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Newsletter Elasto-Plast

11/19 2019/2

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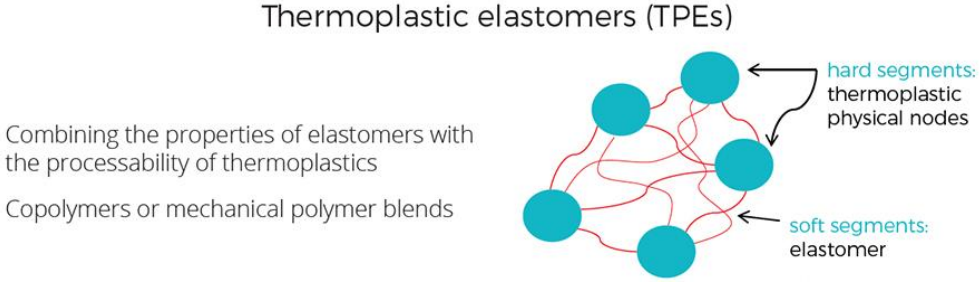
Contact Us

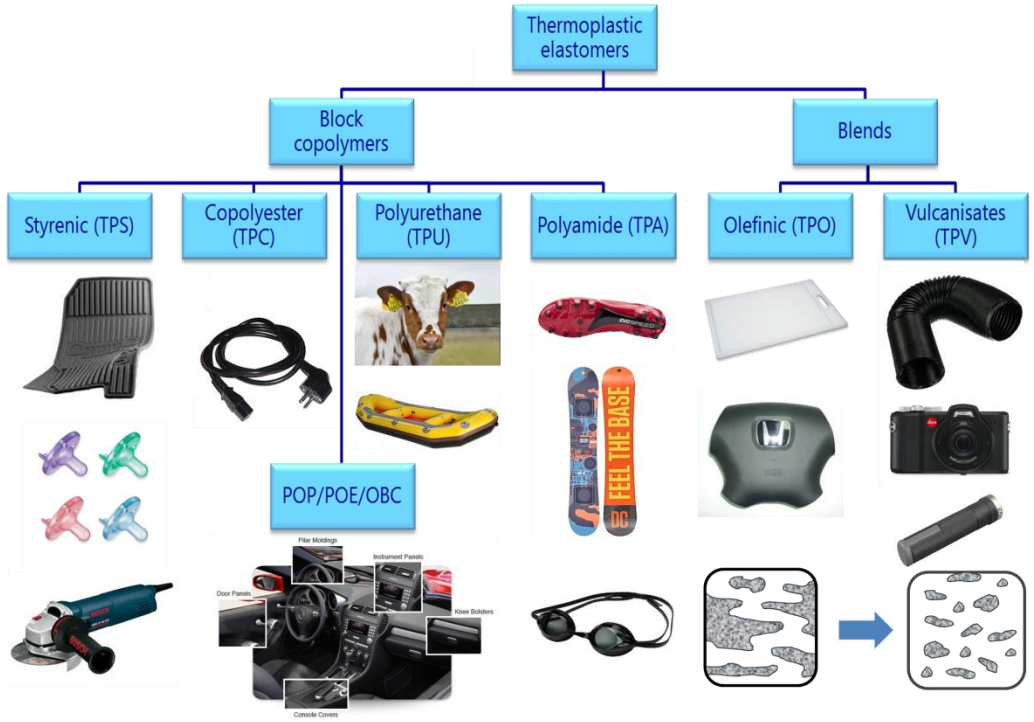
https://interreg-elastoplast.eu/
as@centexbel.be
ids@centexbel.be
sco@centexbel.be

Thermoplastic elastomers: An overview

"Thermoplastic elastomers (TPE)" are a group of plastics, which are elastic at room temperature and which behave as thermoplastics at elevated temperatures. TPE combine properties related to common elastomers (flexibility, elasticity) with processing properties related to thermoplastics.



TPE can be divided in different classes depending on structure and used polymers. A first distinction can be made based on stucture. The majority of commercial available TPE are block copolymers, consisting of 2 or more polymer chains connected together: styrenic TPE (TPS), copolyester TPE (TPC), copolyamide TPE (TPA), polyurethane TPE (TPU) and recently found olefinic block copolymers (POP, POE, OBC). The remaining TPE consist of a mixture (or blend) of different polymers: olefinic TPE (TPO) and dynamically vulcanised TPE (TPV). TPE, which cannot be included in 1 of the previously described subclasses are assembled in a different class: TPZ. These TPE can be block copolymers or blends. In the figure below you can see the different TPE classes, as well as some known applications.



If you are interested in receiving more information, we are happy to invite you to the free TPE course at VKC-Centexbel, Kortrijk (information regarding this course is mentioned below).

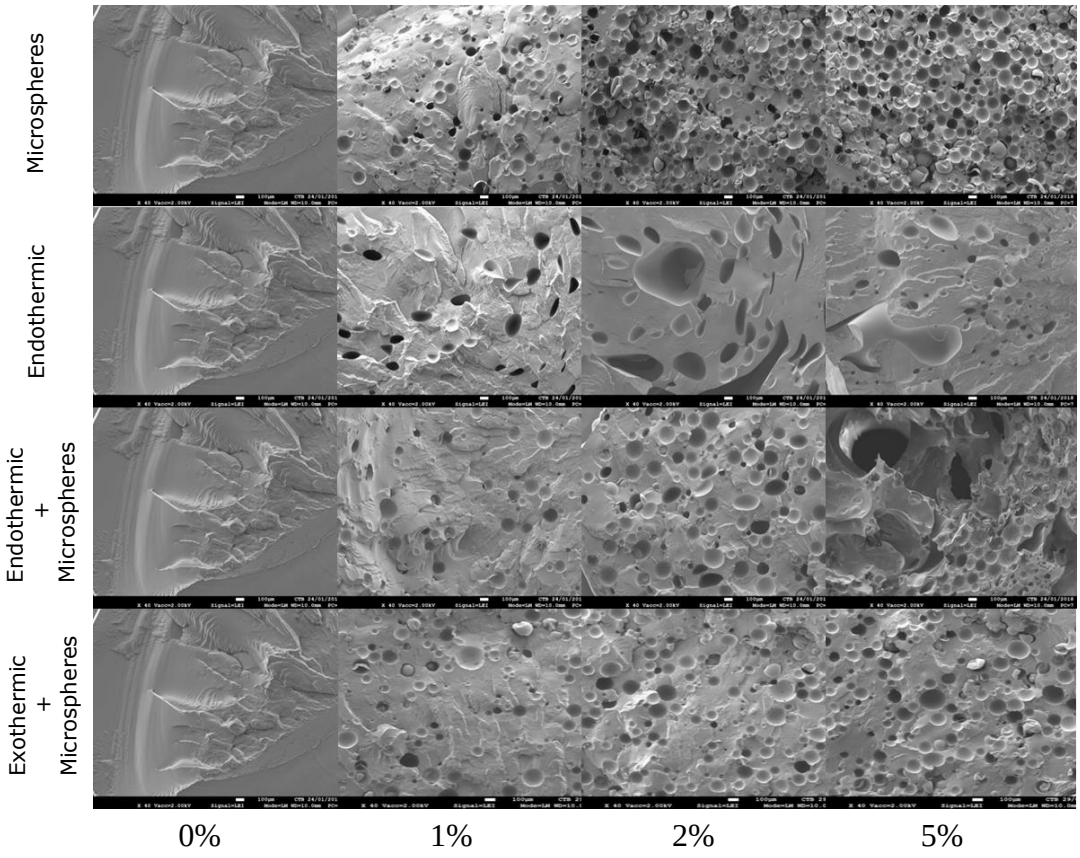
The influence of different foaming agents on POE: extrusion

In the Interreg project Elasto-Plast we analyse and compare properties of commercially available TPE. Furthermore, we investigate if we can improve these properties e.g. through addition of functional additives. One running investigation is focussed on the influence of addition of different foaming agents to different TPE. Addition of foaming agents gives rise to more than density reductions, it also leads to unique properties, such as sound dampening and insulation.

Foaming agents can be divided in 3 groups: physical and chemical foaming agents and microspheres. Physical foaming agents are foaming agents, such as CO_2, N_2 en isobutane, which are added directly to the polymer melt during extrusion or injection molding. Chemical foaming agents on the other hand, are additives which release gasses due to chemical reactions at elevated temperatures. These foaming agents can either be endothermic (take up heat, $NaHCO_3$ and/or citric acid) or exothermic (release heat, ADCA). Microspheres

are polymeric 'balloons', containing a gas (mostly hydrocarbons), which expand without liberating the gas.

Below are SEM-images (microscopy) showing the results of a POE of 80 shore A, with addition of 0 to 5% of microspheres, an endothermic foaming agent, a combination of the endothermic foaming agent and microspheres and a combination of microspheres and ADCA respectively at a processing temperature of 185 °C. Addition of at least 2% of the endothermic foaming agent resulted in coagulation (merging of multiple bubbles).



The influence of different foaming agents on POE: analysis

Density in function of percentage added foaming agent and compression set were analysed.

To determine compression set (CS), samples are compressed till 75% of the original thickness. After 22h the samples are removed and the 'new' thickness

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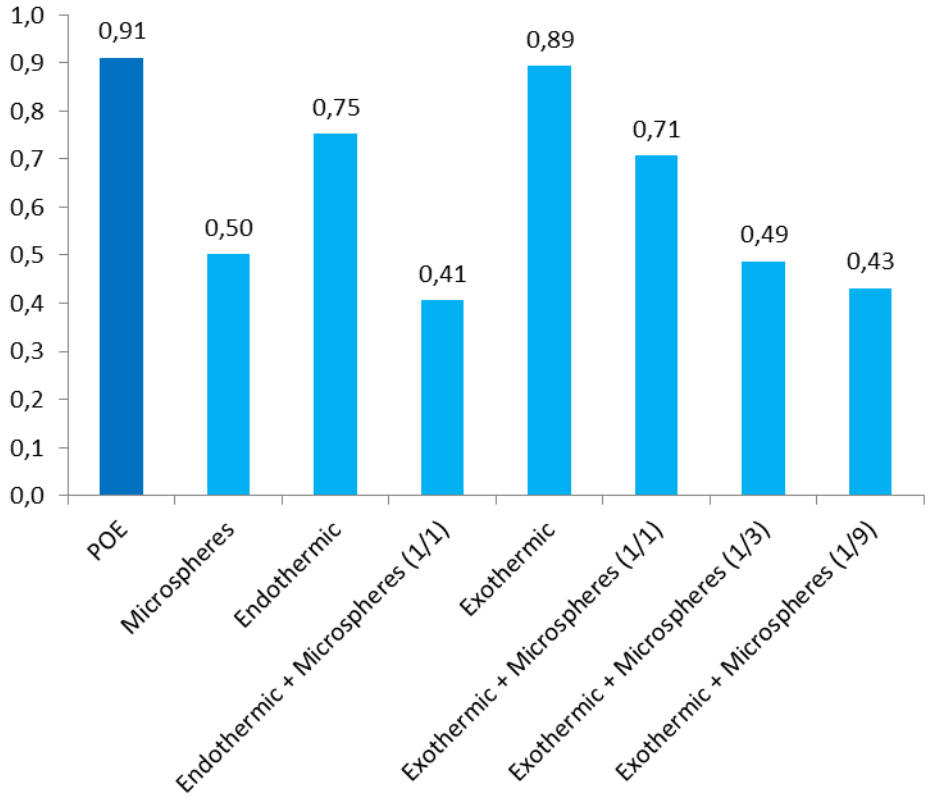
of the sample is measured, after 30min relaxation: $CS = \frac{h_0 - h_1}{h_0 - h_S} * 100$ where h_0 is the orginal sample thickness, h_S is the sample thickness during the test ($0.75*h_0$) and h_1 is the sample thickness after testing. A lower compression set is found in more resilient elastomers, which have a higher ability to return to their original thickness.

In the figure below an overview of the obtained densities (addition of 5% foaming agent) can be seen.

The density of the unfoamed POE (80 shore A) is 0.91 g/mL.

When ADCA was added as foaming agent, almost no reduction in density was seen, which is probably due to its high activation temperature (> 200 °C ⇔ processing temperature of 185 °C).

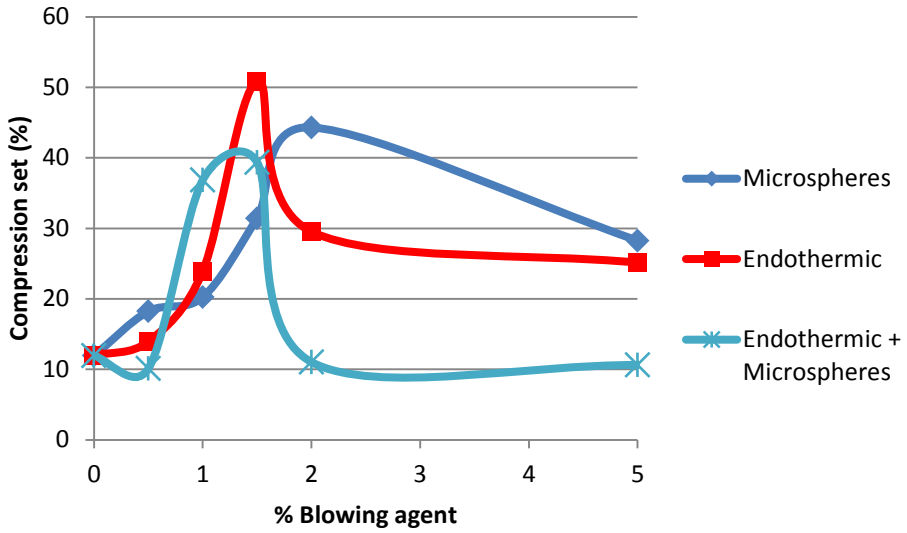
The lowest density is reached when using microspheres as blowing agent. It is, however, interesting to notice that a combination of ADCA and micropheres (1/9) leads to an even lower density (0.43 g/mL ⇔ 0.5 g/mL when only microspheres were used). The even lower density reached, when using an endothermic blowing agent in combination with microspheres, is discarded due to the coagulation of the bubbles, leading to measuring errors in determining the density.



In the next figure an overview of the results of the compression set can be seen. The compression set of POE is 10%.

Addition of 1.5-2% of a foaming agent resulted in an increasing compression set. Further increasing the amount of foaming agent gave rise to a decreasing compression set. It seems that a higher resilience is obtained when higher concentrations of foaming agent are added compared to lower concentrations.

Moreover, the best compression set is obtained when using a combination of an endothermic foaming agent and microspheres (±10%, or the same amount as unfoamed POE).



The best combination of a good density reduction and a good compression set is obtained using microspheres as foaming agents. To maintain a compression set below 30%, an addition of maximum 1.5% of microspheres could be advised.

Introduction course TPE (Kortrijk)

During previous events organised by Elasto-Plast, we noticed that a general knowledge of thermoplastic elastomers is limited in the interested companies. To lower the threshold of using TPE and increasing the knowledge of TPE processing, Elasto-Plast will provide a **free** TPE introduction course on the 31/01/20 (9-12h) to whoever is interested. **Registration** is **mandatory**, due to practical reasons.

During the course the different TPE and their subclasses, theor most important properties and possible processing techniques will be discussed. A lunch will be provided after the course. If you are interested in joining this course, please subscribe by sending an email to as@centexbel.be, ids@centexbel.be or sco@centexbel.be.

Het Elasto-Plast team