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PUCFs come clean

Price has always been a major factor in most areas of footwear manufacture. It is particularly true in the case of women's shoes, where rapid changes in fashion are the norm. Here, price, combined with up-to-the-minute styling, is a driving force behind good sales. Mass market ladies fashion shoes may also only be worn for a relatively short time before a new fashion emerges, so the cheaper the shoe, the less the cost of keeping up with fashion. It is in this market sector that synthetic upper materials have had the greatest impact as they cost less and are easier to process than leather.

Price is also the reason PVC has persisted in some parts of the world as a coating for woven-base synthetics despite environmental pressures. Production costs of PVC are far lower than for PU although the latter produces a far superior material. Transfer-coating fabrics or nonwovens with PVC or PU is also the quickest and cheapest method of production. The best method as far as PU is concerned, however, is a process called coagulation, where the cell structure within the PU coating can be regulated to provide a degree of breathability but still be competitive on price. Referred to as PUCFs, they are consequently a popular choice for women's fashion shoes.

PUCFS

Polyurethanes have had a major impact on footwear design and manufacture in several areas since their invention by Bayer roughly 75 years ago. One of these has been in the coating of textiles in order to produce acceptable synthetic alternatives to leather for shoe uppers. Their usage has grown enormously during the past 20 years not only for women's fashion shoes but also for the increasing output of sports and sports-leisure footwear where they are accepted as being more 'hi-tech' than leather. Experts predict a worldwide market for this type of footwear alone of \$85.4 billion by 2023 and many of these will be made using synthetic upper materials including PUCFs.

Footwear fashion is constantly changing as it has always done. What is new, however, is just how much consumers now expect from their shoes and from the companies that market them. They naturally expect them to look good and to be comfortable. In addition, they now increasingly want to know that their shoes are, as far as is possible, sustainable in terms of their

impact on people and the environment from the origins of the materials used to their complete life-cycle and beyond. High leather prices over recent years have further accelerated growth in the use of synthetics and it is estimated that around seven billion pairs of shoes are now produced annually using PUCFs.

Given the importance of PUCFs and consumers' increasing environmental awareness, their environmental impact has also become of greater significance. Their coagulated PU coating has traditionally been formed using a wet process whereby the substrate is immersed in a viscous PU solution that permeates and coats it. This solution typically consists of 25% PU dispersed in a 75% solution of dimethylformamide (DMF) where the DMF enables the PU to penetrate the substrate. Excess PU is removed before the fabric passes to a second bath and then through successive dips containing decreasing solvent concentrations until it reaches the final tank, which consists only of clean water. Furthermore, DMF is toxic and, although it is not classified as

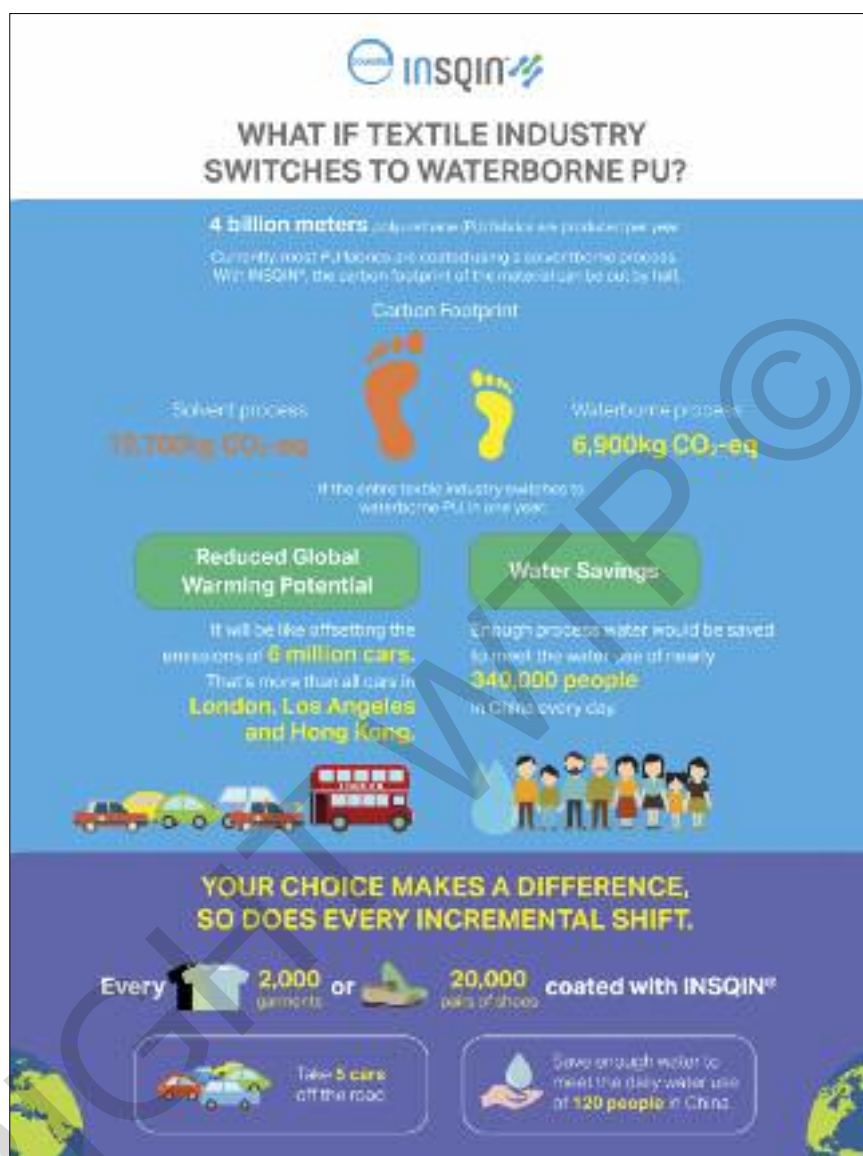
being human carcinogenic, it is nevertheless thought that it may cause birth defects. As a result, women are banned from working with it in some sectors of industry, so it is clearly something it would be better to avoid using if possible.

Coating fabrics with PU has therefore always required large quantities of water in the manufacturing process. As water conservation was becoming an increasing environmental priority, Bayer MaterialScience—now known as Covestro—launched a coating technology called INSQIN in 2014 in which polyurethanes could be used in a particularly environment friendly way. This was a pure waterborne process that the company said made it possible to coat fabrics with PU without the use of any solvents (including DMF) and, at the same time, reduce water consumption during the coating process by up to 95% and energy consumption by up to 50%.

A life-cycle assessment (LCA), reviewed by an independent third party in accordance with ISO standards 14040:2006 and ISO 14044:2006, has now demonstrably shown INSQIN to indeed be a more sustainable way to produce PU coated textiles than conventional technologies. It found that using waterborne polyurethane technology substantially reduces the carbon footprint of the material and that, from cradle to material factory gate, the Global Warming Potential* (GWP) for 1,000m² of waterborne PUCF was 45% less than solvent-based material.

The study compared a comprehensive range of parameters to assess the environmental performance of waterborne PU from the extraction of raw materials to coated fabric production, versus that of the conventional technology involving the use of DMF. According to the results, 1,000m² of PUCF made with INSQIN had a GWP of 6,900 kilogrammes CO₂-equivalent, compared to 12,700 kilogrammes in the case of solvent-based material. To give some idea of the significance of this reduction, if the entire textile industry switched to using this waterborne PU technology, the reduction of greenhouse gas emissions could be equivalent to taking every car off the road in Beijing, or in London, Hong Kong and Los Angeles combined.

While INSQIN itself had a significantly



Covestro's presentation for its INSQIN technology has shown positive results in terms of the environment.

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lower carbon footprint than solvent-borne equivalents, the study revealed that 85% of the reduction in GWP was, in fact, due to the lower energy consumption of the dry textile coating process that the waterborne technology makes possible. In other words, the real benefit of the technology lies in the process changes it makes possible. Furthermore, using INSQIN to coat fabrics with PU also had the potential to reduce acidification in our water and soil by up to 20%, compared to conventional technology.

It is clear that, although leather prices seem likely to remain lower than in the past few years for some time to come, there has been a major shift to the greater use of synthetics as first choice for upper materials in many areas of the footwear industry. Making their

manufacture as 'clean' as possible is therefore mandatory if consumer concerns for the environment are to be met. INSQIN has already proved itself as capable of producing high quality PU fabrics and Covestro has reinforced its environmental claims for the system with this life-cycle assessment. Whereas synthetics have in the past been labelled as being dirty due to their chemical content, they are last beginning to come clean.

Global warming potential, commonly known as carbon footprint, refers to the capacity to influence changes in the global average surface-air temperature and subsequent change in various climate parameters and their effects, such as storm frequency and intensity, rainfall intensity and frequency of flooding.