Carbon Footprint

Underlay 5166 (Underlay GO4CORK FUSION)

Corticeira Amorim

Executive summary, confidential, for internal and limited use only

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Building a better working world

Title "Carbon footprint of Underlay 5166: executive summary"

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EY carbon footprint analysis follows a life-cycle approach based on ISO Standard 14040, and is based on Corticeira Amorim data and business assumptions. These results are not third-party verified.

Lisboa, Portugal

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Introduction

Corticeira Amorim is the largest world producer of cork products, championing the sector since 1870. The company has a portfolio of products with applications in multiple industries, such as wine, construction, flooring, aeronautical, automobile, footwear, among others. The company has implemented an integrated production process that ensures that no cork is wasted. Amorim Cork Composites, a subsidiary of Corticeira Amorim is focused in producing innovative solutions with combinations of cork and other materials, by recycling, reusing and reinventing natural and organic materials. The composite cork industry requires high levels of physical and chemical performance, providing adequate solutions to the needs of several industries such as the automotive, aerospace and aeronautical industries, the construction sector, as well as the shoe and interior design industries.

Goal and scope definition

The main purpose of this study is to quantify the carbon footprint related to the production of Underlay 5166 (also branded as "Underlay GO4CORK FUSION") a thermoformable material used as an inside layer in floor systems, produced from recycled and natural materials, in Amorim Cork Composites's activities. The assessment is focused on a functional unit of 1 m^2 of Underlay 5166, a flooring component composed by medium density cork, regranulated cork, recycled ethylene-vinyl acetate (EVA) foam, recycled medium density polyurethane (PU) foam and polyurethane binder.

The different life cycle stages under a cradle-to-gate approach, included in the inventory boundary are forest management activities, grinding cork, including cork transport from the supplier, grinding EVA, grinding PU and manufacture and packaging. Figure 1 shows the system boundaries of the studied system, the boundaries for the activities performed by Amorim Cork Composites and main inputs and outputs per stage.

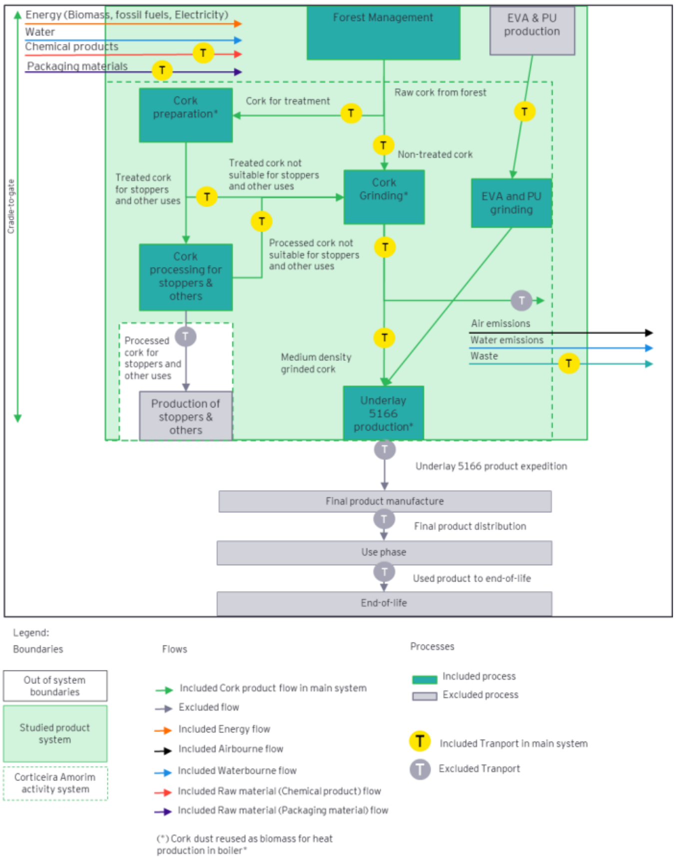

Figure 1 - System boundaries for the studied system and relevant flows and processes

Methodology

This report analyses the carbon footprint regarding the production of Underlay 5166, through a life cycle analysis (LCA) approach. The study was based on the ISO 14040/44 standards (ISO, 2006), complemented with the guidelines from International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance (EC-JRC, 2010).

Impact assessment methods

Inventory results are calculated using the SimaPro software (version 9) (PRé Consultants, 2019). The potential climate change impacts of each stage were estimated selecting the impact category Climate Change from the ILCD (Table 1). In order to assess the carbon footprint on a full year of operation basis (for the year 2018), energy, material use, air emissions, waste and water treatment data was collected for each stage. Potential climate change impacts were allocated to Underlay 5166 and its byproducts using mass allocation (i.e. allocation based on the proportional mass of each of the products), where no further subdivision of unit processes was deemed feasible.

Table 1 - ILCD Midpoint Climate Change (CC) category (EC-JRC, 2011)

Impact category	Unit	Description	Reference
Climate Change (CC)	kg CO_2 eq	Global Warming Potential (GWP) calculating the radiative forcing over a 100-year time.	Fourth Assessment Report of the Intergovernmental Panel for Climate Change (IPCC)

Biogenic carbon content and emissions

Regarding biogenic CO_2 emissions from cork dust consumed and previously originated by the cork that enters the studied system, the following procedure was adopted, based on accepted biogenic carbon accounting methods (Tellnes et al., 2017):

- All cork raw materials that enter the studied system have a similar amount of carbon storage. The calculation of CO_2 content is based on the atomic weights of carbon (12) and carbon dioxide (44), as well as the carbon fraction (dry basis) of 55% and a moisture fraction of 6% (Dias et al., 2014b). As a result, cork raw materials are modelled with a carbon content of 1,896 kg CO_2/kg cork at the point of entry in the system.

- Cork dust produced and consumed within boundaries is considered as a closed loop recycling system; therefore, biogenic CO_2 emissions due to the incineration of cork dust in the biomass boiler are to be accounted, to provide a neutral CO_2 balance when considering all cork flows in the system. Biogenic CO_2 emissions were then determined using a mass balance approach total cork dust used in the boiler and cork dust produced within each stage of the industrial process, avoiding that the carbon content to be wrongfully attributed to the cork products.

Accounting the use of materials from recycling

EVA and PU foam used in underlay 5166 have been previously discarded by their first owner, as these materials were not fit to be used in the primary product manufacturing at their source. As so, by using this material, Amorim Cork Composites becomes the secondary user and needs to account for the use of recycled material (as a flow from technosphere).

The exact boundary settings between the first and the next product systems are defined by the willingness to pay for the recycled material. This implies that from the moment the user of a secondary material pays for the material, this (secondary) product system will also be responsible for the environmental burden from that point on. This principle is referred to as the Polluter Pays (PP) allocation method (EPD International, 2018).

As so, due to the inflow of recycled material to the production system, the transportation of these materials from their source to Amorim Cork Composites is included in this system. It can be assumed that the materials get repurposed once they enter the grinding process in this secondary system.

Inventory Analysis

With regards to data sources, data related to the production of Underlay 5166 was collected through the use of questionnaires carried out by Amorim Cork Composites (local data), while general production processes associated to raw materials production (chemical products, packaging materials), energy, transport and waste management were obtained from ecoinvent 3.5 database (Werner, et al., 2016).

Carbon footprint results

The carbon footprint of Underlay 5166 per stage is shown in Figure 2. As observed, the carbon stored in the product accounts -0,36 kg CO_{2eq} per m^2 of Underlay 5166. Overall impacts of the forest management, grinding cork, grinding EVA, grinding PU and production stages account a total of 0,41 kg CO_{2eq} per m^2 of Underlay 5166. As a result, the carbon footprint accounts for 0,05 kgCO_{2eq} per m^2 of Underlay 5166, under a cradle to gate approach, showing that within the stages assessed, the overall carbon footprint of the product is approximately neutral, for the functional unit.

The impact of Underlay 5166 production stage accounts for 75% of total cradle-to-gate emissions. Relevant sources of overall impacts are related to the manufacture of purchased chemical products such as the glue (71% of total impact) that acts as a binding agent in the production process, electricity consumption (18%), occurring both in the grinding and production stages, and transport activities (5%).

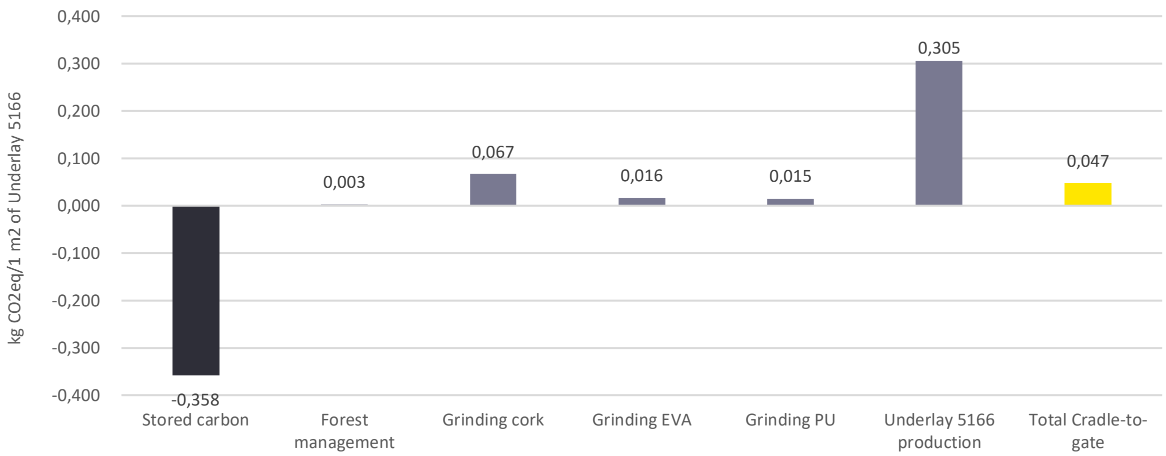

Figure 2 - Carbon footprint of product per stage

Scenario analysis for carbon sequestration of the cork oak forest

In past studies, the assumption that carbon sequestration of the cork oak forest can indirectly be attributed to cork products was simulated, as the cork transformation industry contribute to the exploitation and maintenance of the cork oak forest. This link is further explored by a means of a scenario analysis of how much carbon retention by forest can be linked to an amount of cork produced (PwC/Ecobilan 2008; Rives et al., 2013, EY, 2019a,b).

In this scenario analysis, the GHG emissions of the studied cradle-to-gate system are compared to the carbon uptake by the cork oak forest, considering the cork weight in the functional unit. The resulted carbon balance is here presented as an additional environmental information, as should not be confused with the carbon footprint analysis, where GHG emissions and biogenic stored carbon by cork are addressed. Carbon stored in the product was excluded for this scenario to avoid double counting.

Allocation of CO_2 uptake to the cork extracted from the cork oak stands follows the same premises of allocating environmental impacts in Dias et al. (2014a). Two perspectives were considered:

1. **Weight-based perspective:** All CO_2 uptake by the cork oak forest is allocated to extracted cork as cork production is the main economic activity of cork oak forest;

2. **Mass perspective:** CO_2 uptake by the cork oak forest is allocated to extracted cork considering the physical system of the cork oak stand (tree + cork), where, during the tree life-cycle, cork mass represents about 31% of dry basis weight when compared to wood.

The analyzed scenarios consider carbon sequestration in well-managed cork oak forests, with a high tree coverage and good soil and climate conditions, with an average CO_2 uptake of 11 t CO_2/ha[1], reaching a maximum of 14,7 t CO_2/ha. Translating[2] these values in function of cork extraction, there is a CO_2 uptake of 55 t CO2/ha, reaching up to 73 t CO_2/ha.

Taking into account both allocation perspectives:

- When considering the weight-based perspective of allocation procedure (1), a forest uptake of -11,0 kg CO_2/m^2 (up to -14,6 kg CO_2/m^2) is attributed to the product and a carbon balance[3] of -10,6 kg CO_{2eq}/m2 (up to – 14,2 kg CO_{2eq}/m^2).

- When considering the mass perspective (2), there is a lower forest uptake attributed to the product of -3,4 kg CO_2 (up to -4,5 kg CO_2/m^2) and a carbon balance of -3,0 kg CO_{2eq}/m^2 (up to –4,1 kg CO_{2eq}/m^2), as a lower fraction of CO_2 uptake is allocated to the extracted cork.

These results illustrate the differentiating factor between cork and other forest-based products. As the cork oak tree retains carbon for over 100 years, regardless of cork harvesting (Bugalho et al., 2011), cork exploitation supports the maintenance of the ecosystem, thus having a positive contribution to global climate regulation. As stated above, it is important to note that this result should solely be considered as additional environmental information to the carbon footprint presented in this study.

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[1] Figures considered in the "The value of cork oak montado ecosystem services" (EY, 2019). Average ecosystem CO2 uptake (11 t CO_2/ha) considers wet and dry years in well managed forests, with a maximum of 14,7 t CO_2/ha registered in optimal climatic conditions (Costa-e-Silva et al., 2015).

[2] Conversion of forest ecosystem uptake per tonne of extracted cork considers the total cork oak occupation area in Portugal (719 937 ha) (ICNF, 2019) and an average value of cork production (145 000 t cork) based on a nine-year series (2003-2011) (APCOR, 2011).

[3] Considering 0,4 kg CO_{2eq}/m^2 emitted during the production of Underlay 5166.

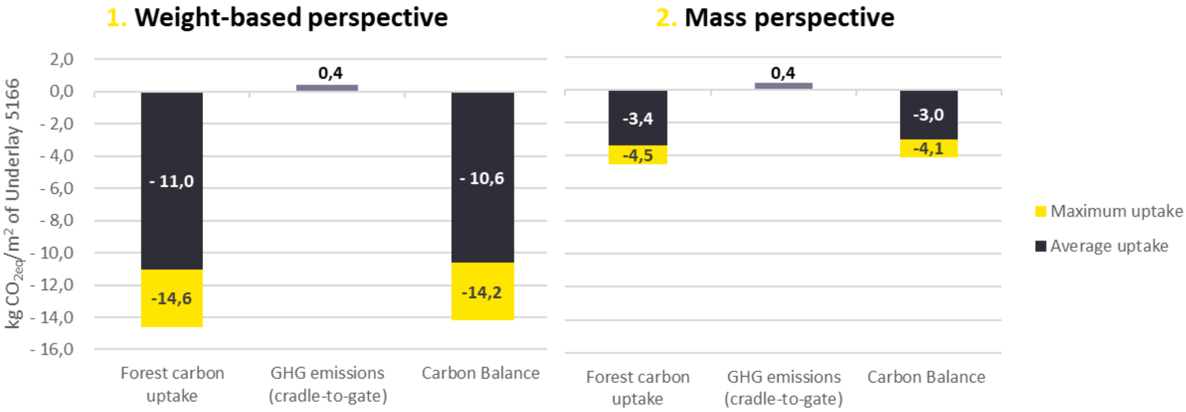

Figure 3 - Comparison of carbon balance results according to each method

Conclusions

Carbon footprint

This study provides a cradle-to-gate carbon footprint of Underlay 5166. Overall results show that, under a cradle-to-gate system boundary, the highest climate change impacts are associated with the processes stages where the consumption of energy and the use of chemical products is higher.

The impact of Underlay 5166 production stage accounts for 75% of total cradle-to-gate emissions. Relevant sources of overall impacts are related to the manufacture of purchased chemical products such as the glue (71% of total impact) that acts as a binding agent in the production process, electricity consumption (18%), occurring both in the grinding and production stages, and transport activities (5%).

Total emissions account for an overall climate change impact of +0,41 kgCO_{2eq}/ m^2 of Underlay 5166. Considering the carbon stored in Underlay 5166 (-0,36 kgCO_2/ m^2) which mainly reflects the amount of cork used in the product, results of a carbon footprint of +0,05 kgCO_{2eq}/ 1 m^2, showing that within the stages assessed, the overall carbon footprint of the product is approximately neutral, for the functional unit.

As Underlay 5166 uses cork and recycled materials such as EVA and PU, Amorim Cork Composites is able to lower the potential climate change impacts stemming from its product. The use of recycle materials that would otherwise be disposed opposes to a scenario where these main inputs would be sourced in the transformation industry and integrated in the final product. Hence, here this recycled materials enter the system with no carbon burdens other than its transport to the industrial facilities. By putting the concepts of circular economy into practice, a reduction of expected climate change impacts in the final product is achieved.

Carbon sequestration of the cork oak forest

When considering a scenario analysis, where the carbon sequestration of the cork oak forest can indirectly be attributed to cork products, based on well-managed cork oak forests, a forest carbon uptake up to -14,6 kg CO_2/m^2can be observed. This results ina carbon balance up to -14,2 kg CO_{2eq}/m^2, considering both forest carbon uptake and GHG emissions of Underlay production (0,41 kgCO_{2eq}/ 1 m^2). This balance illustrates the differentiating factor between cork and other products. As the cork oak tree retains carbon for over 100 years, regardless of cork harvesting, cork exploitation supports the maintenance of the ecosystem, thus having a positive contribution to global climate regulation.

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