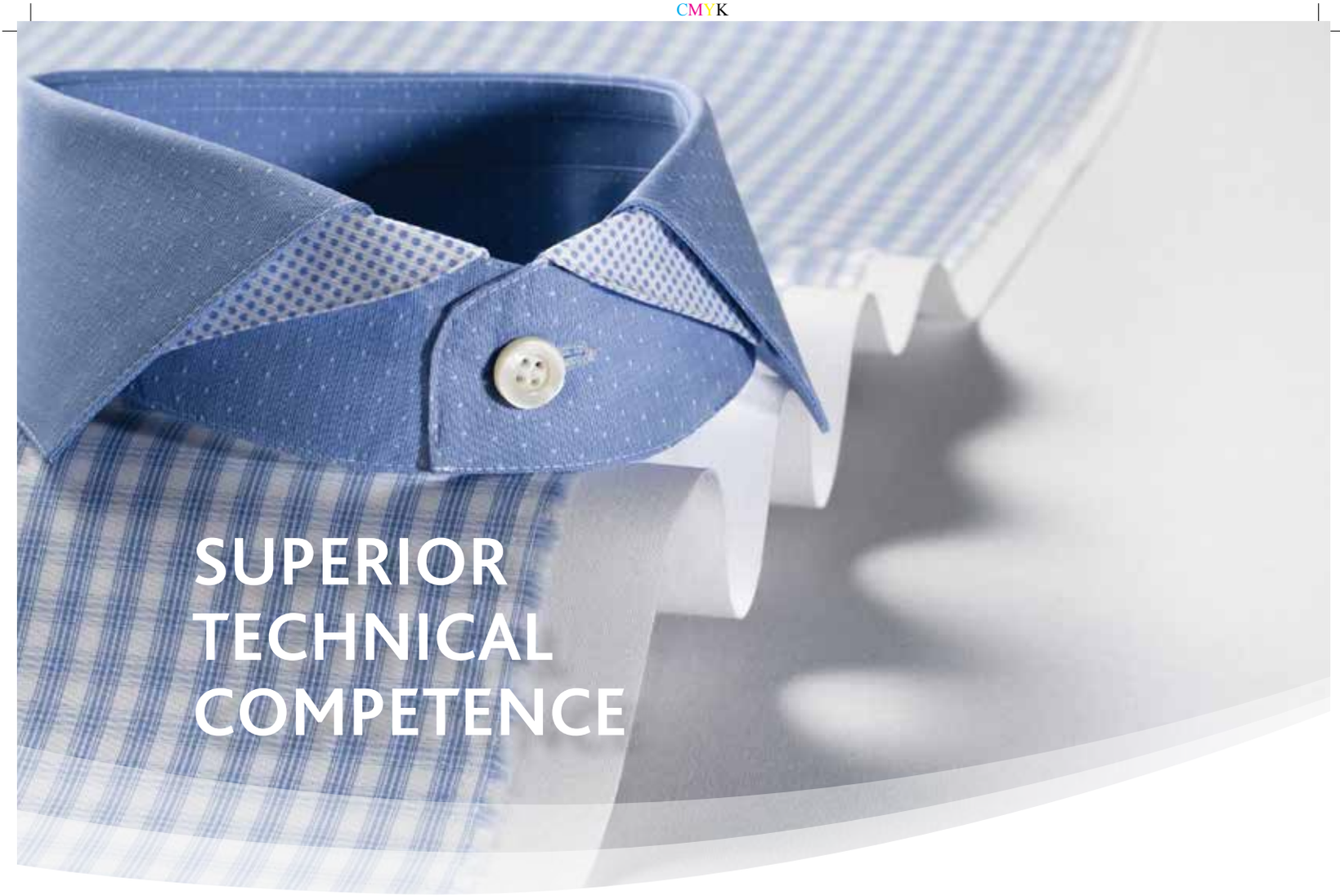
The following FORMAT is suggested to be filled in and one may consult an interlining supplier to conduct a fusing test on the material, preferably on self-owned equipment in the factory and submit a test report for 5, 10 or 20 washes depending upon brand value and price point of garment.

Fusing Test Request

Factory	
Address	
Production Head	
Quality Head	
Buyer/Country	
Style/Art	
Material	Content (100% polyester, georgette 50gsm, provide 1-2mtr original finished fabric)
Item	Ladies Blouse
Care Instruction	
Application area	Collar, neckband, placket, cuff
Fusing	Press model
Test Method	IS-1259

Fabric Sample

Based on the above information, the interlining manufacturer will submit the test results showing:



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INNOVATING TOGETHER

- Samples after fusing and after 5, 10 or 20 washes for appearance, hand feel reference
- Bond strength values after fusing and after washes. The buyer can decide if the results and looks are acceptable or not.
- If left to choose, then one can decide based on:
- Appearance: no bubble or any surface unevenness after wash.
- No change in hand feel making it too hard.
- No change in visual looks: wavy moiré effect or colour change (please refer to picture NW 10). This is due to woven interlining or linear dot print pattern used in light open texture fabrics (see picture NW).
- No shiny dots of glue visible on other side.
- Normally for very light, transparent and flimsy fabric like georgette/ chiffon colour of interlining has to match the base colour and not use white/ black/charcoal in general.
- For small area usage as mentioned which are close stitched from all sides the bond value of 5-7 N per 5cm strip is enough and safe.

Do's	Don'ts
Cut interlining in same direction as shell	Don't cut beyond pattern-5mm lesser
Put fusing on top of shell facing down	Never shell on top of shell
Ensure no folds in shell/fusing	No folds at output end in hot state
Check glue line temp by temp. Strip	Never lower / higher than given temperature.
Check the speed of machine before use	Never faster than set speed-poor fuse
Check roller impression by carbon paper	No dirt on roller/ thread
Check bonding before start	Don't start feed w/o temp check
Care Instruction	
Application area	Collar, neckband, placket, cuff
Fusing	Press model
Test Method	IS-1259

About the Author

Rajkumar Rai is a Textile Graduate from Calcutta University and alumni of Indian Institute of Foreign Trade. He has over 36 years work experience spanning in textile processing, buying house and other areas. He was India head of Freudenberg. He was heading a buying house over 25 years and worked with German buyers.

Tantu Seminar 2017 Report
Performance Textiles: Athleisure and Active Sportswear

The Fifth TANTU seminar on Performance Textiles: Athleisure and Active Sportswear was held on 16th September 2017 at India International Centre, New Delhi. There was an exciting gathering of industry experts, academicians, professionals and Govt. officials from all over India discussing on Athleisure and Active Sportswear. Dr. Prabir Jana, President, TANTU and seminar chairman in his brief welcome address, mentioned the seminar as a watershed event in the Athleisure and Active Sportswear segment in India with experts from nine brands represented in the panel discussion and as many as seven brands are Indian. He pointed out that probably for a change, Indian manufacturers are thinking and working proactively matching up the pace with global growth pattern.

Launching of Tantu Annual Journal 2017

Attentive participants at the Seminar

Seminar panellist 2017 (from L-R Indu Sharma, Roshan Baid, Sanchit Khurana, Bhupinder Singh, Deepankar Sekhri & Kingshuk Pandit)

Seminar panellist (from L-R Anurag Jaichand, Bijesh Todi, Mohit Singhal & Arindam Saha)

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Seminar on
"The Art of Shirt Making"
India International Centre, New Delhi
15th September 2018

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 Journal of TANTU 2018
Chief Guest Address by Partho Kar, Chief Consultant at Biswa Bangla Retail, Government of West Bengal, India

Panel Discussion: The Art of Shirt Making **10:25 AM – 11:30 AM**
Moderator: Prabir Jana, National Institute of Fashion Technology
Panelist:
Abhishek Tiwary, Technical Consultant, Hugo Boss, Switzerland
Sajed Seraj, Deputy Managing Director, Elite Garments, Bangladesh
Kushal Singh Mahal, Group Manager, Technical, Aditya Birla Fashion Retail Limited, India
Raveendra Radhakrishna, Head Industrial Engineering, PT Ungaran Sari Garments, Indonesia
Jagadish BE, Head of Operations, Arvind Exports, India

Tea Break	**11:30 AM – 11:45 AM**
Presentation by Freudenberg, India	**11:45 AM – 12:05 PM**
Presentation by Time SSD, Romania	**12:05 PM – 12:25 PM**
Presentation by SAKHO - Martin Group, India	**12:25 PM – 12:45 Hrs**

Panel Discussion: The Technology of Shirt Making **12:45 PM – 13:45 Hrs.**
Moderator: Prabir Jana, National Institute of Fashion Technology
Panelist:
Efren Pineda, Head of Technical & Quality, Laguna Clothing, India
Didit Handoyo, Head Quality Assurance, PT Ungaran Sari Garments, Indonesia
Gurucharan Kaup, Head of Technology, Marks & Spencers, India
Prashanth TS, Head- IE/ Process Improvement & QMS, Arvind Exports, India

Networking Lunch	**13:45 Hrs – 14:30 Hrs**
Presentation by Tukatech, Asia	**14:30 Hrs - 14:50 Hrs**
Presentation by Veit-Ramsons, India	**14:50 Hrs – 15:10 Hrs.**

Panel Discussion - The Business of Shirt Making **15:10 Hrs – 16:10 Hrs**
Moderator: Ila Saxena, Apparel Resources
Panelist:
Pallab Banerjee, Pro Bono Strategic Advisor, Pearl Global, India
Gaurav Kumar, Director Marketing, Aquarelle, India
Mridul Dasgupta, General Manager, Macy's Merchandising Group, India
Roopak Malik, Director, Textile Sourcing Limited, India

Vote of Thanks

Kingshuk Pandit, Vice President, TANTU	**16:10 Hrs – 16:20 Hrs**
Networking Tea	**16:20 Hrs – 17:00 Hrs**

HIGH PERFORMANCE
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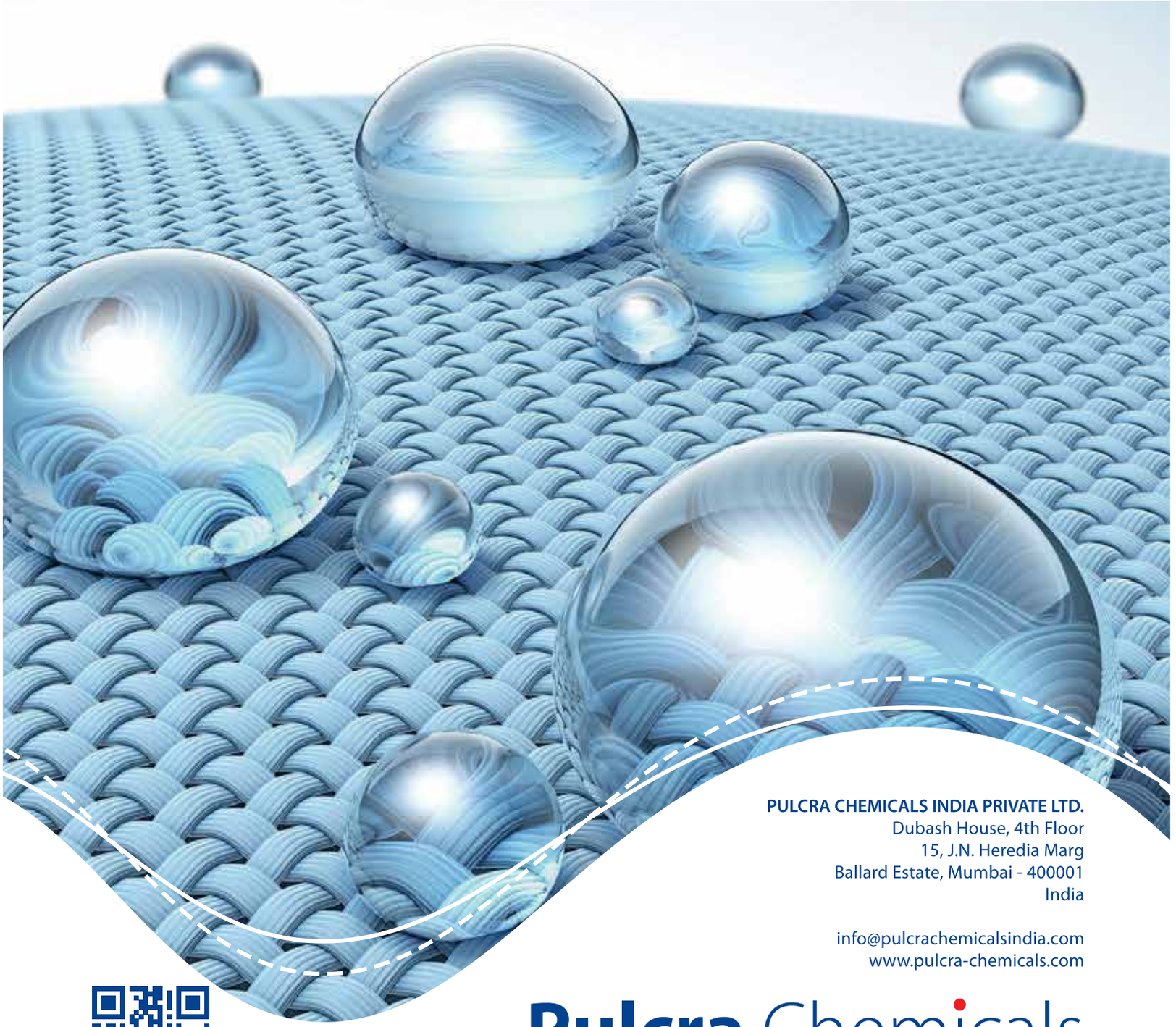
Spin Finish for Synthetic Fibers used for

- Technical textiles
- Functional textiles
- Fiber Manufacturers
- Nonwovens



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