ASK THE EXPERT: RECYCLING POLYESTER

Fibre industry must hit the bottle

Our question-and-answer series on topics of interest to technical textiles and apparel professionals continues, with recycling polyester from post-consumer-use plastic bottles as the subject this time. Answering this time is Gail Baugh, a lecturer at San Francisco State University and at the Fashion Institute of Design & Merchandising, with a specialist interest in reusing existing apparel in mass production of new products. She is also a founding member of an apparel manufacturing trade association serving San Francisco and the Bay Area, called peopleWear SF, which will host the 2015 International Fibre Recycling Symposium in San Francisco. She wrote an influential paper in 2008 that concluded recycled polyester is more sustainable than cotton.

Question: You must be tired of being asked about the benefits of using recycled polyester in the apparel supply chain, especially in comparison to cotton or virgin polyester, but what would be a quick summary of them?

Answer: When I first wrote the article in 2008 (see introduction) comparing recycled polyester to cotton fibre (either conventionally or



The collection and processing of plastic bottles is still not part of new fibre production on a global scale.

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organically grown), consumers were surprised about the large quantities of water required to grow cotton. My research showed 1400-3400 gallons per pound of usable cotton fibre (one pound is roughly enough for two T-shirts). This equates to between 5,300 and 12,870 litres of water to produce 450 grammes of usable cotton fibre. Secondly, industry people questioned the comparison of energy consumption used in cotton fibre production and recycled polyester fibre production. My comparison showed that energy consumption in conventional cotton fibre production was nearly the same as recycled polyester fibre. The use of energy to produce the chemicals used on cotton and to pump water moving irrigation water to the cotton farms in arid regions is not included in the energy consumption of producing cotton fibre.

What is surprising is no one cared about the fact that two-thirds of the cotton plant is not used for fibre (it's discarded, or used as mulch and so on) so the labour-intensive harvest to collect and separate the fibre from the rest of the plant, even with mechanical equipment now designed to speed the process, was not a concern. There are other cellulose fibres that produce much more fibre per acre, but those fibres do not have the marketing power of cotton.

Q: In making recycled polyester, what are the pros and cons of using post-consumer use plastic bottles as a raw material compared to using old polyester clothes?

A: Two different processes are involved. Plastic bottles usually involve a mechanical process (chopping the plastic into small pieces and melting them into a liquid to be extruded into fibre). Impurities in the plastic are not removed. On the pro side, this material is easily available globally and there are now organised efforts to collect bottles for fibre production (providing a continuously available raw material). At the same time we have seen that companies such as Unifi have improved the process and can now create a high-quality fibre that can itself be recycled. Plus, significantly less energy is used to produce this fibre than virgin polyester fibre and the price is now competitive compared to virgin polyester.

Against this, though, I'd point out that the process usually produces low-quality fibre (weak and with irregular shape) and must be blended with other fibre for better performance. Also, there is no effort to collect fabrics produced from plastic bottles for recycling into new fibre, which suggests we are simply diverting plastic bottles into fibre that will go to landfill anyway.

For fibre from clothing or any polyester fabric, there is a chemical process to depolymerise (to break down the basic building blocks) and then repolymerise them to build them into new fibre.



Gail Baugh of San Francisco State University wants higher-quality polyester fibre from recycled plastic bottles so that the recycled fibre can make fabric that can itself be recycled into new polyester fibre after use.

Gail Baugh

Significantly less energy is used to produce this fibre than virgin polyester fibre and the new fibre is of the same or higher quality than original virgin fibre. Technically, though, this fibre is not "recycled" because it has been chemically rebuilt using existing polyester fibre or fabrics. Think of aluminium can recycling. The new cans are not marketed as "recycled" simply because they use existing cans.

The cons are that this is more expensive than virgin polyester, although Teijin Frontier will open its new Eco Circle fibre in China early next year, so prices will begin to decrease. Also, collection and processing is limited to one or two suppliers worldwide and they must have a formal relationship with fibre mills that are chemically recycling polyester.

Q: What response would you give to consumers raising concerns that traces of potentially toxic substances might remain in the yarn if a bottle had been used to store paraffin or bleach or something?

A: Based on the descriptions of mechanical or chemical recycling here, it is unlikely that such chemicals will remain on the new fibre. Chemical recycling sorts out the polyester building blocks, which is why the new fibre is often of higher quality than the original virgin

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fibre. The toxins, which are chemical, too, are not part of the fibre's building blocks. High heat in melting and mechanical recycling should eliminate most of these toxins, since they are chemicals used in the container, not part of the chemical polymer of PET. The real question should be about what finishes are being applied to the fabric, and what toxins are in the yarn and fabric finishes. See Greenpeace's study and the EU's efforts to block toxic chemicals in dyeing and finishing.

Q: Are there changes you would recommend for consumers to take on board? Should we all, for example, shun bottles that are coloured? Would it be easier for the supply chain to produce recycled polyester from clear bottles?

A: Clear plastic definitely is easier to recycle into fibre. There may be additional chemical enhancements for marketing purposes (sparkles, cooling technology, and so on) that may make it impossible to recycle. Simple, clear is better.

Q: What is your opinion of the way clothing brands are presenting recycled polyester in finished garments? It's not uncommon, for example, to see PET on garment labels, even though polyethylene is not an official fibre category. What name do you believe the industry should use?

A: PET is polyethylene terephthalate, which is the chemical description of generic polyester. Somehow you've dropped the "terephthalate" from your question. You're correct, polyethylene is not a generic fibre group, but PET is polyester. The brands are correct to use PET to describe fibre from plastic bottles. There are many variations of the polyester polymer, which will have different fibre characteristics. However, this basic chemical structure of the polymer uses PET molecules.

Q: What are the most important advances in collecting bottles and using them to make recycled fibres and yarns that you have observed since you and other experts first began to talk about this idea?

A: Unifi, in the US, has developed high-quality fibres using plastic bottles as the raw material. Without knowing their specific process, it is my understanding that in order to create a higher-quality fibre from plastic bottles requires chemical processing, not simple mechanical chopping and heat. Their new fibre can also be recycled into new fibre. These steps in creating a closed loop of raw material to fibre and back to fibre again, creates a Cradle to Cradle concept, a very important step for future polyester fibre production. Patagonia pioneered this closed loop strategy, partnering with its suppliers to accomplish this vision.



Nike utilise recycled materials for their football shirts.

Nike

Q: Are you aware of any effect that our taste for recycled polyester is having on the production, globally, of virgin polyester?

A: There are two barriers to widespread adoption of polyester fabrics produced from existing polyester resources. The first is that the collection and processing of either plastic bottles or discarded clothing and fabrics is not a part of raw material collection or production of new fibre on a global scale. We need to encourage fibre production that uses these sources only, instead of producing new chemicals for virgin polyester from new petroleum sources. Second, the price of chemically recycled polyester is high and therefore virgin polyester production continues.

One unintended consequence of using PET fabrics without a home for the discarded clothing or textiles is that plastic bottle PET fabrics, currently competitively priced, will only temporarily divert plastics from landfill, with the discarded fabrics eventually headed to landfill anyway. New fabrics from bottles won't reduce use of landfill unless the fabrics produced are themselves collected and recycled into new fibre or fabrics.

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