Progressive Hands of Nanomaterials in Blooming Textile Industry

Physics

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ABSTRACT

This research paper emphasising on the production and demand of nanomaterials in textile sector. Nanotechnology is providing new methodology & strategies for all the categories of textile manufacturing. The growth rates for technical textile products in new applications are generally higher than those for clothing and home textiles considering the aspect of industries. It will be elaborated in this paper in graphical representation with respect of different modes by which we can inculcate the formation of Nano-textile in the winning era of textile industry for this competitive scenario

Introduction

Nanotechnology is a promising technology which enables development and applications of many different kinds of products. Nanomaterials are developed and used because they have new specific physical and chemical properties compared to the conventional material of the same chemical composition. Clothing today is expected to be flame resistance, water proof, self cleaning, insect repellent and antimicrobial to protect human being from infection, UV light, chemical and biological agents, be warmer in winter and be cooler in summer. Nanotechnology has performed well in such expectations and doing well regularly for upcoming demands. Nanomaterials are defined as the materials with at least one external dimension in the size range from approximately 1-100nanometers[1,2]. Nanomaterials have the potential to improve the quality of life and to contribute to industrial competitiveness. Materials engineered to such a small scale are often referred to as engineered Nanomaterials, which have unique optical, magnetic, electrical and other properties. In this era the nanomaterials are used to design pharmaceuticals that can target specific organs or cells in the body such as cancer cells and upgrade the effectiveness of related therapy. These are also be added to cement, clothes and other materials to make them stronger, tougher and lighter. Nanotechnology has been the fundamental essential of human life. The nanotechnology research in the textile area mainly centres on creating unique properties in everyday fabric such as self cleaning, water and oil repellent, stain proof, antibacterial, UV protective, antistatic, improved moisture regain and comfort in synthetic based textiles but without compromising the original hand, breath-ability and durability of the fabric. It also shows promising applications in developing advanced textile materials such as nanocomposite fibres, nanofibres and other nanomaterial incorporated textiles for applications in medical, defence, aerospace and other technical textile applications such as filtration, protective clothing besides a range of smart and intelligent textiles[3-5].

Textile: A fast growing sector

The main sectors in which nanotechnology rapidly growing, are Energy and Textile. Textile industry is currently the most benefited sector in market world. The textile industry has been expanding to many new areas in the past decade. Textile and clothing play a major role in the development and industrialisation process of countries and their integration into the world economy. All world regions have experienced double digit growth in the manufactured goods sectors within the last six years. While textile and clothing industries account for only a small percentage of total world manufactured exports, 4.6% in 2006, 6.9% in 2009 according to reports, some regions and countries rely on T&C for a much higher percentage. Regions with an above average share include Asia, and for clothing South and Central America, Africa and Asia [6,7].

Figure:1 Schematic representation of Wool

Figure 2: A pathway of Industry

The main fields of textile applications are Healthcare, Packaging, Sports and Leisure, Defence, Home and Household, Industry and Machinery, Environmental protection, Geotextiles and Civil Engineering Materials, Clothing[Figure 1& 2].

Success of Nanotechnology in Textile industry

Human life style has been changed with the fast development. The new generations have been very comfy and need all things smaller to carry them easily, cheaper, safer and fast working products. Nanotechnology is contributing with its unique properties in textile for everyday fabric such as self cleaning, water and oil repellent, stain proof, antibacterial, UV protective, antistatic, improved moisture regain and comfort in synthetic based textiles but without compromising the original hand and breath ability and durability of the fabric. The unique and new properties of nanotechnology have attracted researchers and scientists to the textile industry that's why the use of nanotechnology has tremendously increased in textile industries very rapidly. In last decade Nanotechnology has given the achievements in the field of textile sector. Nanotechnology developed the several fabric treatments to achieve the quality of fabric in terms of durability, softness, tear strength, abrasion resistance, wrinkle resistance etc. According to the history the textile sectors have been used worldwide in a wide range of consumer applications. Natural fibres used commonly such as cotton, silk, and wool along with the synthetic fibres, such as polyester and nylon. Synthetic fibres are mostly useful for domestic and industrial applications, such as, carpets, tents, tyres, ropes, belts, cleaning clothes, sport goods and medical products[8-11].

Nanotechnology also offers many advantages as compared to the conventional process in terms of economy, energy saving, eco-friendlyness, control release of substances, packaging, separating and storing material on a microscopic scale.Nanoparticles can provide high durability for treated fabrics as they posses large surface area and high surface energy that ensure better affinity for fabrics and led to an increase in durability of the desired textile function. The textile industry has been amplified to lots of new areas in the past decades due to new technologies. Textiles or textile- based composites are expected to replace many metallic and plastic material used in for example the auto mobile industry, construction sectors, machinery and machine tools industry, electronics, and to a lesser extent in wood, leather and other natural materials in future, sport goods, and many other smaller application areas. It is clear that nanotechnology is imagined to play a key role in textile industry[12-15].

Contribution of Nanomaterials in textile manufacturing

When using nanomaterials in the manufacturing, these materials are either integrated into the fibre volume or applied as a coating onto the textiles. Nanoparticles provide high durability for treated fabrics as they posses large surface area and high surface energy that ensure better affinity for fabrics and led to an increase in durability of the desired textile function.

Nanocomposite Fibre

Nanocomposite fibres are intensively used in automotive, aerospace and military applications. These fibres are produced by dispersing nanosize filler into a fibre matrix. Due to their large surface area and high aspect ratio nanofillers interact with polymer chain movement and thus reduce the chain mobility of the system. Most nanocomposite fibres use filler such as nanosilicates, metal oxide nanoparticles, graphite nanofibre as well as single- wall and multi-wall carbon nanotube. SiO_2 increase the durability of fibre, control fragrance and make that antibacterial, self cleaning and water/dirt repellent[16].

Clay Nanoparticles

Clay nanopartcles are resistant to heat, chemical, and electricity, and have the ability to block UV light. Nanosized TiO_2 and ZnO are more efficient at absorbing and scattering UV radiation than the conventional size and are better to provide protection against UV rays. This is due to the fact thatnanoparticles have a large surface area per unit mass and volume than the conventional materials, leading to the increase of the effectiveness of blocking UV radiation[17]. Incorporating Clay Nanoparticles into a textile can result in a fabric with improved tensile strength, tensile modulus, flexural strength and flexural modulus.

Carbon nanofibre and Carbon nanoparticles

Carbon nanofibre can effectively increased the tensile strength of composite fibres due to its high aspect ratio while carbon black nanoperticles can improve their abrasion resistance and toughness. Nano-titanium dioxide and nano-silica improve the wrinkle resistance of cotton and silk[Figure 2] .

Carbon nanotubes

CNTs are one of the most promising materials due to their high strength and high electrical conductivity. CNTs could be used in the construction of clothing which incorporates electronic devices or wearable computers. CNTs provide fire resistance, electro conductivity, self cleaning, water repellent, antistatic and high durability for fibre[Table 1].

Table 1: Global Carbon Fibre production demand in metric tonnes from 2012 to expected years up to 2020.

Market	Year 2012	Year 2016	Year 2020
Woven Fabric	20770	36880	53640
Thermoset UD Prepag	42420	57280	76470
Thermoset Fabric Prepag	36330	61400	78640
Thermoplastic prepag	6830	13070	27340
Raw Fibre	19990	30440	40770
Molding Compounds	25070	38960	44850

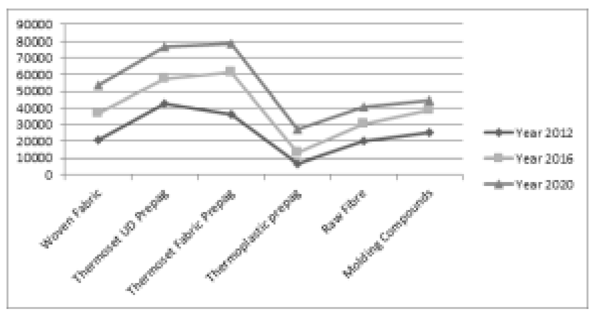

Figure [2]: Schematic of carbon fibre production demand globally

Conclusion

We have shown here the world wide carbon fibre production demand from 2012 in metric tonnes. According to these pre gain data the demand has been and will be increased approximately two times or double within four years as 2012 to 2016, which is a drastic change in figures in a very short period. Expected data have also been shown upto 2020 in consonance with demands from 2012 to 2016 that might be minimum one and half times more than 2016 in 2020. In the development of nanotechnology strong, highly durable and required functions oriented fabrics are efficiently produced for a large number of applications like military, sports, medical and industrial purposes. Considering the properties as well as favourable results we can have a hope that the future of nanotechnology is marvellous and can see the dreams for being human life smooth and comfy[18,19].

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