



SHORT FEATURE

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Clothes from Plastic Bottles!

THE worldwide demand for textile fibre is a whopping figure of over 99 million tonnes per annum. Obviously, it cannot be met by natural fibres (derived from plant and animal sources) only, thus necessitating the use of synthetic (or man-made) fibres for the textile and apparel industry.

Polyester, acrylic, nylon, rayon, polypropylene, viscose, etc. may be used for making of synthetic fibres. Of these, polyester, nylon, acrylic, and polypropylene dominate the market accounting for approximately 98 % of the entire synthetic fibre produced. However, polyester alone accounts for around 60% which means most synthetic fibres are produced from polyester.

The polyester most often used in the textile industry is polyethylene terephthalate (PET), which is also used for making bottles used for colas, mineral water, soda, juices, and edible oil. But every day, millions of plastic or PET bottles are being thrown away, which besides adding to waste puts a pressure on the landfill sites and oceans affecting marine life. The incineration of this plastic waste adds to environmental problems.

Reusing or recycling these bottles can help keep plastic out of landfills and oceans. PET bottles are now also being recycled into fabrics. They are melted, extruded and spun into polyester yarn, called recycled polyester or rPET. Fabrics can be woven entirely from rPET or in combination with other fabrics. Considered to be ecofriendly, cost-effective and safe, the rPET fabrics perform equally well as fabrics made from 100 % virgin polyester (vPET).

rPET: Beneficial Aspects

By a broad estimate, if we were to use, say, 2 kg of rPET yarn to make fabric, we could save a full gallon of gasoline, save enough water to provide drinking water to one person for five days and save as much Greenhouse Gas (GHG) emission that goes to the atmosphere while driving a hybrid car (using fuel cell and gasoline) for almost a distance of 25 km.

There are some more benign and interesting facts about rPET. Recycling one plastic (PET) bottle saves the equivalent of 3 hours of energy from a 60W light bulb. Moreover, 1 kg of rPET can keep 60 water bottles out of landfill. The making of rPET also needs 90% less water as compared to virgin polyester (vPET).

The energy needed to make rPET fibre is less than what is needed to make vPET fibre. Various studies agree that it takes from 33% to 53% less energy. The energy needed to make vPET fibre is 125 mJ per kg of fibre. If we take the higher estimate (53%), the energy needed to produce rPET fibre is about 66 mJ per kg. Table 1 shows the energy requirement of various synthetic (chemically produced) fibres. The energy requirement of rPET fibre is far less as compared to vPET fibre or other synthetic fibres.

rPET is also cited as producing far less carbon footprint as compared to virgin polyester (vPET). Carbon footprint relates to the amount of carbon dioxide released into the atmosphere based on the fuel consumption. Estimates of carbon footprint released by synthetic fibres vary. But, according to a study by the Stockholm Environment Institute on behalf of the Bio Regional Development Group, virgin polyester (vPET) has much greater carbon footprint as compared to organic or even conventional cotton.

Table 1: Energy needed for production of various synthetic fibres

Fibre	Energy use in mJ per kg of fibre
rPET	66
Viscose	100
Polypropylene	115
Polyester (vPET)	125
Acrylic	175
Nylon	250

Table 2: Carbon emission (in kg) per tonne of the spun fibre

Fibre	Carbon dioxide emission (kg) per tonne of the spun fibre
rPET	5.19
Polyester (vPET)	9.52
Cotton (Organic)	3.75
Cotton (Conventional)	5.90

A concept called closed loop makes us believe that the plastic yarns can indeed be recycled again and again.



Fabrics made from recycled plastic are now becoming more commonplace with rPET fabrics being made by companies such as Marks & Spencer, EcoSimple and Armani Jeans. The first eco-project of Armani started in 1995 with the development of a process to recycle denim. The fabrics made by

Table 2 shows carbon dioxide emission (in kg) per tonne of the spun fibre. It may be noted that carbon emission for rPET obtained from an independent study has been included in the table for facilitating comparison.

rPET fibre is also called post consumer polyester, which means the polyester from bottles. Indeed, the demand for used bottles, from which rPET fabric is made, is outstripping supply in some areas. Some manufacturers are, therefore, now buying new, unused bottles directly from bottle producing companies to make polyester textile fibre that can be called recycled.

Ways of Recycling

Recycling of polyester can be done either mechanically or chemically. Mechanical recycling is accomplished by melting the polyester and re-extruding it to make yarn. Chemical recycling means breaking the polyester into its molecular parts and reforming the molecules into a yarn of the same quality and strength as the original one. The technology to separate out the different building blocks, called depolymerisation, so that they can be reassembled (a process called repolymerisation) is very costly and is almost never done. Therefore, most recycling is done mechanically.

The recycling process starts from the moment the water bottles are collected and brought to a recycling facility where the conversion process of turning waste into wearable fabric begins. First, caps and labels from the bottles are removed through a floatation and separation process. This is essential because caps and labels are generally made of plastics of different characteristics. The plastic bottles are thereafter processed into chips, also called flakes. These flakes are then washed and melted; the yarn is pulled from this melted stuff. This produces a clean, valuable and recycled raw material perfect for the textile industry. The raw filament yarns are then spun and ultimately woven into a variety of different fabrics.

But, can recycling be done again and again? A concept called closed loop or cycle makes us believe that the yarns can indeed be recycled again and again i.e. infinitely recycled without losing their value.

rPET Fabrics in the Market

Patagonia, an American clothing company based in Ventura, California, US began making rPET fabrics from recycled plastic soda bottles in 1993. The company has recently partnered with Teijin, a Japanese company, which has developed its own closed-loop polyester recycling system.

EcoSimple are a blend of recycled cotton and rPET, which is made from recycled plastic bottles.

Levi Strauss, famous for its jeans, recycles an average of eight plastic bottles in the making of one pair of jeans. The Nike company was able to create a buzz in the recent past by developing the Team India kit for the World Cup 2015 from 33 plastic bottles; cricketers' jerseys were made from 15 recycled bottles while their pants were made from 18 such bottles.

The American apparel company Timberland, famous for its outdoor fashion and shoe wears, recently launched Timberland X Thread collection of apparels by teaming up with Thread, a manufacturer that turns plastic bottles into fabrics. The 30-A company also launched a new eco-friendly apparel line called Dumpster Diver, made from water bottles and other recycled plastic salvaged from landfills. Dumpster Diver includes T-shirts, polo shirts and other wearable fabrics.

The US company Wellman Inc. has developed Eco-fi (formerly known as EcoSpun), which is a high quality polyester fibre made from recycled plastic soda pop bottles. The company Unifi, based in Greensboro, North Carolina, has developed what is known as Repreve yarn spun from plastic bottles. Repreve yarn is used to make everything from jackets and T-shirts to dress pants. A gown maker company Oak Hall Cap & Gown makes graduate gowns from the 100 % Repreve yarn. It takes 27 used bottles to make one gown. Many universities including Brown University, Michigan State University, Yale University, Notre Dame University and University of North Carolina at Chapel Hill are using Repreve-based graduate gowns. The Unifi company, over a span of seven years, has been able to turn about 4 billion plastic bottles into yarn.

Some companies have gone a bit farther. Instead of using recycled plastic bottles, they are turning recycled ocean plastic and used fishing nets into clothing. Adidas, in partnership with the ocean conservation group, Parley for the Oceans, has recently introduced a line of swimwear made of recycled ocean plastic and used fishing nets. The Swedish clothing company H & M, which is one of the world's biggest users of recycled polyester, as part of its Consumer Exclusive Campaign, has in February 2017 made an intricate pleated gown from a sustainable material BIONIC®, which is a recycled polyester made from plastic shoreline waste.

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