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Mini Review

Sustainability, gives Impetus to Innovation and Research

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Abstract

An increasing population of the Globe in general and that of India and China in particular brings before us a number of challenges of providing the people enough food, shelter, clothing, sanitation & health facilities, infrastructure, etc. To meet these challenges, unbridled manufacturing activities disregarding environment and society has been taking place almost all over the world which has resulted in alarming level of increase in Green House gases and depletion of valuable nonrenewable resources and water bodies. Under this backdrop business practices based on sustainability are becoming inevitable and textile sector is no exception to it. India's aspiring young population, like consumers from developed countries, further demands quality apparels with multifunctional performance properties and thus Technical Textiles consumption is growing rapidly. The present paper explains how innovation and sustainability driven research can meet the challenges of coming decades. In this paper a few examples of the research work and their findings are summarized and their potential in meeting such challenges is presented.

Introduction

Indian Textile Industry being Mother industry, its growth is weaved with the future of over 55 million people connected directly or indirectly to this sector. Many a times Business as usual manufacturing activities are carried out with unbridled freedom, and total disregard to optimization and use of raw materials/ processes and energy sources. This is leading to air & water pollution; Green House Gases Emission and rapid depletion of fossil fuels and water resources. It has been reported that Globally we have ploughed in extra 30% of earth's resources depriving our future generations. Hence, it is natural that Sustainability issues take center stage. It is inevitable that we adapt to Sustainable value model.

Environment has to be protected and people have to be respected and looking after the profitability of any business enterprise. Planet, People and Profit are these three pillars on which business success is to be measured. While following sustainability agenda, the steps to be taken include more and more use of renewable raw materials and energy; process intensification to conserve energy, water, and use of utilities, etc. increase the use of products which are bio-degradable, etc. Thus, SUSTAINABILITY is never to be considered as financial burden; in fact, it is a key driver for Innovation based research as well as Technological Developments which can give an enterprise competitive advantage.

When we look at the respect to environment and people over the profitability, it is not a philosophical or wishful thinking. Top management needs to have commitment to sustainability; intern it, it is a matter of commitment to ethically doing the business. Indeed, when ethics becomes core component of business, only then no one would compromise environment and the society for the paltry sum of profits. Sustainability requires multipronged approach. It necessitates exploration of newer ways of processing, newer raw materials, technologies which require minimum energy/water inputs and has lowest level of emissions and effluents. Hence, naturally the regular processes and technologies need to be relooked in to the sustainability lens and explored giving impetus to research and developments. Fortunately, awareness about use of products made by eco-friendly processing technologies is increasing and such products based on green technology are being preferred even paying slight premium. Positive development in India is the introduction of new company law, making it compulsory for the companies to spend 2% profit of theirs for Corporate Social Responsibility projects, which again creates mental frame among the corporates about social commitment and corporate philanthropy.

India is a Young Nation as 65 % of its population is below the age of 35 years. This aspiring young Population with increasing standard of living and surplus disposable income, are quite aware

about Consumer rights and environment, and are Brand conscious and quality conscious. They need improved quality of life and Standard Medical care. And to meet these demands of enlightened and economically affording section of customer base, we have to switch from traditional Textile manufacturing to the diversification towards manufacture of Technical Textiles. Coming decade is thus going to be decisive in terms of adapting to various products based on Technical Textiles of different segments.

Many of the reported technologies such as Digital Printing; Transfer Printing; Ultrasonic /Laser Energy, Supercritical Carbon dioxide dyeing of Polyester; Plasma application etc. can be further extrapolated and up-scaled to see their application potential on large scale level. Also, a number of efforts in Process intensification giving rise to optimum use of utilities, with improved performance of the product and quality , various Fibre Modification processes and Nano -Technological applications need to be thoroughly investigated to extract the un-tapped value in these technologies which can propel us toward the fulfillment of our sustainability agenda.

Personally, I have been privileged to guide the research in the field of fibre science, technical textiles and textile processing for close 40 years with over 200 students for Master and Ph D degrees. Due to the paucity of the space and time, it will be prudent to describe here the outlines of a few pieces of our research work which are deeply rooted in sustainability, process intensification and technical textile applications. The examples taken here are not exhaustive and they are just representative samples.

Ecofriendly and Economical Finishing agents for Cotton and Cellulosic fibres

Cotton and cellulosic fibres enjoy important position in clothing. In fact, today Cotton garments have become revenue earners and are the materials for those who can afford to have them. However, fibre lacks wrinkle resistance and it is important that these required properties are imparted to cotton. Traditional way is to modify this fibre by resin finishing, which makes use of formaldehyde-based resin. This itself gives rise to the issue of release of formaldehyde during wearing. Hence low formaldehyde and formaldehyde free finishing agents are in demand. Polycaroxylic acid such as 1,1,2,2, butanae tetra carboxylic acid(BTCA) is presented as an alternative to this; however, it is cost prohibitive and hence used only in a limited extent. We have worked on similar lines making use of polycarboxylic acids such as polymaleic acid, citric acid and their combination and we have found interesting results with respect to crease recovery properties. The use of Polyethylene emulsion further helps in reducing the stiffness caused and thus fabric does not suffer on that account too. In addition, when this formulation is mixed with Chitosan, (We had prepared the naturally occurring biopolymer Chitosan from shrimp shells obtained from the fish market), it gets further enhanced with regard to imparting antibacterial properties. Padding through the solution was done with Wet pick up of 95% and then drying on pin frames at 80°C for 2 min. This was followed by curing at 160°C for 2 min .The results indicate very good degree of CRA and wrinkle resistance properties as well as acceptable softness level, and antibacterial properties [1].

Dyeing of finished Garments as per the Market needs

The limited aim was to address the need of the Garment dyers to quickly deliver the goods as per the purchase order, which is fluid. Since the demand for typical fashion colors keep changing fast, it is important to avoid the unnecessary large inventory of the garments in specific color combinations. The wise things to do is to have the garments finished in un-dyed form which can be dyed in a short time as per the orders placed and made available promptly. Technologically this is a bit difficult thing to do as after finishing the color uptake of the garments is reduced to as low as 10% of the unfinished garments.

We undertook this work with an aim to convert the finished un-dyed garment into dyeable form as and when needed as per color requirements. To that effect we used N- containing Additives in finishing formulation for garment dyeing. Nitrogen containing additives such as Triethanol amine can act in acidic conditions of dyeing enabling protonation of the fabric due to cationisation effect and the exhaustion of the reactive dye takes place very easily which can then be fixed well. The results were quite promising, and additives used in finishing were found to give the dyeability as good as or near about equivalent to that when finish was absent [2].

Simultaneous ACID Dyeing and Finishing of Cotton

It is well known that Acid dyes are cheaper than that of direct dyes; however, they do not have any substantivity for cotton and hence one is compelled to restrict the use of acid dyes only to proteinic fibres. In this piece of work, we attempted to establish linkage between acid dyes and cotton using a bridging chemical such as multifunctional resin or polycarboxylic acids. The resin as well as polycarboxylic acid while reacting with hydroxyl groups in cellulosic chains on one end, can be made to react with amino groups of acid dyes at the other end ,in one single operation of pad, dry and cure technique. A lot of trials to optimize conditions were taken and it was concluded that acid dyes which contain free primary or secondary amino groups can participate in this reaction with cross-linking agents, which intern can also react with the cellulosic fibre and impart wrinkle resistance properties as well as dyeability. The padding bath contained cross-linking agent, catalyst, acid dye and after padding the fabric with 100%expression, it was dried and cured at 150oC for 3 mins. Detail studies showed that the dye forms a covalent bond with the cross-linking agent which inturn is covalently bonded with the fabric. Hence the fastness properties exhibited by these dyeing were exceptionally good.

The Advantages of this process include capacity to make dyeing operation continuous; acid dye application on Cotton and cellulosic fibres; high performance properties; simultaneous resin finishing happening and thus saving on energy, chemicals and water. Shortening of the process will give rise to extra production and thus this process is Eco-friendlier and more sustainable one [3,4].

Development of Hygienic, Fragrant and Mosquito repellent Cotton

Fragrance and essential oil have specific effects on individual's feelings and emotions such as relaxation, exhilaration, sensuality, happiness and wellbeing through odour via stimulation of

brain. Essential oils also have antibacterial, insect repellent, and mosquito repellent properties. However, many of these oils are volatile and hence lose their property very rapidly. However, the storage life of a volatile compound can be increased markedly by micro-encapsulation technique. Microencapsulation of fragrance compounds maintain fresh aroma on textiles, so that material retains its freshness for longer duration. Capsules rupture by friction during wearing giving necessary fragrance and under normal conditions remain intact. Fragrance oil has been encapsulated in gum Arabic and gelatin. The microcapsules containing these oils (Cederwood , Lavender, Lemon grass oils) with aroma are applied on cotton fabric from resin as well as binder bath.

The evaluation of the final finished fabric involved estimation of intensity of aroma, washing durability of the aroma, Antibacterial activity of these oils in microcapsules and efficiency of Mosquito repellency of microcapsule treated fabric. All these anticipated properties were found to be imparted on to the cotton fabric using this one shot natural herbal recipe. In other words, finished fabric in addition to being wrinkle resistant, also showed, pleasant aroma, antibacterial property, as well as mosquito repellency. The feasible end uses of such products include ribbons, handkerchiefs, curtains and furnishing fabrics [5].

Conclusion

These are just a few examples of actual research having carried out by my group of students, it shows that there lies a great potential to exploit commercially the findings of these pieces of research work and convert them into acceptable novel technologies/products which can satisfy the parameters of sustainability and requirement of technical textiles demanded by the modern consumers. Indeed, they can provide the products of high-quality performance, the products which can be delivered in shorter dwell time, the products having optimized use of utilities and thus low Carbon foot prints. The novel products and technologies developed can offer a very good potential of industrial exploitation.

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