



ALL CREDITS: HUNTSMAN POLYURETHANES

Flexible 3D printing materials

Interest in 3D printing or, as it is often also called, additive manufacturing, has grown steadily since it first appeared in the 1980s for rapid-prototyping. It has now reached a tipping point, with the technology growing ever faster and moving increasingly towards mass production. The Wohlers Report 2017 forecast a doubling of the global market in the three years from 2017 to 2020 from \$7.3 billion to \$15.8 billion for 3D printing products and services. It went on to predict continued growth to £23.9 billion in 2022 and \$35.6 billion in 2024. Of this, some 13% relates to consumer products which includes footwear. Against this background, chemical company Huntsman has launched a range of soft and flexible urethane-based 3D printing materials for the footwear industry under the name Iroprint.

FOCUSING ON FOOTWEAR

The company has in fact been involved in 3D printing from the very beginning through its Advanced Materials division and its epoxy capabilities. In 2012, the Huntsman polyurethane team started to invest in R&D in this area when it became aware of a surge in demand. In such a potentially huge market and with so many possible applications, the problem was where to start as a urethane material supplier and where to focus the effort. With so many sectors looking to embrace the technology, it had to make a choice. Recognising that 3D printing materials needed to be more functional in order to make the shift from rapid prototyping to mass manufacturing,

it decided to initially focus on just one industry.

Stijn Reynders, global innovation project manager at Huntsman Polyurethanes says, "We ruled some industries out immediately because they focused on the use of metal-based materials. Others were too complex as a starting place because of the properties required or because of regulatory limitations and restrictions. Others were simply too small. One sector however stood out: footwear. The footwear market leads the way in design and the industry is constantly looking out for innovative new ways to make shoes. Plus, as a team, we already had good credentials in the footwear sector, serving big sports brands as well as casual shoe and working boot markets too."

THE CHALLENGE

Across the footwear industry, major brands are beginning to invest heavily in this area and the use of the technology is evolving quickly in both sports and non-sports applications. However, given that the industry produces around 24 billion pairs of shoes per year, relatively small numbers of them are currently produced using 3D techniques. Wider adoption is currently being held back by material challenges that still need to be overcome and most of which relate to material functionality for mass manufacture. When it comes to polymers and plastics, the company sees four key challenges facing the 3D printing industry that are holding back mass manufacture.

1. Properties – existing materials are too stiff and brittle, with many of them developed for prototyping where appearance was more important than performance. What the market needs are materials that are soft, flexible and durable.

2. Productivity – one key bottleneck of 3D printing is speed. Currently, it can take up to several hours to print a sole. Some of this relates to the printer and some to the material. What is needed are materials that are fast and easy to print such as filaments that can be easily pulled or pushed through the printer. Materials should also not be too sticky, plus there are many other aspects that need to be optimised for 3D printing.

3. Scalability – the industry needs larger printers (not just desktop) and related materials that are available in large quantities. For example, a filament spool of 1kg is fine for prototyping but for production, 5-8kg spools are what is required.

4. Cost – footwear and consumer goods in general are cost sensitive. Currently, given the low volume of additive manufacturing materials used in production, costs remain high and therefore need to go down in order to allow wider adoption.

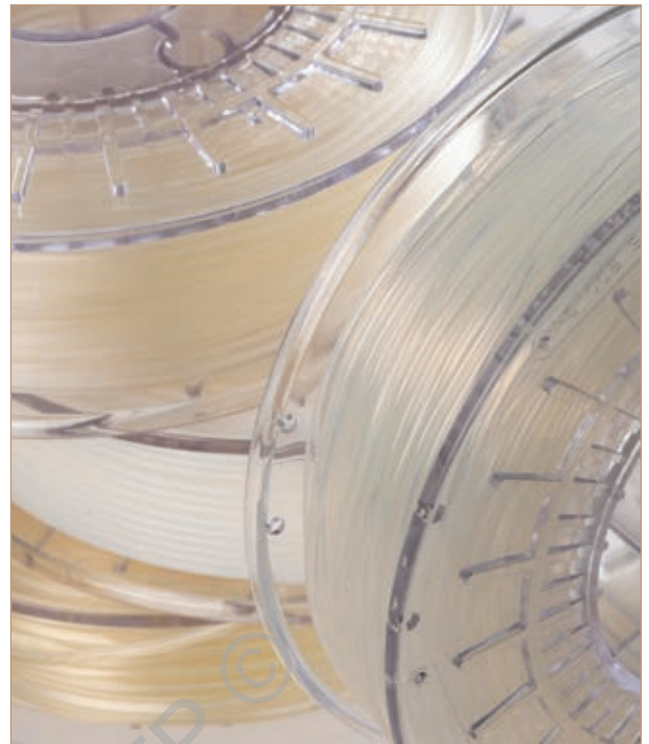
THE SOLUTION

The key to 3D printing on a mass scale is to align the printer, software, material and application requirements. Huntsman has spent time developing urethane materials that address these issues and can be used for mass manufacturing in the footwear field. Stijn Reynders explains, “We set up our own additive manufacturing business, which operates like a start-up within our PU division. Working in an agile, flexible way enables us to get closer to customers, but with the backing and resources of a larger, reliable, global group when it comes to R&D, manufacturing and EHS (environment, health and safety). We decided to take an open innovation and collaborative approach with existing players in the industry, augmenting them with our urethanes expertise and manufacturing capabilities. The result is Iroprint a family of urethanes-based additive manufacturing materials, built on solid application knowledge with partners.”

Huntsman says that Iroprint is a unique product platform for additive manufacturing and the only urethanes-specific 3D printing material. The range is designed to enable footwear manufacturers to create and produce 3D printed footwear components with the right designs, properties and high productivity for the mass-market. The platform is also said to be compatible with multiple manufacturing techniques and also open and evolving, so that it can be built on for years to come. At present, a multitude of printing technologies exist and in footwear production there are three core types: radiation curing, fusing and sintering, and extrusion. As there appears to be no real winner out of these three so far, the company has sensibly decided to develop a platform spanning those methods that are most achievable and scalable.

It currently includes three different kinds of PU- and TPU-based materials; PU resin systems, TPU powder systems and TPU filament systems.

IROPRINT R resins – soft, flexible and durable one-component liquid resin systems that can be 3D printed using SLA (stereolithography), DLP (digital light processing) and



IROPRINT F filaments are designed for use with FFF and other extrusion-based printing techniques.

other radiation-curing methods. One product is currently available, Iroprint R 1801 which offers easy material handling, is scalable, durable, functional and with large volume build for mass-manufacturing. It also has good elongation, tear and tensile strength, and is soft and flexible (Shore 85 to 95A hardness). The target application for this product is midsoles.

IROPRINT P powders – high-performance TPU material for HSS (high speed sintering) forms of printing. One product is currently available, Iroprint P 1019 which offers easy printing with excellent powder flow, a wide sintering window and is consistent in particle size and distribution. It has good elongation, tear and tensile strength, and abrasion. It is again soft and flexible (Shore 85 to 95A hardness). This material is suitable for insoles and midsoles.

IROPRINT F filaments – high performance TPU materials with a consistent diameter and designed for use with FFF (fused filament fabrication) and other extrusion-based printing techniques. Four products are currently available in in two colours and two widths, Iroprint F 80112, Iroprint F 80213, Iroprint F 90116 and Iroprint F 53117. These offer fast printing depending on printer and design, and are consistent in regard to diameter size and properties. Abrasion, elongation and tensile strength are good and the materials are again soft and flexible (Shore 78 to 95A hardness). Typical applications are for insoles and uppers.

When it comes to succeeding in the world of 3D printing, Huntsman believes that building strategic partnerships is the key and, to this end, it is already somewhat down the line with this process, building a network of contacts and its own ecosystem. By forging partnerships across the industry with established players, start-ups and brands it hopes to solve the equation of printers, software, materials and applications in order to develop the right materials for the future. 