Thermoplastic elastomers (TPE) are plastics that combine the properties of classic elastomers (flexibility, elasticity) with the processability of thermoplastics. Most conventional thermoplastics tend to have low wear resistance and flexibility. TPE can be used as an alternative to meet these desired requirements. In addition, the impact strength of conventional thermoplastics can be improved by adding a TPE.

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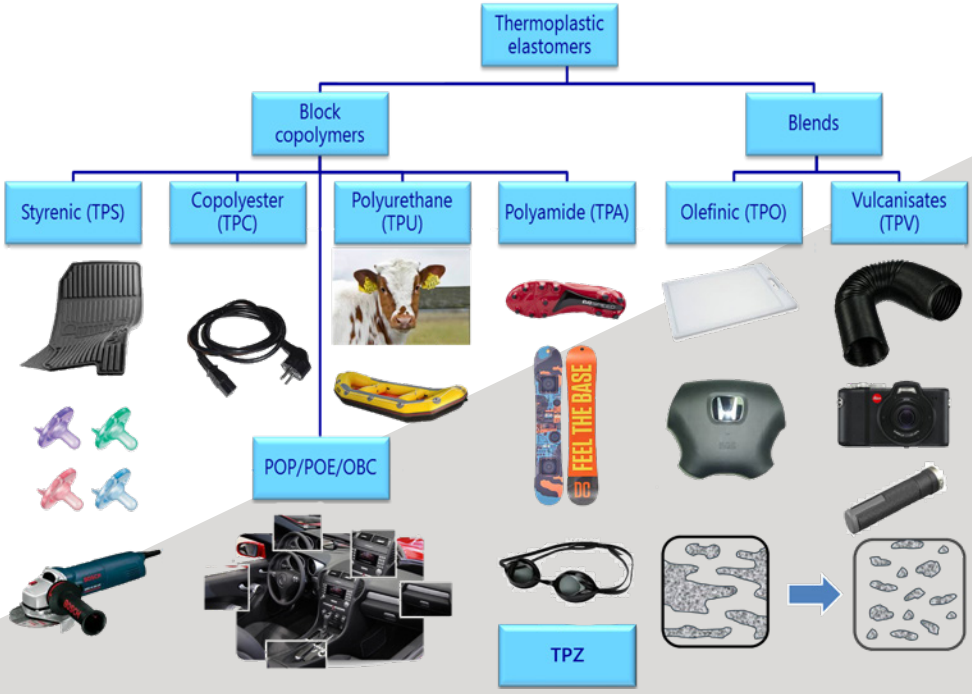
Thermoplastic elastomers are one of the fastest growing markets within the plastics industry worldwide (annual >6%). The possibilities of TPE are endless. They are widely used in the automotive industry, but are also increasingly being applied in the medical, food and sports articles sectors. The flexible and elastic properties as well as the soft feel of TPE are key factors here.

TPE can be divided into different classes. A first classification is based on the TPE's structure. Most of the commercially available TPE are block copolymers, consisting of 2 or more polymer chains linked together: styrene-based TPE (TPS), copolyester TPE (TPC), copolyamide TPE (TPA), polyurethane-based TPE (TPU) and recently also olefinic block copolymers (POP, POE, OBC) have been added.

The second "class" of TPE consists of a mixture (or blend) of different polymers: olefinic TPE (TPO) and dynamically vulcanised TPE (TPV). TPE which do not belong to these classes are included in a separate class and may therefore be either block copolymers or blends (TPZ). The different classes, as well as some typical applications, are illustrated below.



TPE, like most plastics, are synthesized from petroleum-based raw materials. Because ecological awareness is growing among customers, they insist on sustainability and bio-based as being desired product properties. This prompted the industry to invest more in research into bio-based, 'green' alternatives to conventional plastics. As TPE are a recently developed class of plastics, research on biobased TPE is still in full development.

In 2010 the company Braskem succeeded in producing polyethylene (PE) on an industrial scale from sugar cane[1]. Polyolefins are often blended with TPS to confer a certain hardness and mechanical strength to the material. The use of bio-PE from sugar cane (as an alternative to petroleum-based PE) led to the first bio-based TPE, which is generating increasing interest.

This was the kick-off for further research into bio-based TPE. In the years that followed, more and more possibilities were explored by the industry. This not only resulted in more bio-TPE, but also in bio-TPE with new and improved properties. The company Kuraray won ß-farneseen from sugar cane, which can serve as a building block for bio-TPS with damping properties[2]; the company Covestro researched numerous bio-based polyols from sugars for bio-TPU and the company Arkema developed bio-TPA from PA11, which was produced from bio-based oil extracted from the Castor Plant[3].

Despite these many developments, not a single TPE that is 100% bio-based is currently being produced on an industrial scale. These developments always contain a percentage of non-bio-based raw materials. The main reasons why 100% biobased TPE are not industrially available are, on the one hand, the cost price (which increases significantly with the use of a higher percentage of biobased raw materials) and, on the other hand, the decrease in mechanical properties. Research on bio-TPE is on-going.

In het Interreg-project 'Elasto-Plast'[4], we are looking together with our partners to solve the problem of 100% bio-TPE at an acceptable price. The research group of Prof. Dr. Ir. Wim Thielemans (Chemical Engineering Group, KULeuven department Kortrijk) analyses the possibility of synthesizing 100% bio-TPE from sugars. The properties and industrial applicability are then evaluated by Centexbel. The project runs until March 2021.

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1 http://plasticoverde.braskem.com.br/site.aspx/Im-greenTM-Polyethylene
2 Kuraray, Development of a new styrenic elastomer using renewable monomer, TPE Magazine, 2015, 262-263
3 Sebasien Merzlic, Towards a new generation of Pebax elastomers, TPE World Summit Milan, 2018
4 https://interreg-elastoplast.eu