TPEs take on more markets and applications

Advances in polymer chemistry, compounding capability and injection moulding sophistication are taking thermoplastic elastomers (TPEs) into new territories. As is so often the case, the automotive industry is providing the greatest impulse for development, but it is not the only one. TPE suppliers are also increasing their offerings for high performance applications in medical, consumer electronics, and beyond, with materials that can help processors and OEMs cut costs and improve sustainability.

Possibly the most interesting recent development in TPEs comes from one of the oldest names in the business: Kraton. Shell came up with the name when it invented SEBS hydrogenated styrene block copolymers in the 1950s. The now-independent Kraton Corporation earlier this year introduced Kraton Injection Molded Soft Skin (IMSS) technology. It says IMSS enables injection moulding of large, thin-walled soft-skin products, “opening the market to larger applications including door panels, consoles and instrument panels (IPs) as thin as 0.8mm.”

The capabilities of the new technology were demonstrated in front of processors and OEMs during a week in January at a plant operated by Hi-Tech Mold & Engineering in Rochester Hills, MI, USA. Production trials were carried out on a 30,000 kN Engel injection machine fitted with a mould for an IP skin.

According to the company, the demonstration proved that its polymers can be thin-wall injection moulded with minimal changes to the slush moulded design’s A-surface. “It also shows how the IMSS technology can be used on standard equipment and under normal processing conditions, using both skin-only and over-moulded injection moulding processes,” the company says.

Kraton has developed TPE grades with melt flow indices much higher than “regular” SEBS types to facilitate thin-wall moulding. These include Kraton MD6951, which has an MFI of 48 g/10 min (230°C, 2.16kg); and Kraton MD1648 has an MFI of around 220 g/10 min. It says compounds based on these polymers can have MFI as high as 500 g/10 min. Both polymers are said to present a balance of high elasticity, tensile strength and lower melt viscosity. MD6951 belongs to the Kraton A family, which have greater polarity than other types. MD1648 is an ERS (enhanced rubber segment) copolymer, more compatible with polyolefins.

According to Kevin Campbell, Kraton’s Vice President, Emerging Business, IMSS is the only solution on the market for injection moulding large...
soft skin product designs without the need of a top coat. “Kraton IMSS technology will allow manufacturers to achieve highly-valued benefits such as vehicle weight reduction, safety and manufacturing efficiency – all from a single technology,” he says. Development programs are ongoing, with Kraton targeting commercialisation in the 2019 to 2020 timeframe.

Kraton IMSS technology can be used on standard equipment and under normal processing conditions, using both skin-only and over-moulded injection moulding processes.

The company says production system costs for production of parts like IP skins are lower than PVC slush moulding commonly used as well as sheets thermoformed in TPO elastomer-modified polyolefin. Parts can also be lighter, thanks to a density of around 0.9 g/cm³ for SEBS compared with around 1.2 for PVC. No painting is required to hide weld lines and blemishes, aging properties are very good, and there are no problems with VOCs and associated fogging and odour issues.

**Fog and odour reduction**

Kraton says its TPE technologies deliver “excellent” cold temperature flexibility, even after long-term heat aging and Weather-Ometer testing. Plasticiser loadings are “minimal.”

A further claimed advantage for the process is its speed. While slush moulding an IP skin can sometimes take five minutes or more, a Kraton IMSS skin can be injection moulded in little over a minute.

Several other TPE suppliers are upping their game for automobile interior applications. “In recent years quality standards for vehicle interiors have steadily increased, particularly with regards to vehicle interior air quality (VIAQ), where the main concerns are interior odour, fogging and VOCs,” says Thomas Köppl, product manager with Hexpol TPE.

He points out that raw materials often need to undergo German VDA tests such as VDA 270 (“Determination of the Odour Characteristics of Trim Materials in Motor Vehicles”) and VDA 278 (“Thermal Desorption Analysis of Organic Emissions for the Characterisation of Non-Metallic Materials for Automobiles”). Additional testing on VOCs is done on the components (for example VDA 276) and finally the air of the whole vehicle interior is tested in large chambers (ISO 12219-1 or Chinese regulation HJ/T400-2007).

“Emission limits were lowered in recent years both by OEMs and legislation,” Köppl says. “These reduced levels can be challenging for some [styrenic] TPE-S-based compounds, therefore new materials were required.”

Hexpol’s Dryflex Interior range are still based on TPE-S, but designed to minimise emissions,
enabling them to be used in applications such as floor mats, cup holder liners, fascia mats and HVAC components. “They display low odour with results 2.0 to 3.0 [on a scale from 1 to 5 beginning with ‘detectable’ and ending with ‘disturbing’] in standards such as VDA 270,” Köppl says. “They achieve VOC results from 60 to 120 µg/g and Fog from 200 to 600 µg/g. According to gravimetric fogging standard DIN 75201 they achieve condensate less than 1.0 mg.”

Kraiburg TPE says it has speeded up its application-specific development of TPEs in response to increasing demand for the materials in high-quality exterior applications. The latest developments include TPE-S compounds in its Thermolast K series with improved adhesion to EPDM rubber and high UV resistance (see also automotive feature in Injection World Nov/Dec 2017). Target applications include two-component window trims and sealing profiles, where they go up against styrenic block copolymers and TPVs.

The first two compounds are TC7EAZ and TC7EFZ, both with a hardness of 70 Shore A.

“Weathering tests have shown that the surface quality of Kraiburg TPE compounds is superior to that of competing materials,” the company says. For the first of the two new compounds, the company focused its development attention on adhesion, while the second scores higher on low fogging values.

**Improved adhesion to EPDM**

Kraiburg carried out EPDM/TPE adhesion tests in accordance with the VDI-2019 standard (at ambient temperature and after 1,500 hours at 90 °C) and also ISO 37. It assessed tensile stress and elongation, as well as the force required to destroy the specimen.

In these adhesion tests, the new materials received good results with both foamed and compact EPDM workpieces. The tests showed that adhesion mainly depends on the cleanliness of the inserted EPDM profiles, and that the best and most consistent results are obtained when the EPDM profile parts are cut as shortly as possible before the TPE component is over-moulded.

Kraiburg TPE partnered with LWB Steinl in its tests. LWB Steinl is one of the world’s leading global manufacturers of vertical transfer moulding presses and horizontal injection moulding machines for rubbers.

Kraiburg TPE adds that its new EPDM adhesion compounds also feature economical processing. They are moulded at relatively low temperatures of 200°C to 220°C, so cooling times are relatively short and holding pressure time can also be reduced. The initial good adhesion of the compounds to EPDM also ensures that the finished parts can be removed from the mould earlier and more easily than with other TPEs.

“Together with LWB Steinl, we have managed to optimise the material and process technologies in such a way that they meet the requirements of different automotive window systems,” says Kraiburg TPE CEO Franz Hinterecker.

Several companies highlight sustainability issues in connection with new material developments. Says Klas Dannäs, Global R&D manager at Hexpol TPE: “Dryflex PCW TPE compounds demonstrate how we can turn waste into a resource. The materials contain a volume of post-consumer recycle from 33% to 80% by weight. Recyclate consists of polypropylene drawn from automotive mouldings, or rubber tyre crumb from both OEM and after-market tyres.”

**Sustainability trend**

Compounds exhibit excellent UV and weathering resistance (conforming to EN ISO 4892-2:2006 and VW PV 3929 : 2008 Kalahari Test), Dannäs says. They are already being used in applications such as automotive mud flaps, sidesteps and antidrag lips.

Dannäs also points to Dryflex Green, a family of TPE compounds based on raw materials from renewable resources such as plant and vegetable crops. “To give the right balance or renewable content, performance and mechanical properties, we continue to investigate new sources of raw materials as they become available,” he says. These include products and by-products from agriculture that are rich in carbohydrates, especially saccharides such as grain, sugar beet and sugar cane.

“We’re also working with suppliers and customers to discuss how we can improve life cycle
impact; from where the raw materials are sourced, how our compounds are produced, packaged, transported and what happens at the end of a product’s life.”

Recent additions to the Dryflex Green portfolio include adhesion compounds for multi-component applications. “In general, the Dryflex Green compounds show very good bonding behaviour to PE and PP,” says Dannäs. “We have also developed special grades for bonding to ABS, PET and PLA.”

The bio route is also being trodden by Trinseo. “With our Bio & Beyond initiative, we are focused on the development of a wide range of biomaterials designed to reproduce current soft TPEs with bio-based and bio-degradable versions,” says a spokesperson for Trinseo.

“These products are based on raw materials from renewable natural sources and will contribute to a reduction in CO2 and greenhouse gas emissions as well as in fossil fuels usage, to a better agriculture resources efficiency and finally to the development of the depressed rural areas no longer suitable for foodstuff cultivation.”

Trinseo has seen a growing demand for high-quality applications that require the combination of soft and rigid substrates. It says the over-moulding of soft TPEs and rigid plastics - Trinseo’s portfolio includes polycarbonates and various styrenics - “delivers genuine advantages for a product’s functional, visual, acoustic and tactile properties.”

“Application areas range from automotive to consumer technologies to medical devices where we’re seeing a growing need for materials to enhance aesthetics, improve usability, and perform specific functions such as comfort handles, as in the case of a surgical instrument, or flexible grips to prevent slippage in electronics, or elastomers on hard surfaces to improve safety,” says the spokesperson. “Now we can offer a wide range of modified thermoplastic elastomeric compounds, all providing exceptional adhesion to the most common rigid plastic substrates.”

At the beginning of May, polyamides specialist EMS-Grivory announced a cooperation with API-Trinseo, specifically aimed at the spectacles market where it says many applications call for a hard polyamide substrate to be over-moulded with a soft elastomer.

The cooperation has two goals, says EMS-Grivory. The companies will initially offer products from the existing product portfolios of both companies which bond reliably and durably; second, during the cooperation work, new products will be developed and tailor-made to suit each other. “Both bio and crude oil based products with different shore hardness values will be developed and examined,” the company says.

More for medical

Medical is also of increasing interest for compounder Teknor Apex. At the NPE2018 show in Florida, it introduced new Medalist medical-grade TPEs for injection moulded plunger stoppers, said to provide improved syringe performance while being less costly and easier to mould than natural and isoprene rubber and providing processing advantages over thermoplastic vulcanize (TPV) elastomers.

Stoppers moulded in Medalist TPEs apparently perform well in both glass and plastic syringe barrels, achieving a consistent piston release and travel force due to a low coefficient of friction. The compounds can be over-moulded onto plungers. In addition to grades for over-moulding onto polypropylene, specialty grades are available for

Right: Swedish outdoor product company Wildo used a Dryflex Green bio-based TPE compound for its famous Fold-A-Cup
over-moulding onto various engineering thermoplastics. Teknor Apex adds that, unlike most TPVs, Medalist TPEs do not require pre-drying. Furthermore, they exhibit improved compression set in comparison with competing TPEs, making possible a more secure seal. All grades are sterilisable. They come in natural and black.

“The Medalist compounds provide substantial advantages over rubber, which has been the predominant material for use in syringe stoppers,” says the company. “TPEs avoid the curing step required in rubber processing, eliminating concerns about extractables and leachables, and their scrap can be recycled. As thermoplastics, TPEs process in considerably shorter moulding cycles and lend themselves to more intricate designs and tighter dimensional tolerances.”

“Stoppers must move smoothly against the wall of the syringe barrel, provide an exceptional seal to preserve the integrity of the drug, and be chemically inert to prevent interaction with the syringe contents,” says Ross van Royen, senior market manager of regulated products. “Teknor Apex has developed a portfolio of Medalist TPEs that meet these performance requirements while providing substantial economic advantages because of their ease of processing.”

Teknor Apex produces Medalist compounds in ISO-13485 facilities in the USA and Singapore. All Medalist materials are made with FDA listed ingredients, are certified to ISO 10993-5 standards for biocompatibility, and are REACH SVHC compliant. They are free of DEHP and other phthalates, BPA, and latex. Standard grades are ADM-free.

Also introducing new medical grades to its portfolio at NPE was Elastocon TPE Technologies. Elastocon 8028N (Shore A hardness 28) and Elastocon 8068N (68A), which recently passed USP Class VI testing for respirators and other medical product applications, can be injection moulded and extruded. They are characterised by high flow, zero odour, and resistance to chlorine and most sanitizers, as well as many cleaning products.

**Filling a gap in high performance**

Speciality polyamides producer Nylon Corporation of America (Nycoa) is a new player in the TPE arena. It has launched an extended product family of polyether-block-amides (PEBA), branded Ny-Flex. The type and the ratio of the polyether and polyamide blocks can be varied. Nycoa is aiming at applications in automotive, sporting goods, personal electronics, and composites, as well as in specialty films.

Nycoa says Ny-Flex grades exhibit a broad range of performance attributes in terms of impact toughness and flexibility. It currently offers grades with hardnesses ranging from 82 Shore D to 90 Shore A.

“These innovative materials have been designed to fill a technology gap in the engineering TPE [E-TPE] material space,” said Pratik Shah, vice president of new business development for Nycoa. “During the extensive development cycle, our...
Following on from its successes with Samsung’s Galaxy Gear S2 watch and Chinese camera maker YI Technology’s M1 (Injection World Sept 2017), it also scored with ZTE’s Quartz smart watch. As with the Samsung watch, Arnitel was selected for the soft strap, providing comfort, flexibility, safety and design flexibility. Arnitel also feels cool and smooth on the skin, with a good balance of physical and chemical properties, DSM says.

DSM began research and development in the smart wearable market in 2014, says Martin Chen, Marketing Manager Electronics (Wearables). “We are happy to see that our intensive R&D efforts have paid off.”

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www.emsgrivory.com  
www.teknorapex.com  
www.elastocontpe.com  
www.nycoa.net  
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Below: Sports shoe soles are one of several target applications for new PEBA TPE from Nycoa.

customers have repeatedly pointed out the need for E-TPEs with superior performance characteristics and the need to lower overall systems cost. We believe that our Ny-Flex grades deliver incredible value to the customer compared to other E-TPEs.”

Shah says the new PEBA materials are principally, but not exclusively, based on PA6 and fit into a price-performance gap above copolyester- and polyurethane-based TPEs and below high-end PEBA TPEs such as Arkema’s Pebax, which are based on PA12. “There are a lot of applications where users need just a small step up from something like TPE-Cs or TPUs,” he says.

Ny-Flex E-TPE grades are said to have excellent flexibility at low temperatures, superior retention of properties to elevated temperatures, and exceptional toughness and resilience.

DSM appears to be finding more of a niche for its Arnitel copolyester TPEs in consumer products.

This international conference from AMI will provide valuable insights into developments in fittings and joints, which play a critical role in the integrity and performance of plastic piping systems. Expert speakers will discuss trends in materials, production technologies, designs and applications, as well as addressing the latest advances in testing and certification.

In addition to the busy programme of informative conference sessions, the event will provide excellent networking opportunities during the refreshment breaks and evening drinks reception.

For further information about attending the conference, taking a table top exhibition space or sponsoring the event, please contact Jordaine Minchin at jordaine.minchin@ami.international, Tel: +44 (0) 117 314 8111.