Foam roller alternatives

Introduction

The material of our foam roller is ethylene-vinyl acetate (EVA). The source for EVA is crude oil. It is difficult to recycle and not considered sustainable. As we aim for positive impact on our planet, we need to find out what we can change.

What is Ethylene-vinyl acetate (EVA)

EVA is a plastic that can be made into foam, creating properties of bounce and stiffness. It is copolymerized by ethylene and vinyl acetate (VA). Ethylene is a gas colorless and flammable, with a faint "sweet and musky" odor when pure[1], and vinyl acetate is an organic colorless liquid and an important precursor for many industrial polymerizations[2].

How is an EVA foam roller made?

The copolymerization of ethylene and VA is done under pressure and uses free-radical catalysts. The grades of EVA vary in weight due to different content of VA from 5-50%[3]. The detailed manufacture process can be found on the website of FOAMTECH. EVA has not only good resistance to stress-cracking and environmental factors, but also is sulfur free and with low odor. More importantly, the rigidity varies dependent on the ratio of ethylene and vinyl acetate. The higher the proportion of vinyl acetate in the mix, the more flexible and versatile the product can be[4].

Figure 1. Sterkur's foam roller, currently made from ethylene vinyl acetate.

In figure 2, you can see the production chain of the EVA foam roller.

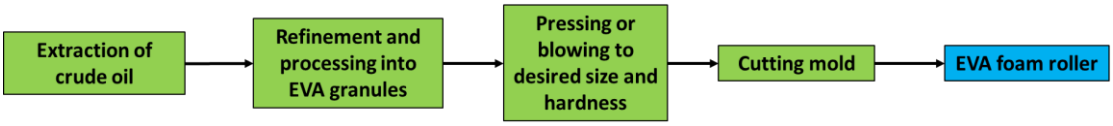

Figure 2. Production chain of EVA foam roller

[1] ('Ethylene', 2019)
[2] ('Vinyl acetate', 2019)
[3] (The Editors of Encyclopaedia Britannica, 2019)
[4] ('EVA Foam', 2017)

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 Natuurverdubbelaars[5]. 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 EVA foam roller (or for other plastic products). We know we will need to find an alternative.

For EVA, the environmental impacts it has on climate and air quality are most significant. The process of synthesizing this polymer consumes much energy and therefore release much greenhouse gas (GHG) to the atmosphere. The raw material of EVA is crude oil. The process to make crude oil into an EVA monomer is also energy demanding and releases GHG as well. Not only the GHG is released to the atmosphere, but also other air pollutants such as sulfide and nitride, having impacts on air quality. Exploitation of oil also contributes much to the impacts of climate change and air quality. As for the other categories of sustainability, biodiversity and land use change impacts are also prominent but constrained in the location where the crude oil fields and factories are. Establishment of a factory and exploitation for crude oil fields need land use change. Thus, the designated areas and the activities of the facilities all influenced biodiversity as well as the surroundings. 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. Lastly, the only way to process EVA foam currently is landfill[6].

So, as mentioned above, EVA is bad for the environment. Let's move straight to the alternatives.

The alternatives

We found two kinds of rollers that met our requirements. One is and expanded polypropylene (EPP) foam roller and the other is cork roller. Both have less impact on the planet compared to EVA. Here we do not take other materials into account because of practicality. For example, wood roller is too hard and not bouncy so that it needs another layer to function as cushion, such as a layer of cork or plastic.

Expanded Polypropylene (EPP)

From a material perspective, EPP foam is a wonderful product. It provides a variety of density grades, water and chemical resistance, energy absorption, it is light weight and impact resistant. EPP has almost all the properties that EVA has, including durability, rigidity, light weight and environmental factors resistance.

---

[5] www.natuurverdubbelaars.nl

[6] (GREENMAX, n.d.-a)

Regarding manufacturing, EPP can be obtained from 3 sources, crude oil, recycled EPP, and biomass such as corn, sugarcane or plant oil [7]. Polypropylene (PP) is expanded to form EPP. Along with other additive ingredients, PP resin is processed and extruded into pellets and the pellets are expanded and shaped into beads of EPP foam. The beads are then injected under pressure and heat to fuse the beads into final forms[8]. Furthermore, EPP can be 100% recycled in plastic stream[9]. EPP waste is collected and compacted or melted for storage and for later recovery to make into other products[10]. EPP is not perfect but it is a step in the good direction, with the source and end-of-life strategies being more environmentally friendly.

Sustainability

In the 7 environmental categories, similar to EVA, the main impacts are on climate change and air quality, and the other impacts as well. Both EPP and EVA are made through synthesis and from crude oil. However, if we can assure that our raw material of EPP comes from recycled EPP instead of crude oil, we can lower the energy and resource used significantly for making EPP roller. Regarding using biomass as raw material sources, it is still in debate about food crops not functioning as food, and the impact of this is unclear.

Cork roller

Cork is made from a tree species *Quercus suber* (the cork oak), which is endemic to southwest Europe and northwest Africa. It is harvested from the bark of the cork oak every 9-12 years by hand. In cork factories, cork barks are boiled to be softened and cleaned. Cork stoppers with different sizes for wine bottles are made from these cork barks. The remaining of the barks is ground into granules and glued with an additive adhesive (in some cases food-grade polyurethane) to make other cork products such as cork roller[11]. Cork has similar qualities and functions that EVA foam roller has. On top of that, it has antibacterial and anti-static properties. The chemical substances in cork tissue can prevent the growth of some bacteria and some small insects, and a waxy substance called Suberin keeps dust, hair and small particles away from the surface.

Sustainability

Among the 7 environmental categories, using cork as the material can have some positive impacts. Biodiversity and land use sustain as the forests are conserved for the cork production. Through harvesting by hand, the impact on the trees and the forests is the lowest compared to timber harvest. Air quality and climate also benefit

[7](Gotro, 2013; Stiven, n.d.)
[8](ARPRO, n.d.)
[9](ARPRO, n.d.)
[10](GREENMAX, n.d.-b)
[11](42Birds, n.d.)

from keeping cork forests. Trees functions to purify air and with harvesting the cork, the cork trees sequester carbon from the atmosphere in a higher rate than unharvest trees[12]. Soil and water quality remain similar as only the bark of the trees are harvested, which does not influence the surroundings. While processing cork, a large amount of water is used to soften the cork.

In general, it does not have much impact on the environment, and it can be easily recycled. The harvest of cork bark is done by hand and will not harm the trees themselves since bark is a dead tissue of the tree. Harvested trees absorb 3-5 times more CO_2 than unharvested ones[13]. Furthermore, as cork material is recyclable, the cork products can be collected and recovered to make new products. For example, many programs have been initiated to collect used cork stoppers and manufacture new products from them such as cork roller. This indicates that cork roller can be made from remnants of fresh cork stoppers or from recycled cork stopper. Therefore, it is suggested to recycle cork products with particular recycling organizations. Only one minor concern is that plastic such as polyurethane is used to glue cork granules, which is also a derivative of crude oil.

Conclusion

EVA is the current material that we use for foam roller. From the result of this report, cork roller is the best candidate to replace EVA foam roller. The reasons are not only cork roller has the similar properties as EVA regarding durability, environmental resistance plus anti-bacterial properties, but also it can easily be recycled for recovery.

In table 1, you can find an overview of this analysis. The black circle indicates it is beneficial to the environmental category and the white circle indicates it is not beneficial. In figure 3 you can find the sustainability scale of these three products, while the EPP here is indicated differently as crude oil sourced and other.

Table 1. The overview of EVA, EPP and cork roller on sustainability. The black circle indicates it is beneficial to the environmental category and the white circle indicates it is not beneficial.

	EVA	EPP	Cork roller
Biodiversity	●○○	●●○	●●●
Air quality	●○○	●○○	●●●
Climate	○○○	●○○	●●●
Land use change	●○○	●○○	●●○
Soil quality	●●○	●●○	●●○
Water quality	●●○	●●○	●●○

[12] (42Birds, n.d.)
[13] (42Birds, n.d.)

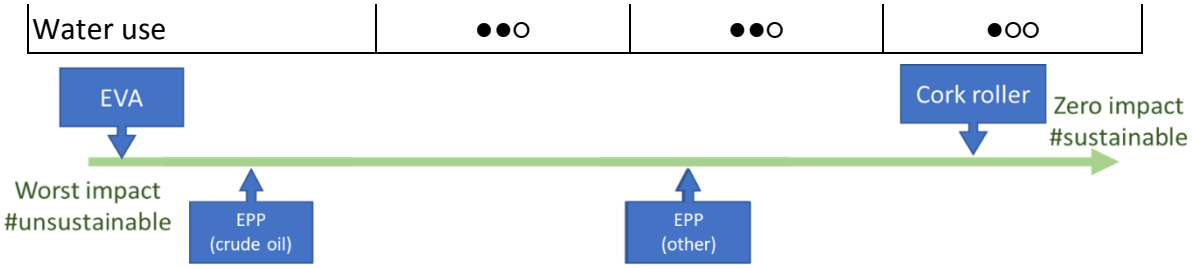

Figure 3. The extent of sustainability for EVA, EPP and cork roller.

References

42Birds. (n.d.). Why Cork? Retrieved 19 June 2019, from 42 Birds website: https://42birds.com/pages/why-cork

ARPRO. (n.d.). Expanded Polypropylene (EPP). Retrieved 8 May 2019, from British Plastics Federation website: https://www.bpf.co.uk/plastipedia/polymers/Expanded_Polypropylene_EPP.aspx

Ethylene. (2019). In *Wikipedia*. Retrieved from https://en.wikipedia.org/w/index.php?title=Ethylene&oldid=896024253

EVA Foam: 3 Things You Need to Know. (2017, August 22). Retrieved 7 May 2019, from Custom Case Group website: https://customcasegroup.com/news/eva-foam-3-things-to-know-cheat-sheet/

Gotro, J. (2013, April 30). Bio-Based Polypropylene; Multiple Synthetic Routes Under Investigation. Retrieved 9 May 2019, from Polymer Innovation Blog website: https://polymerinnovationblog.com/bio-based-polypropylene-multiple-synthetic-routes-under-investigation/

GREENMAX. (n.d.-a). Ethylene-vinyl acetate copolymer (EVA) foam waste recycling company. Retrieved 8 May 2019, from https://www.intcorecycling.com/How-to-Recycle-EVA-foam.html

GREENMAX. (n.d.-b). Expanded Polypropylene (EPP) Foam Recycling Company. Retrieved 9 May 2019, from https://www.intcorecycling.com/how-to-recycle-epp.html

Stiven, A. (n.d.). Axpoly® recycled polypropylene pellets. Retrieved 9 May 2019, from Axion website: https://axiongroup.co.uk/products/recycled-plastics/axpoly-recycled-polypropylene-pellets/

The Editors of Encyclopaedia Britannica. (2019, April 4). Polyethylene. Retrieved 6 May 2019, from Encyclopædia Britannica website: https://www.britannica.com/science/polyethylene

Vinyl acetate. (2019). In *Wikipedia*. Retrieved from https://en.wikipedia.org/w/index.php?title=Vinyl_acetate&oldid=892349734