

TPE Stretch bands

Introduction

TPE stands for thermoplastic elastomers. It is not the material but a general feature describing the property of this substance. TPE refers to a class of copolymers or physically a mixture of a rubber and a plastic. The source of TPE is mainly crude oil, and it is considered not sustainable. As we aim for having positive impacts on our planet, we act for what we can improve.

What is Thermoplastic Elastomer(TPE)?

TPE usually refers to a class of copolymers or physically a mixture of a rubber and a plastic. They perform excellent resistance to such as high temperature, UV and impact and have the property of thermoplastic processability. However, if TPEs' requirements of temperature were not met, permanent deformation could happen, making reprocessing and recycling even more challenging.¹ Most



Figure 1. Sterkur's Stretch band, currently made from TPE.

importantly, these TPEs are all made from synthesis processes and their raw materials are derived from crude oil. We sought for the alternatives of TPEs and found out that **natural rubber** is an ideal candidate due to its similar properties to TPE and for potentially having a positive impact on the environment.

Six types of TPEs are²:

- Styrenic block copolymers (TPS)
- Thermoplastic polyolefin elastomers (TPO)
- Thermoplastic vulcanizates (TPV)
- Thermoplastic polyurethanes (TPU)
- Thermoplastic copolyester (TPC)
- Thermoplastic polyamides (TPA)

TPS contains polystyrene parts and rubber parts. It has many properties that natural rubber has but with more resistance to heat, weathering, and chemicals.

TPO are a mixture with polymers and a filler. A filler refers to substances added to resin or binders (plastics, composites, concrete) that allow us to improve specific properties. TPO is very common in outdoor application for its property of UV

¹ ('Properties of TPEs', n.d.)

² ('Thermoplastic elastomer', 2019)

resistance³.

TPV is a vulcanized alloy made mostly of rubber particles encapsulated in a polypropylene (PP) matrix. It provides good resistance to temperature, oxidation and UV³.

TPU is any of a class of polyurethane plastics providing many properties, including transparency, elasticity and resistance to oil, grease and abrasion³.

TPC as the name suggests is made of copolyesters. It is also thermoplastic and offers good elasticity and resistance to impact, flex fatigue, high temperature, chemicals and oils³.

TPA is a copolymer from several amide polymers. TPAs have a high service temperature compared to other types of TPEs and possess the properties of low deformation potential, good heat aging, and improved solvent resistance³.

Here we do not specify which TPE we are using because with different strength of the bands may differ. TPEs can be very customized.

Sustainability

We inspected in 7 categories: biodiversity, air quality, climate, land use change, soil quality, water quality, and water use. These seven categories are directly adopted from the impact-model made by De Natuurverdubelaars⁴. However, we are only able to give a very brief analysis. We know that using crude oil is not good for our planet. Therefore, it will not make sense to make a deep analysis on the production process for the TPEs. We know we will need to find an alternative.

These TPEs are the derivatives of crude oil and are made through synthesis. Similar to the impacts of EVA foam roller, not only the processing of crude oil, but also the syntheses of these polymers create significant impacts on climate and air quality. Energy used produces GHG and thus contributes to climate impact. Air quality is also influenced by the release of other gases during crude oil extraction and process as well as syntheses. Biodiversity and land use change impacts are also prominent but constrained in the locations where the crude oil fields and factories are. Establishment of a factory and exploitation for crude oil fields result in land use change. The process of plastic did not use much water and therefore it has less impact on water related categories. There is also limited impacts on soil quality.

The alternative - Natural rubber

As the abovementioned, TPE is environmentally unfriendly. Natural rubber is an ideal alternative which has good elasticity and resistant to heat (melting point: 180°C) and light.⁵ It has high strength and excellent resistance to fatigue and to cutting, chipping

³ ('Properties of TPEs', n.d.)

⁴ www.natuurverdubelaars.nl

⁵ ('Natural rubber', 2019; 'Natural Rubber', n.d.)

and tearing.⁶

Natural rubber is collected and made from rubber trees, mainly from the species *Hevea brasiliensis*. Making incisions in the bark and collecting the fluid is called "tapping". This sticky and milky fluid is latex and will be processed to rubber. Natural rubber is often vulcanized. It is heated in vulcanization process and sulfur, peroxide or bisphenol are added to improve resistance and elasticity and to prevent it from perishing. The vulcanized rubber can be further processed or added with chemicals for different required properties like hardness and strength.⁷

Sustainability

We looked into the seven environmental categories again from the impact-model made by De Natuurverdubbelers⁸.

The plantations of rubber trees can be regarded as a renewable source of rubber if the plantations practice sustainable management. Rubber trees can produce latex for about 25 years after 7 years of maturation.⁹ Using rubber as material is for sure a good step moving away from crude oil which has much more impact on the environment. However, there are still some concerns about the environment.

Biodiversity impacts may happen on genetic diversity, species richness and ecosystem services.¹⁰ Monoculture and artificial forests is not ideal for the environment, but they do provide shelter and temporary habitats for local species.¹¹

On land use, impacts result from deforestation and exploitation for rubber tree plantations, and the erosion due to vegetation loss may impact the soil quality.¹²

Water use may increase because of monoculture plantations. The impacts of air and water quality are limited since rubber tree plantation still functions as a forest which is able to catch carbon and preserve water.

A minor concern is that if our stretch band is made of natural rubber, additives which are derived from crude oil such as bisphenol can be added in the process for the texture or the strength of the bands. However, the additives only comprise a very small proportion of the product.

Conclusion

We know TPEs and natural rubber both have their negative impacts on the environment. However, in our perspective, using natural rubber will have reduced much negative impact because the base of the band will not be crude oil derivatives. Having a plantation forest may cause some impacts on the original forests but it still

⁶ ('Natural Rubber', n.d.)

⁷ ('Natural rubber', 2019)

⁸ www.natuurverdubbelers.nl

⁹ ('Natural rubber', 2019)

¹⁰ (Global Nature Fund, n.d.)

¹¹ (Brockerhoff, Jactel, Parrotta, Quine, & Sayer, 2008)

¹² (Global Nature Fund, n.d.)

provides some essential ecosystem functions to the local species, which is better than having exploitations for crude oil field. This can possibly offset the negative impacts and obtain to having a positive impact. Therefore, using natural rubber as the main material for stretch band instead of TPEs seems a logical next step.

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