LCA Report

LifeClean International AB

Life Cycle Assessment (LCA) of disinfectant

2023-05-04

In collaboration with

ATMOZ

CONTENTS

General aspects

Introduction

This document contains a summary of the methods used and the results of a life cycle assessment (LCA) study of an alcohol-free disinfectant, LifeClean Disinfectant. The study is commissioned by LifeClean International AB and conducted by Atmoz Consulting AB. An LCA study describes the environmental impacts of a product throughout its life cycle. The goal of this study is to assess the climate impact of the production of disinfectants, in accordance with the international standards for life cycle assessment ISO 14040:2006 and 14044:2006. Hence, the study is limited to the assessment of greenhouse gas (GHG) emissions.

Product description

The study covers the product LifeClean Disinfectant 1000 ml, which is an alcohol-free disinfectant available with two different concentrations of active substances – 200 ppm (LifeClean Disinfectant) and 400 ppm (LifeClean Disinfectant Plus). The results presented in this report are calculated based on the 400 ppm solution but is valid for both concentrations. The disinfectant consists of a unique and patented chemical formula which acts as a sporicidal, fungicidal, bactericidal and virucidal high-level surface disinfectant that also breaks down and prevents the formation of biofilm and microbial resistance. The studied product is visualized in Figure 1.

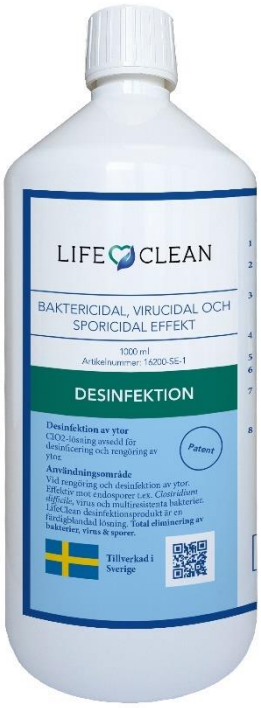

Figure 1 – LifeClean Disinfectant.

Content declaration

The product volume, active substances and their relative shares, as well as packaging material and weights are shown in Table 1.

Table 1 – Content declaration for LifeClean Disinfectant.

Parameter	Value	Unit
Product volume	1000	ml
Ingredient A	<0,2	%
Ingredient B	<0,2	%
Packaging		
Plastic bottle, cap and label	0,057	kg
Carboard box	0,027	kg

Declared unit

The results presented in this report relate to the declared unit of 1000 ml LifeClean Disinfectant including packaging, ready to be delivered to a customer.

The weight per declared unit is shown in Table 2.

Table 2 – Weight per declared unit.

Parameter	Value	Unit
1000 ml LifeClean Disinfectant including packaging	1,084	kg/declared unit

System boundary

The system boundary depicts the life cycle stages of the product system that are part of the study. This LCA study takes a cradle-to-gate approach, i.e. includes the production-related steps of the product's life cycle - from raw material extraction to finished product at the factory gate. In this study "factory gate" is defined as LifeClean's factory in Uddevalla, Sweden. The system boundary is depicted in Figure 2 and each lifecycle stage described in Table 3 below.

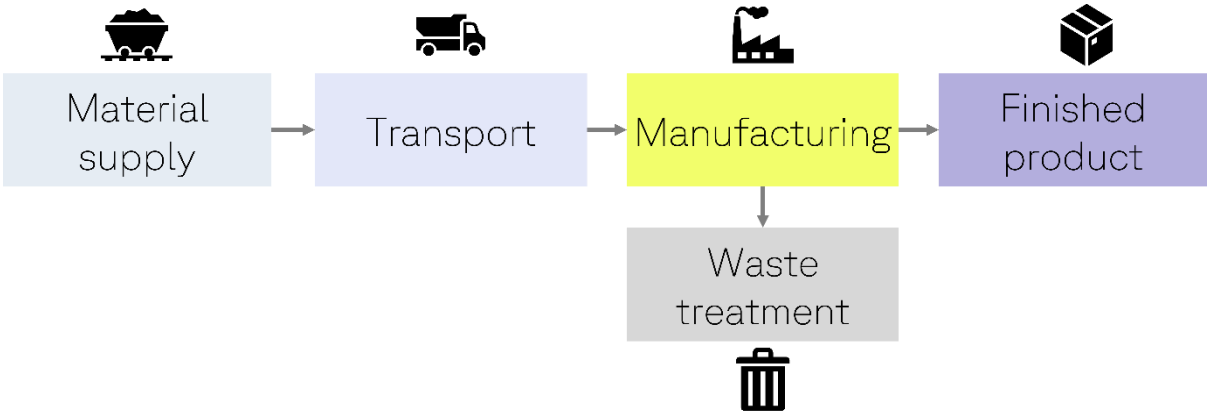

Figure 2 – Flow chart of life cycle stages included within the system boundaries.

The system boundary with nature is set to include those processes that provide the material and energy inputs into the system, the following manufacturing and transport processes up to the gate as well as the processing of any waste arising from those processes. With regards to recycling or other recovery of waste, impacts are borne by the product and included in the system until the waste is managed to the end-of-waste state. For recycling, end-of-waste is defined as the factory gate at the recycling facility. For energy recovery, end-of-waste is defined as the waste treatment process where conversion of waste into usable heat, electricity, or fuel occurs. Benefits and credits of recovery are outside the system boundaries.

Table 3 - A list of the life cycle stages included within the system boundaries.

Life cycle stages	Description
Material supply	The extraction and refinement of materials going into the product.
Transport inbound	Transportation of materials to the manufacturing site.
Manufacturing	The energy and auxiliary materials required during the manufacturing of the disinfectant at the factory in Uddevalla, Sweden. The manufacturing process consists of three steps: • Step 1 – Chemical reaction. Dosing of process chemicals and product-controlled production of active substance, through chemical reaction. • Step 2 – Physical mixing. Addition of additives and water to final concentration for final product. • Step 3 – Bottling of finished product and packaging for delivery to customer.
Waste treatment	Collection and treatment of waste generated during manufacturing.
Finished product	Product that has passed or completed the manufacturing process and is ready to be sold or distributed to customer.

Allocation

Allocation has been avoided whenever possible in the primary data of this study. However, in some instances allocation was required. These cases are described below.

Allocation of site data was performed for the energy required and waste generated during the manufacturing of LifeClean Disinfectant in Sweden. Since several different products are produced on the same site, and it was not possible to separate between the different products, data has been allocated to the production of 1000 ml disinfectants based on estimates from LifeClean – 62% of the annual electricity consumption and 70% of annual waste volume. These shares are then divided equally per 1000 ml disinfectant based on annual production volumes.

Cut-off criteria

The cut-off criteria, meaning the general rules for the exclusion of inputs and outputs, are defined in accordance with guidance in ISO 14044. The total of neglected flows shall be a maximum of 1 % of energy usage and mass for a particular unit process. The application of cut-off criteria is described below.

In general, all processes and flows that are attributable to the analyzed system are included. However, the following exclusions have been made based on the cut-off criteria:

- Production and transport of unspecified additives, which amount to <0,01% of product volume.
- Production and transport of packaging materials used for incoming raw materials used in manufacturing.
- Production of infrastructure, capital goods, travelling by personnel and research and development.

Life Cycle Inventory

Data collection and data quality

The data for this assessment was provided by LifeClean. The data was collected for the year 2022 and reviewed by Atmoz Consulting for consistency. The reference year for this study is thus set to 2022.

Foreground data for the manufacturing in Uddevalla, Sweden, are based on primary data. All background processes (e.g. raw materials and energy production) are based on secondary data from Ecoinvent 3.6. The data quality of the background data sources is compliant with ISO 14040 and 14044.

Inventory

The inventory model, from which the LCA is calculated, includes all relevant flows (see Cut-off criteria) in and out from the life cycle stages included within the system boundary (see Figure 2 and Table 3 in the section System boundary). An overview of all input and output flows can be seen in Table 4.

Table 4 – Inputs, outputs, and transports associated with the manufacturing of a declared unit,

Category	Subcategory	Description	Input	Output	Unit	Mode	Dist. (km)
Energy	Electricity	Grid mix	0,751		kWh		
Energy	Electricity	District heating	0,945		kWh		
Ingredient	Ingredient A	-	0,002		kg	Truck*	83
Ingredient	Ingredient B	-	0,002		kg	Truck*	83
Ingredient	Water	-	0,996		kg		
Packaging	Bottle	Pet-Plastic	0,048		kg	Truck*	180
Packaging	Cap	HDPE-Plastic	0,006		kg	Truck*	243
Packaging	Label	PE85 -Plastic	0,003		kg	Truck*	343
Packaging	Box	Cardboard	0,027		kg	Truck*	61
Waste	Recycling	Well		0,004	kg	Truck*	10
Waste	Recycling	Plastic		0,006	kg	Truck*	10
Waste	Energy recov.	Combustible		0,025	kg	Truck*	10
Finished product				1	pcs.		

* Truck 20-26 t, E5, Diesel MK1, 40% load factor.

Treatment of electricity

Electricity is purchased from two sources for the manufacturing: 1) grid mix, and 2) from district heating, combined heat and power (CHP) plant.

The electricity bought from the grid is assumed to be a Swedish average electricity grid mix, with a GHG emission factor of 26 g CO2e/kWh[1].

Electricity from district heating is provided by Uddevalla Energi AB and mainly generated from waste incineration (73,45%), biomass (26,5%) and a small fraction (0,05%) of fuel oil[2]. Emission and pre-combustion of waste incineration are attributed to the waste generator and are hence excluded, in line with the system boundaries (see section System boundary). Emission and pre-combustion for electricity generation from biomass and fuel oil is based on LCA data from Ecoinvent, with a resulting GHG emission factor of 17,8 g CO2e/kWh.

[1] Swedish Energy Agency 2022
[2] Swedenergy 2022, "Fjärrvärmens lokala miljövärden 2021"

Life Cycle Impact Assessment

Characterization models, factors and methods

The characterization model ReCiPe 2016[3] is used for the calculation of the Life Cycle Impact Assessment (LCIA) results, for classification and characterization of input- and output flows. The following environmental impact categories are calculated and included in the study:

- ReCiPe 2016 Midpoint (H), Global warming

All relevant greenhouse gases are included in the calculations. Total emissions are measured in CO_2 equivalents (CO_2e), which is the weighted sum of GHG emissions corresponding to their climate impact, often called Global Warming Potential (GWP), over a 100-year period.

Results

The GWP results per declared unit, expressed in kg CO_2e, per process, category and activity are shown in Table 5 and visualized in Figure 3 and discussed in the following section.

Table 5 – GWP results, in kg CO_2e, per process, category and activity for LifeClean Disinfectant 1000 ml.

Process	Category	Activity	GWP	Share
Manufacturing	Energy	Electricity	0,036	14,2%
Material supply	Ingredient	Ingredient A	0,002	0,7%
Material supply	Ingredient	Ingredient B	0,005	1,9%
Material supply	Ingredient	Water	0,0003	0,1%
Material supply	Packaging	Bottle	0,152	59,6%
Material supply	Packaging	Cap	0,017	6,5%
Material supply	Packaging	Label	0,007	2,7%
Material supply	Packaging	Box	0,023	8,8%
Transport	Transport	Truck 20-26t	0,001	0,4%
Waste treatment	Waste	Waste	0,013	5,0%
Total			0,255	100%

[3] https://www.rivm.nl/en/life-cycle-assessment-lca/recipe

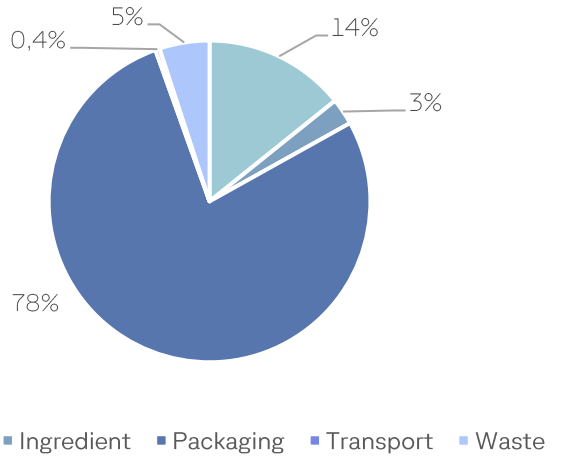

Figure 3 – Contributions per category for LifeClean Disinfectant 1000 ml.

For the LifeClean Disinfectant product the supply of packaging materials for bottling and boxing the products is the largest contributor to the overall GWP, accounting for 78% of the total. The plastic bottle has the highest impact of all packaging materials, comprising around 60% of the GHG emissions.This is mainly due to its relatively large weight (0,048 kg) compared to the cap and label (0,009 kg) and cardboard box (0,027 kg). In contrast, the disinfectant solution has a minor contribution to the total GWP, as it is primarily composed of water (>99,6%), with the ingredients only accounting for 3% of the GHG emissions.

The category with the second highest contribution to the total GWP is the electricity consumption of the manufacturing site, which accounts for 14% of the total. It should be noted that this parameter may be affected by fluctuations in production volume, as the energy consumption per unit is based on the site's average and may not scale linearly with production. However, the data collected for this study is considered representative over the period analyzed. Additionally, since electricity has a relatively low contribution to the overall GWP, any annual fluctuations are unlikely to have a significant impact on the final result.

Lastly, waste treatment and transportation of materials to LifeClean's manufacturing site have a relatively small contribution (5% and <1%, respectively) to the total GWP.

Conclusion

The main interpretations and conclusions of this evaluation are described hereinafter:

- The LCA results and contributions, see section Results.
- The cradle-to-gate GWP per declared unit is 0,255 kg CO_2e
- The main contribution to the overall GWP of the LifeClean Disinfectant occurs from the supply of materials used for packaging, accounting for 78% of the total. In contrast, the supply of materials for the ingredients has a minimal impact, contributing to only 3% of the GWP. This is largely due to the disinfectant solution mostly consisting of water (>99,6%), which has a low climate impact. The second largest contributor is the electricity used during manufacturing, accounting for 14% of the total. Waste treatment and transport of materials to the manufacturing site have a relatively small contribution (5% and <1%, respectively) to the total GWP.

Based on the results of this study, the following actions could be taken to reduce the climate impact of the LifeClean Disinfectant product:

- Packaging – Source packaging materials that have a lower climate impact, e.g. increasing the share of recycled content in main materials used for the packaging, and aim to minimize the amount of packaging material used.
- Manufacturing – Improve material and energy-efficiency in the manufacturing processes, reducing the amount of waste generated and materials and energy required for production.
- Waste – Reduce waste generation during manufacturing. For the waste that is not possible to avoid, increase recycling and limit incineration.

References

ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines