

Jennifer Markarian examines the latest thermoplastic elastomers designed to meet growing demands in the automotive and medical markets. Plus she looks at new renewably resourced, flame-retardant and multi-component-moulding grades



The secrets of soft-touch success

Consumer goods are the highest profile market for TPEs - these Gillette razors feature soft-touch TPEs from PolyOne's GLS division

Thermoplastic elastomers (TPEs), which combine rubber-like properties with the processing advantages of thermoplastics, find use in a wide range of applications. The automotive market, despite recent struggles, is a key outlet for TPEs in injection moulding applications such as 'soft-touch' interior components. TPEs are growing in the medical market for injection moulded articles like device grips, gaskets, valves, and stoppers. And the consumer goods market, while generally not as high-margin or as fast-growing as medical, shouldn't be overlooked. Injection moulded TPE applications here include athletic shoe soles, vibration dampening in high-performance sporting equipment, and soft-touch grips for everything from toothbrushes to tools. Material suppliers have been steadily at work developing new resins and compounds that meet the different requirements of these markets.

Automotive drivers

Weight and cost reduction are still major drivers in the automotive market, and these are opening up opportunities for thermoplastic vulcanates (TPVs) according to Ian Mills, managing director at **Albis UK**. Albis recently introduced a TPV High Flow range that meets demands of complex components with long flow paths and thin

walls, and offers higher temperature and media resistance than standard TPVs.

ExxonMobil Chemical introduced Santoprene TPV 8211-85 M350 last year to meet the needs of automotive OEMs and Tier 1 suppliers looking for cost-effective solutions for automotive interiors. The new TPV provides high "comfort touch" and can be processed with two-component moulding.

Kraiburg TPE launched Hipex high-performance elastomers in 2008 to compete with thermoset rubbers in high-temperature, media-resistant applications. Hipex adheres to nylon and PET and is now being used in two-component mouldings for oil-pan gasket sealing layers as well as other under-the-hood applications.

Thermoplastic urethanes (TPUs) are experiencing 20 to 30% growth in automotive and industrial equipment markets, claims Roger Huarng, principal at new TPU distributor and service group **Alliance Polymers and Services**. While this growth rate seems astonishing, Huarng says it is a solid number, based on customers giving firm orders for five months out, as they are trying to "catch-up" very low vehicle inventories. He says TPUs are taking market share from TPVs because TPUs have greater puncture, tear, and abrasion resistance that meets the need for longer-lasting products.



Meeting medical needs

Many are looking for growth opportunities in medical applications, and new TPE compounds are designed specifically for some of the unique needs in the medical market. In addition to meeting property and processing requirements, medical-grade TPEs must be biocompatible and sterilisable, have low extractable levels, and possess appropriate regulatory approvals.

TPEs are attractive as alternatives to latex, which can cause an allergic reaction, and to PVC, which is under pressure in the medical market because of concerns with phthalate plasticizers and halogens, comments Dr. Sachin Sakhalkar. He is manager of new business development in the Thermoplastic Elastomers Division of **Teknor Apex**, which offers the Medalist range of medical-grade TPEs. Joe Kutka, technology launch manager for PolyOne's GLS Thermoplastic Elastomers, notes that **PolyOne's** GLS Versaflex HC portfolio of medical-grade TPEs is also positioned to help customers respond to these market trends.

Kraiburg TPE recently introduced the Thermolast M series of SEBS (styrene-ethylene/butylene-styrene or TPE-S) TPEs for pharmaceutical and medical markets. The compounds are produced on a dedicated line and have all necessary regulatory approvals. In addition, Kraiburg TPE offers a guaranteed two-year supply once a material is qualified. This helps mitigate supply risk, which is critical given the extensive material qualification process for these applications, says Jeff Frankish, managing director at Kraiburg. Injection moulding applications such as drip chambers benefit from Thermolast's good resealing characteristics. Thermolast SEBS compounds compete with thermoset elastomers

like silicone and polyisoprene, says Frankish.

Foster Corporation, which is part of **PolyMedex Discovery Group**, announced in February that it had expanded its NanoMed nanoparticle technology into TPE formulations. The nanoparticles increase flexural modulus and tensile properties. However, unlike some traditional reinforcing agents, they do not compromise flexibility or ductility, texture, biocompatibility, or processability explains Bryon Flagg, product manager at PolyMedex Discovery Group. He notes that, although some revalidation is required to use the new additive, approval is not nearly as complex as it is when changing a base polymer. NanoMed has broad applications in both medical extrusion and moulding, particularly in thin-wall, high-stress components, says Flagg. He says TPE injection moulders can use NanoMed compounds to help maintain properties when reducing wall thickness.

Multi-component movements

Multi-component moulding, or over-moulding, continues to expand in all major TPE markets because it is a way to add value to parts, either by differentiating with texture or colour, or by simplifying assembly. Soft-touch over-moulding is also expanding beyond its traditional automotive and consumer markets into new markets like packaging and closures.

Parts consolidation is an important growth driver. For example, designers can replace a separate thermoset seal with a TPE-S seal incorporated into a part via two-shot moulding, which reduces cost and improves recyclability, comments **Kraiburg's** Frankish.

"When done right, over-moulding can reduce assembly costs. In some cases, we see this allowing

Kraiburg's Thermolast TPEs are used in Joby's Gorillapod camera tripods. They provide the required anti-slip properties and also bond well to the ABS body of the device

RTP is supplying a red polyolefin TPE for this axe manufactured by Garant of Canada. The material is over-moulded on the long-fibre composite handle to improve its grip and aesthetics.



North American moulders to compete with low-cost, offshore moulders," says Paul Killian, technical marketing manager for the TPE Division at specialty compounder **RTP Company**. It can combine bondability with other features like static dissipative additives or special colours to help its customers pursue specific applications.

Moulders are looking for materials that can over-mould a broad range of substrates. SEBS, which have long been used to over-mould a wide range of polymers including polyolefins, styrenics and polyamides, have also expanded into the over-moulding of engineering resins like PC and PET. In response to customer requests, Kraiburg has developed SEBS grades that can bond to POM and, the most challenging yet, a glass-filled polyarylamide (PARA), says the company.

PolyOne's new, patented universal over-moulding TPE grade for PA consistently bonds to a range of different PA materials. The company's new Dynalloy 8900 bonds to both LDPE and PP, and sets up quickly for a faster cycle time than unfilled styrenic TPEs. The new product resists skin oils, which helps maintain properties and appearance in handheld products, notes Kutka.

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To meet the need for consistently good adhesion to HDPE in medical applications, such as connectors and seals for fluid-storage vessels, **Teknor Apex** developed TPE compounds with double the adhesive strength of standard TPEs when over-moulded onto such substrates. The new Medalist medical-grade elastomers use Teknor Apex technology previously used for TPE cap liners.

Renewable revolution

'Renewably-sourced' or 'bio-based' plastics – polymers made with some or all plant-based rather than petroleum-based raw materials – are beginning to find their way into the TPE market. Although still in their infancy and currently limited to specific TPE raw materials, products containing bio-content are gaining momentum in injection moulding applications such as footwear. Growth is expected in soft-touch over-moulding for consumer goods, while in other markets such as automotive, users are evaluating if the market will support the cost. Bio-based TPEs are typically not biodegradable, and many have physical properties that equal or even exceed those of their petroleum-based counterparts. The main driving force for using bio-based



products is the desire throughout the supply chain to improve sustainability and reduce carbon footprint. Even for TPEs that contain only a small percentage of bio-content, every little bit counts in the sustainability effort.

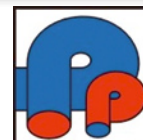
The bio-content in **Arkema's** Pebax Rnew polyether block amide (PEBA) grades reduces global warming potential by 30 to 40%, says Basker Lalgudi, sales and market development manager at Arkema. Pebax Rnew

PolyOne's Versaflex TPE is over-moulded onto the cap of this Nalgene drinking bottle to improve its grip and feel



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Merquinsa renewably-sourced Pearlthane Eco TPU is being used in the frame of these Evolve snow goggles from Smith Optics



sourced products later this year, and sees demand particularly in Europe. Looking at an alternative way to improve sustainability, RTP is also investigating using recycled materials in compounds.

with 20 to 90% plant-origin carbon (from the plant-based castor-oil amide component) have been available since 2007, and have been used commercially in applications such as footwear for the past year. Arkema recently introduced Pebax Rnew100, which combines a bio-sourced polyol with the castor-oil-based amide to make a PEBA derived entirely from renewable resources. Rnew 100, a 35 Shore D material, is being considered for injection moulded applications such as shoe soles and electrical and electronic parts, comments Lalgudi. Pebax Rnew grades offer drop-in processability for standard Pebax. Because they are based on PA 11 chemistry, Rnew grades offer even better cold impact resistance, flexibility at low temperature, flex fatigue resistance, and higher thermal resistance than standard Pebax according to Arkema.

Merquinsa's Pearlthane and Pearlbond Eco bio-based TPUs, containing 20 to 90% bio-content using plant-based polyols, were launched in 2007 and are used in injection moulding applications like sporting goods, consumer electronics, and automotive parts. At NPE 2009, Merquinsa launched a new family of Pearlthane Eco TPU made with DuPont Cerenol renewably-sourced polyol. Merquinsa says that Eco TPU's properties and processing are comparable to those of standard TPU grades, and shrinkage is the same so they can be used on existing tooling. "In certain cases we have seen some cycle advantages over standard TPU," adds Dennis Lauzon, North American general manager for Merquinsa. He notes that while today only the polyol building block for TPU is available as a plant-based material, biochemical companies are working on deriving the isocyanate and chain extender building blocks for TPU from plant-based materials.

DuPont offers DuPont Hytrel RS TPE, a thermoplastic polyester containing 20 to 60% bio-based polyol. Hytrel RS properties and processing characteristics are comparable to those of standard Hytrel, says DuPont.

Several compounders have also introduced bio-based grades. For example, PolyOne's new GLS OnFlex Bio TPE alloys contain 20% bio-content, and the company's GLS Versaflex Bio TPE alloys have up to 70% bio-content. Teknor

Apex produces compounds with 30 to 60% thermoplastic starch, using proprietary technology from its relatively new Bioplastics Division. RTP Company expects to roll out renewably-

Stopping flames and meeting RoHS

Most TPE suppliers offer grades that are compliant with the EU's RoHS (Restriction on Hazardous Substance) regulations, which now restrict deca-BDE flame retardants, among other additives, for electrical and electronic (E&E) applications. "We see significant demand for BDE-free compounds in both Europe and North America, with more North American companies converting over the last several months. The trend in Europe has now moved on to completely halogen-free flame retardants (HFFR)," says Dr Sakhalkar at Teknor Apex. The company introduced a new series of Elexar TPEs last year that provide a combination of RoHS compliance, UL-V0 flame retardance, and good performance over a wide range of end-use conditions.

Some alternatives are 'drop-ins' with comparable processing to compounds containing deca-BDE, while others have narrower processing windows. The appropriate alternative depends on the TPE type and the desired flame retardancy and other properties, notes Killian at RTP, which announced deca-BDE free grades last year. It claims that its flame retardant TPEs offer superior bondability for over-moulding. "UL94 flammability ratings for these compounds are predominantly V-0 at 1.5 mm with some grades extending down to 0.8 mm," says Killian.

Kraiburg introduced halogen-free flame retardant (HFFR) grades of Thermolast SEBS TPEs last year that can replace PVC in E&E applications. The compounds balance flame retardance and physical properties using an intumescent FR system, says the company.

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The collar of the new Salomon Ghost alpine ski-boot is one of the first commercial applications of DuPont's Hytrel RS TPE which is produced from renewable resources

