

Spiky ball



Introduction

Sterkur's spiky ball is made of Polyvinyl chloride, PVC. It is a very common and popular thermoplastic. It contains a high content of chlorine and carbon, which are derived from crude oil or natural gas. PVC's properties of low cost, high processability, malleability and light weight make it possible for customized needs. It is also a very durable material due to its resistance to oxidation and degradation.¹ The property of thermoplastic allows PVC products to be recycled and converted into new products again. However, the raw materials of PVC are crude oil or natural gases derivatives. Therefore, in this paper, we look into the environmental impacts of using PVC and tries to find out if there are any sustainable alternatives for PVC. The alternatives need to remain similar functions.



Figure 1. Sterkur's spiky ball, currently made from PVC.

Polyvinyl chloride, PVC

PVC is the world's third widely produced synthetic plastic. It is produced by polymerization of the vinyl chloride monomers. Different plasticizers are added depending on the types of the PVC products to achieve different properties. PVC is excellent for its resistance to many chemicals, high hardness and mechanic properties. It has a lot of applications from construction, sewage pipes to clothing and healthcare items. However, it is easy to deform under high temperature. Also, there was also a health concern that potential toxins like dioxins and lead could be released. When PVC products are disposed of, the best waste management is to recycle them. Landfills and incineration of PVC will release much CO₂ and toxic gases, or the degradation of PVC will release microplastic particles which will accumulate in organisms and cause a health risk.²

Sustainability

The raw materials of PVC are derived from crude oil. From the exploitation of crude oil, the environmental impact begins with land use change and biodiversity. Lands were transformed into crude oil fields which might accommodate many lives before. Establishment of PVC factories may also cause land use change and biodiversity impacts. Climate and air quality are also significant. Not only the extraction of the

¹ (Johnson, 2018)

² ('Polyvinyl chloride', 2019)

crude oil, but also the process of synthesizing this polymer consumes much energy and therefore release much greenhouse gas (GHG) as well as air pollutant such as sulfide and nitride to the atmosphere. 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.

Wood

Wood is a renewable and sustainable resource. Deforestation and environmental impacts may occur without sustainable forest management. By following sustainable certification bodies such as PEFC and FSC, we can ensure that production forests can be sustained, and the lives related it will have the lowest impacts. Also, by using wood as the material for spiky ball, we will be able to reduce the use of plastic, which is made from crude oil, and indirectly reduce our negative impacts on the planet.

The properties of wood material are similar to which PVC has. The firmness is even more stiff than PVC. Coating can be applied for waterproof function and the spikes on the wooden ball are also as stable as they are on the PVC balls.

Sustainability

It is suggested to use sustainably harvested wood as the material. Certifications of the wood like Programme for the Endorsement of Forest Certification (PEFC) and Forest Stewardship Council (FSC) are highly recommended. These certification bodies can help reduce direct and indirect impacts on the environment.

On biodiversity aspect, plantation forests function as temporary shelters and habitats for species living in the areas.³ As these plantation forests are run on a rotational basis, the functions of sheltering and as habitats are temporary but so will the disappearance of the plantation be. For land use change, as long as the plantation forests are maintained sustainably, there will not be much land use change impact happening because the land basically function as wood production.

The use of wood actually help mitigate climate change. Trees sequester carbon from the atmosphere and store it in their tissues. Humans harvested these tissues and make them into products. This act indirectly increase the carbon storage in general. The carbon is stored in the form of wooden products and used by humans. If these products are preserved well, the time that carbon is fixed instead of giving back to the atmosphere can be longer than natural cycle. The concentration of CO₂ in the atmosphere can be reduced as well. Air quality can also benefit from tree plantations. Photosynthesis gives more oxygen and the structure of the forests can function as blocks for air pollution diffusion.

The water used in plantation is mainly from natural precipitation, and therefore,

³ (Brockerhoff, Jactel, Parrotta, Quine, & Sayer, 2008)

there is no need for irrigation like crop fields. Water and soil quality are preserved since sustainable plantations are usually located in the areas that are less impact concern in terms of land slope or watershed areas.

Natural rubber

Natural rubber has good elasticity and resistant to heat (melting point: 180°C) and light.⁴ It has high strength and excellent resistance to fatigue and to cutting, chipping and tearing.⁵

Natural rubber is collected and made from rubber trees, mainly from the species *Hevea brasiliensis*. By making incisions in the bark and collecting the fluid is called "tapping". This sticky and milky colloid/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.⁶

The material of rubber is used for spiky ball as well on the market already.

Sustainability

The plantations of rubber trees can be regarded as a renewable source of rubber if the plantations follow sustainable management. Rubber trees can produce latex for about 25 years after 7 years of maturation.⁷ However, there are still some concerns about the environment.

Biodiversity impacts may happen in terms of genetic diversity, loss of species and ecosystem services.⁸ Monoculture and artificial forests is not ideal for the environment but they do provide shelter and temporary habitats for local species, and thus are in debate.⁹ On land use change, impacts result from deforestation and exploitation for rubber tree plantations, and the erosion due to vegetation loss may impact the soil quality.¹⁰ 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 Sterkur's stretch band is made of natural rubber, additives which derives from crude oil such as bisphenol can be added in the process for the texture or the strength of the bands.

⁴ ('Natural rubber', 2019; 'Natural Rubber', n.d.)

⁵ ('Natural Rubber', n.d.)

⁶ ('Natural rubber', 2019)

⁷ ('Natural rubber', 2019)

⁸ (Global Nature Fund, n.d.)

⁹ (Brockhoff et al., 2008)

¹⁰ (Global Nature Fund, n.d.)

Conclusion

From this paper, we can see that wood might be an alternative for the spiky ball. The sustainability, impacts and the properties are better than PVC. Advise for Sterkur is to look further in these possibilities.

Update Sterkur 01/09/2020:

Wood for the spiky ball is extremely expensive compared to PVC. We are not able to make this switch.

Recycled PVC might be a better option?

References

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