

Comparative Life Cycle Assessment

Of Polypropylene and cardboard layer pads for transport

Background Report

Commissioned by Cartonplast Group GmbH



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Imprint

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Contents

1	<u>Management summary</u>	1
2	<u>Background</u>	3
2.1	<u>Organization of the study</u>	3
3	<u>Goal and scope definition</u>	4
3.1	<u>Goal of the study, target audience and critical review</u>	4
3.2	<u>Scope of the study</u>	4
3.2.1	<u>Spatial scope</u>	4
3.2.2	<u>Temporal scope</u>	4
3.3	<u>Functional unit</u>	4
3.4	<u>System boundary</u>	5
3.5	<u>Cut-off criteria</u>	5
3.6	<u>Environmental impact assessment</u>	5
4	<u>Life cycle inventory – characteristics and assumptions</u>	7
4.1	<u>Data collection and data quality</u>	7
4.1.1	<u>Life cycle inventory data and sources</u>	7
4.1.2	<u>Data quality considerations</u>	9
4.1.3	<u>Modelling and calculation of inventories</u>	10
4.2	<u>Description of PP layer pad life cycle</u>	10
4.3	<u>Description of CB layer pad life cycle</u>	12
4.4	<u>End-of-life allocation: application of allocation rules</u>	13
5	<u>Life cycle impact assessment</u>	15
5.1	<u>Overview</u>	15
5.2	<u>Breakdown of results</u>	16
5.2.1	<u>Climate change</u>	17
5.2.2	<u>Human toxicity and freshwater ecotoxicity</u>	18
5.2.3	<u>Natural land transformation</u>	20
5.2.4	<u>Water depletion</u>	21

6	<u>Interpretation and discussion</u>	23
6.1	<u>Sensitivity analysis</u>	23
6.1.1	<u>Open-loop allocation</u>	23
6.1.2	<u>Variation of key parameters</u>	24
6.1.3	<u>Oxalic acid proxy</u>	26
6.2	<u>Limitations, completeness and consistency</u>	26
6.3	<u>Conclusions</u>	27
7	<u>References</u>	28
<u>Appendix A: Methodological aspects</u>		30
<u>A1 Background datasets: ecoinvent</u>		30
<u>A2 Life cycle impact assessment</u>		30
<u>A2.1 ReCiPe: general aspects</u>		30
<u>A2.2 ReCiPe: human toxicity and freshwater ecotoxicity</u>		30
<u>A2.3 ReCiPe: natural land transformation</u>		31
<u>A2.4 ReCiPe: water depletion</u>		31
<u>A2.5 ReCiPe: fossil depletion</u>		31
<u>A2.6 Cumulative energy demand</u>		31
<u>Appendix B: Comprehensive ReCiPe impact indicator results</u>		32
<u>Appendix C: Certificate of validity and critical review (TÜV NORD)</u>		33

Our preface to the study

Based on our guiding principle "Reliable, Reusable, Recyclable", our pool system, with its reusable plastic interlayers, was the focus of our first sustainability report in 2014 – a sustainable business model for the hygienically safe, efficient and economical transport in the container industry.

Our initial report was the beginning of regular reporting. Following from that, we have developed a product life cycle assessment (LCA) of the plastic interlayers, because companies are currently assessed according to how "green" their environmental footprint is.

In our first LCA we compare polypropylene interlayers with cardboard interlayers and their impact on our environment. Both types of interlayers are used for the transportation of glass in the beverage, food, pharmaceutical and cosmetic industries.

Our study was conducted by the Sustainserv GmbH (Zürich, Switzerland) in conformity with the requirements of ISO 14040/44. The TÜV NORD CERT environmental expert critically examined the study in order to verify the method and results of this LCA. The results of our scientifically sound investigation therefore provide reliable data on the effects of plastic interlayers used in our pool system on the environment as well as their benefits of being measurable, transparent and consistent.

We have precisely illustrated the life cycle of our rentable plastic interlayers in order to demonstrate the environmental impact in comparison to the usage of interlayers of a relevant alternative made from corrugated cardboard. The main aim of our investigation was to demonstrate the environmental impacts of welded polypropylene web interlayers under European market conditions in comparison to the environmental performance of alternative interlayers made from corrugated cardboard.

The overall result was that durability was identified as the most important factor in reducing the environmental impact of interlayers. About 10.8 kg of CO₂ emissions are avoided over the entire life cycle of a single PP-interlayer. To demonstrate: this is 67% lower emissions of greenhouse gases over the whole lifetime of a polypropylene interlayer. More cardboard interlayers are needed to achieve the durability of a polypropylene interlayer. Therefore a polypropylene interlayer shows significantly better results, regarding the impact on the environment, than the equally examined corrugated cardboard interlayer.

In conclusion: recycling is obviously more ecological than throwing away, which is a clear advantage of the use of plastic interlayers, as their reuse and durability reduces detectable environmental pollution.

In general we invest in environmentally friendly work processes and concepts for our customers. Our improvement processes are a balance between ecology and economy, also for the benefit of our environment, because our long term further developments in reusable transport packaging are based on both principles. As a company in the European leading group of transport packaging, we are always seeking to increase the influence of our rentable, reusable transport products, this is also through useful cooperation with our customers and partners. We want to inspire and mobilise our employees and partners even more for sustainable strategies in business processes, as we only believe we can be sustainable in this way, as a company, as a society and as individuals. Our ambitions and our commitment to sustainability are further reflected in new goals which we aim to achieve in the near future.

We hope you enjoy this interesting read!



Joachim Kreuzburg
CEO



Michael Heikenfeld
Managing Director & CSO

A personal greeting from the company management



Joachim Kreuzburg
CEO

"In compliance with our position as the European market leader for reusable transport packaging, we have expanded our social commitment and positioned the long term issue of sustainability in the company. We have taken extensive measures and have set ourselves ambitious targets especially in the wake of our current expansion course. Thereby we provide our customers with a focused and vital added value in global competition. Our sustainable activities play an important role in the assessment of our business activities, as an important part of our long-term competitive strategy."



Michael Heikenfeld
Managing Director & CSO

"We very much welcome the publication of our comparative LCA study, because the results clearly show that the best way to reduce the environmental footprint of transport packaging is to improve its long term viability and therefore its overall durability. Our study records the environmental impact of both types of interlayers by systematically comparing the products and provides companies from the container industry, who use interlayers for transport, with sound data material to optimise the relevant factors within their entire supply chain. In this way we want to make the ecological performance measurement applicable for our products in the market and therefore putting substantial improvements into operation."

1 Management summary

This report presents the results of a comparative environmental life cycle assessment (LCA) of reusable corrugated layer pads made from polypropylene (PP) and corrugated cardboard (CB) which are used as divider sheets for the transport of glass containers. The study was commissioned by Cartonplast Group GmbH (Dietzenbach, Germany) in order to understand the environmental impacts of their corrugated PP layer pad and compare its environmental profile to the one of a relevant cardboard alternative. The results of the study are applicable to Western Europe (EU15). The main goal is to facilitate the continued reduction of the environmental footprint of the Cartonplast pool system and to derive relevant aspects for marketing purposes, based on current LCA best practice. The study was carried out by Sustainerv GmbH (Zurich, Switzerland), following the guidelines of the ISO 14040 series. A critical review was conducted by TÜV NORD CERT Umweltgutachter GmbH. It verifies the methodology and results of the LCA. The certificate of validity and report are included in this document.

The functional unit for this study is defined as the average use cycles of 21 for a single PP layer pad, representing its performance over the life cycle. Primary data was provided by Cartonplast for the PP layer pad product system. In addition, best available international LCA data was used, complemented by expert information. The system models and calculation of results was performed using the latest version of SimaPro, a leading software tool for LCA. A comprehensive set of environmental impact categories related to the product systems under investigation was selected, in line with the goal and scope of the LCA.¹

Under the model assumptions laid out in the following chapters, the PP layer pad product system shows significantly better performance in comparison to its cardboard counterpart. Over the life cycle of a single PP layer pad approx.

- 10.8 kg of CO₂ emissions (67%) are avoided,
- 1.9 kg of oil equivalents (42%) are saved in terms of fossil energy, and
- 25.1 m³ of water (78%) is saved.

The results for this subset of impact categories are illustrated in Figure 1 below. A more comprehensive and detailed compilation of results can be found in chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** and Appendix B, respectively.

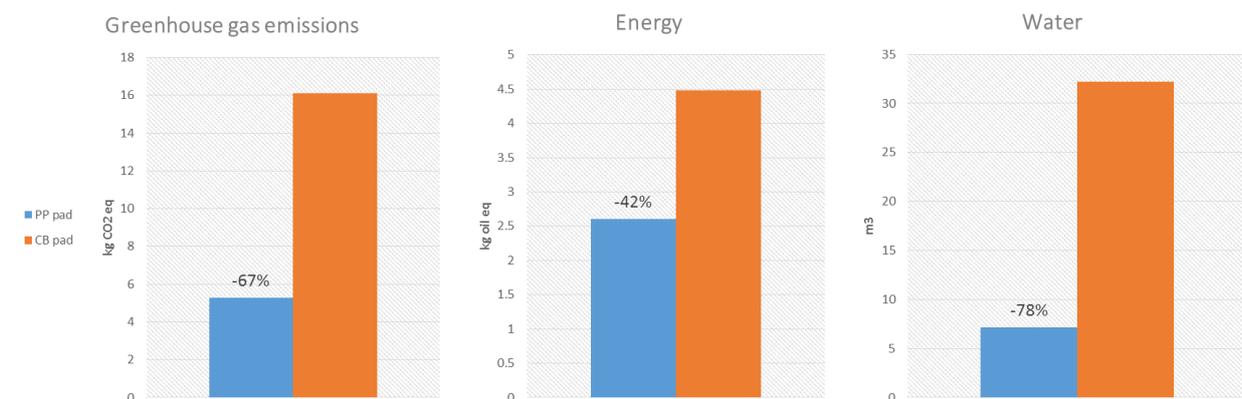


Figure 1: Results for key environmental impact indicator categories

¹ Environmental impacts were calculated for the climate change, fossil depletion (cumulative energy demand, respectively), water depletion, human toxicity, freshwater ecotoxicity and natural land transformation categories.

The principal reason for the better performance of the PP layer pad product system is that for every use cycle a new CB layer pad has to be produced, leading to a high impact associated with the cardboard production process.

A sensitivity analysis confirmed that the application of allocation rules (cf. chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) as well as the life cycle impact assessment (LCIA) results (cf. chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) are robust. It also revealed that the most important levers with regard to environmental impact are the number of PP layer pad reuse cycles and the percentage of recycled polypropylene used in the production of new layer pads.

2 Background

The Cartonplast Group is the leading European provider of reusable plastic layer pads on a rental basis, which are used as divider sheets to provide hygienically safe, efficient and cost-effective transport in the food and beverage, pharmaceutical, and cosmetic industries. By utilizing modern cleaning technologies and effective service and logistics processes, Cartonplast occupies a world-leading position in the industry. Cartonplast operates 13 cleaning and logistics centers in Europe, Russia, Turkey and South Africa. Subsidiaries exist in Brazil, Japan and Australia. The company is headquartered in Dietzenbach, Germany.

The innovative products in the center of Cartonplast's unique pool system are variants of PP layer pads. They enable the complete automation of production processes, allowing transport and storage costs to be reduced significantly. Hygienic security is their most exceptional characteristic: The chemically and physically-safe surface of the layer pads provides the ideal conditions for use in Cartonplast's pool system. Machine stops and transportation risks from contaminated or inadequate packaging variants can be excluded. Cartonplast has different types of PP layer pads available in their pool system in order to meet customers' requirements:

- solid
- sandwich
- corrugated with sealed edges

The layer pads vary in dimensions, thickness, surface finish and other physical properties, so that the full range of containers can be covered – from lightweight plastic to the heaviest champagne bottle.

The Cartonplast Group has focused on sustainability since its foundation. The company was awarded the renowned 'Blue Angel' ecolabel in the "returnable transport packaging" category.

With this study, Cartonplast would like to investigate environmental impacts of their corrugated PP layer pad and compare its environmental profile to the one of a relevant cardboard (CB) alternative. For this purpose, a comparative life cycle assessment (LCA) in accordance with the ISO 14040 standard series (ISO 14040:2006 and 14044:2006) was conducted.

2.1 Organization of the study

The study was commissioned by Cartonplast Group GmbH (thereafter CPL) based in Dietzenbach, Germany in 2014. It was carried out jointly by Sustainserv GmbH (thereafter Sustainserv) and members of the Quality Assurance and Process Engineering Department of CPL. CPL carried out the data investigation within the CPL Group while Sustainserv was responsible for general research, verification, modeling, impact assessment, interpretation as well as documentation. This study was performed in accordance with the relevant ISO standards on LCA (ISO 14040:2006 and 14044:2006). A critical review was conducted by TÜV NORD CERT Umweltgutachter GmbH (thereafter TÜV NORD). The members of the project team are:

- Dr. Jörg Elias (Group Director QA / Group Process Engineering Manager at CPL)
- Katrin Scheid (Marketing Assistant at CPL)
- Adrian Siegrist (Practice Leader Data and Management Systems at Sustainserv)
- Paul Schnabl (Consultant at Sustainserv)

3 Goal and scope definition

3.1 Goal of the study, target audience and critical review

The aims of the comparative LCA of layer pads for glass container transport in the food and beverage, pharmaceutical, and cosmetic industries are the following:

- to elucidate environmental effects of the corrugated PP layer pad variant under European market conditions,
- to compare its environmental performance with that of a cardboard (CB) layer pad variant,
- to facilitate the continued reduction of the environmental footprint of the CPL pool system, and
- to derive relevant aspects for marketing purposes.

Results of this study will be used in both internal and external communication, i.e. including (potential) customers and the general public. However, it will not be published as a whole. A critical review according to the ISO 14040 series was carried out by TÜV NORD. The certificate of validity and report can be found in Appendix C.

3.2 Scope of the study

The objects of investigation are two variants of layer pads which are used to facilitate the transport of glass containers in the food and beverage, pharmaceutical, and cosmetic industries. CPL's reusable corrugated PP layer pad (constituting approx. 60% of their layer pad pool) is compared to an equivalent corrugated CB variant. In Table 1 below, the key parameters of the most prominent corrugated PP layer pad variant and of a comparable CB variant are summarized:

Table 1: Specification of investigated layer pads

Aspect	Unit	PP pad	CB pad
Area	m ²	1.2	1.2
Grammage	kg/m ²	1.15	0.415
Weight	kg	1.38	0.498

3.2.1 Spatial scope

In terms of the geographic scope, the study focuses on the production, distribution, processing and recycling/disposal of layer pads in Western Europe (EU15), which is considered by the commissioner as a relevant market for the PP layer pads.

3.2.2 Temporal scope

The reference time period for the comparison of packaging systems is 2013. Where no figures are available for these years, the used data shall be as up-to-date as possible.

3.3 Functional unit

The functional unit for this study is defined as the average use cycles of 21 for a single PP layer pad, representing its performance over the life cycle. While both PP and CB layer pads may perform the same function in general, there is a significant difference between the two products in terms of durability. That is, each PP pad may be (re)used 21 times on average before it needs to be replaced with a new layer pad. For glass container transport – which is the focus of this study – CB layer pads can only be used once.

3.4 System boundary

This study reflects a "cradle-to-grave" LCA approach, i.e. taking into account the extraction and production of raw materials, converting processes, all transports and the final disposal or recycling of the layer pads.

The study covers the following steps:

- production, converting, recycling, downcycling and final disposal of the layer pads
- all transport processes
 - layer pad manufacturer to CPL (or to glass container manufacturer [customer] in the case of CB layer pads)
 - CPL to glass container manufacturer (customer)
 - filler to CPL (or from filler to waste management site in the CB layer pad case)
- production and disposal of process chemicals, as far as not excluded by the cut-off criteria (see below)
- storage and sorting of PP layer pads at CPL
- washing of PP layer pads at CPL

Since no relevant differences between the systems under scrutiny are to be expected, the following aspects are excluded from the LCA:

- transport from glass container manufacturer to filler²
- empty runs
- production of glass containers
- food, beverage, pharmaceutical and cosmetics production
- environmental effects related to layer pad storage at glass manufacturer and filler
- environmental effects from accidents/spills
- LDPE shrink-wrap and pallets used in the transport processes

3.5 Cut-off criteria

In order to ensure symmetry of the layer pad systems under investigation and to maintain the study within a feasible scope, a limitation on the detail in system modelling is necessary. So-called "cut-off criteria" are used for that purpose. According to ISO 14044, cut-off criteria shall consider mass, energy and environmental significance. Regarding mass-related cut-off, 5% by weight of the required cleaning and water treatment agents are excluded. 60% by weight of the omitted substances are commercially available standard detergents (e.g. multipurpose cleaners), for which no significant environmental impacts are to be expected. The exclusion of these substances is therefore considered acceptable.

Corporate administrative overhead at CPL, such as staff commuting, business travel, paper use, etc. is excluded from the study.

3.6 Environmental impact assessment

To evaluate the environmental performance of the examined product systems, a set of environmental impact categories according to current LCA best practice is used. The indicator selection is performed in accordance with the goal of the study (cf. section 3.1): results should be comprehensible and relatable to the product systems' life-cycle aspects. In life cycle impact assessment, a distinction is made between so-called "midpoint" and "endpoint" approaches. Midpoint refers to the relative environmental impact of using resources and emitting substances. These are commonly expressed in terms of substance

² This unit process is characterized by the glass container transport.

equivalents (e.g. CO₂ equivalents for global warming potential, 1,4-Dichlorobenzene equivalents for toxicity). Midpoint results can be further aggregated to endpoint indicators, describing the actual damage to nature (e.g. extinct species, disability-adjusted life years lost).

The following impact categories at the midpoint level are used:

- climate change
- human toxicity
- freshwater ecotoxicity
- natural land transformation
- water depletion
- fossil depletion³

More details and the results of the life cycle impact assessment (LCIA) are presented in chapter **Fehler!**
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³ This indicator is complemented by cumulative energy demand (CED) aspects. CED is the total quantity of primary energy needed to produce, use, and dispose of a product.

Appendix C: Certificate of validity and critical review (TÜV NORD)



CERTIFICATE OF VALIDITY

ISO 14040 : 2009 / 14044 : 2006
(LCA - life cycle assessment)

Evidence that the application conforms to the regulations was delivered, and is herewith certified according to the TÜV NORD CERT - procedure for

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Range of application

Comparative Life Cycle Assessment of „Polypropylene and cardboard layer pads for transport“ as of 2014-11-10

The requirements were fulfilled and proven by a critical review concerning

- **Standard methodologies**
- **Representative categories of balancing and effects**
- **General transparency and consistency**

Audit Report No. 3514 7459

Certification office of the TÜV NORD CERT GmbH

Essen, dated 2014-11-10

A handwritten signature in black ink, appearing to read "W. Hirt", written over a horizontal line.

Dr. Winfried Hirt
Environmental verifier

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