
# LCA of Composite Waste Processing

## Report SGS INTRON B.V.

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|---|---|
| Status: | Final report, Recycling into Cement |
| Date: | October 7th 2024 |
| Document number: | A144650/R20241613a |

WHEN YOU NEED TO BE SURE

# Colophon

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Offer:
A144650/O20231285a

Date:
18 April 2023

Purchase order:
Signed order

Date:
10 June 2023

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Date:
September 30th 2024
October 7th 2024

Reason of change:
R20241613a: textual corrections

## Disclaimer

# Report Summary

## Introduction

Thermoset composites are designed to be durable, strong and resistant to water and chemicals. For the end-of-life waste treatment of these durable materials, multiple technologies exist at present. The technologies with the highest Technology Readiness Levels (TRLs) include treatment in cement manufacturing plants (so-called “co-processing”), mechanical milling with subsequent processing into new composites formulations, and pyrolysis with subsequent recycling of the fibres and the pyrolysis oil, while several other technologies are currently under development and are at much lower TRLs

EuCIA (the trade association for the European composites industry) asked SGS INTRON to investigate through a Life Cycle Assessment (LCA) the environmental impacts of processing glass fibre reinforced composite waste through cement co-processing.

The recycling of composite waste in cement kilns uses the mineral fraction of the glass fibre reinforced composite waste as raw material for the cement production, while the organic fraction is used as alternative fuel supplying the energy content of the resin matrix for heating the reaction.

This method is compared with incineration of glass fibre reinforced composite waste (with energy recovery), which is the most common method for the treatment of this type of production and end-of-life waste at present.

## Aim of the study

The objective of this study is to investigate and quantify the benefits and burdens of this waste treatment option and to generate a data set for including these in cradle-to-grave LCA calculations of glass fibre reinforced composite components (e.g. wind turbine blades, boats, profiles, automotive body panels).

## Work executed

For this study, three typical glass fibre reinforced composite profiles were defined, which are representative for a large portion of the glass reinforced composite market:

1. GF50: glass fibre reinforced composite with 50% glass fibre and 50% resin, which is a typical composition for Hand lay-up, Spray-up, and Filament winding transformation processes.
2. GF70: glass fibre reinforced composite with 70% glass fibre and 30% resin, which is a typical composition for RTM, Infusion and Pultrusion transformation processes.
3. SMC: containing 28% glass fibre, 25% resin and 47% calcium carbonate filler, which is a typical composition for SMC (sheet moulding compound) and BMC (bulk moulding compound) formulations.

EuCIA and SGS INTRON jointly established process flow charts for the waste treatments scenarios for these material profiles, and discussions were held with various parties that supply the necessary technology (shredding machines) for processing the waste in such a way that it can be used in cement co-processing.

Additionally, CEMBUREAU[1] supplied data to establish a scenario for including the avoided fuels and raw materials when replaced by using glass fibre reinforced composite waste as an alternative fuel and a source of alternative decarbonated raw material in European cement kilns.

[1] CEMBUREAU is the representative organisation of the cement industry in Europe.

Based on these inputs, LCA models were set up and calculations made for this waste treatment option. The results were compared with a conventional waste incineration process commonly used for treatment of glass fibre reinforced composite waste.

Besides reporting the results for the three different profiles, a “weighted industry average” value” was calculated using a market volume distribution of 32.6,38.4, and 29.0 % for GF50, GF70, and SMC respectively. These percentages are based on market figures provided by German composites trade association AVK in their yearly report on the European Composite Market [1].

## Status of this study

This report has been subject to a third-party review by Mantijn van Leeuwen of NIBE BV. Below the statement of the reviewer is included:

Statement of Mantijn van Leeuwen on 29 September 2024:

> *“I hereby confirm that the methodology and data collection as described in the background report “LCA of Composite Waste Processing” comply with the demands set forth in ISO 14040/140444 and the EN 15804:2019+A2. The background report dates September 6th 2024.”*

The letter of approval is included in the appendix B. The verification is documented in a dialogue document which includes all questions and remarks of the reviewer and the way in which they are processed in this version of the report [2].

## Results

Co-processing in cement plants uses glass fibre-reinforced composite waste as input for cement production, consuming the glass and mineral fraction as decarbonated alternative raw material, while enabling the efficient recovery of the energy content of the resin fraction, therefore reducing the fossil fuel energy consumption of the process, and considerably lowering $CO_2$ emissions.

Table 12 of the report provides the reduction of $CO_2$ emissions in the cement manufacturing process per ton for the different glass fibre-reinforced composite waste profiles. A summary of the results is given below:

| GF 50 | GF 70 | SMC | Industry average (weighted) |
|---|---|---|---|
| | | | |
| -411 kg $CO_2$ eq | -362 kg $CO_2$ eq | -213 kg $CO_2$ eq | -335 kg $CO_2$ eq. |

Table 14 of the report provides the avoided $CO_2$ emissions which are generated when glass fibre-reinforced composite waste is treated by incineration with energy recovery. A summary of the results is given below:

| GF 50 | GF 70 | SMC | Industry average (weighted) |
|---|---|---|---|
| | | | |
| 719 kg $CO_2$ eq | 420 kg $CO_2$ eq | 347 kg $CO_2$ eq | 496 kg $CO_2$ eq. |

In conclusion, Co-processing in a cement kiln is a more favorable waste treatment method than waste treatment in a waste incinerator. The calculations reported in this study show that recycling/ co-processing

waste into cement saves 213 to 411 kg $CO_2$ eq. per ton of waste (weighted average 335 kg $CO_2$ eq.), in comparison to the generation of 347 to 719 kg $CO_2$ eq. per ton of waste (weighted average 496 kg $CO_2$ eq.), when incinerating the waste. This translates into an aggregated difference of 1130, 782 and 560 kg $CO_2$ eq. for GF50, GF70, and SMC respectively (or a weighted average of 831 kg $CO_2$ eq.),

In conclusion, each ton of End-of-Life composite waste treated by co-processing in a cement plant delivers an average combined GHG emission reduction of about 0.83 ton of $CO_2$ in comparison with waste incineration with energy recovery (the current common treatment for the majority of End-of-life composite waste).

Note: While the focus of this LCA study is GHG emission comparison, it also indicates that co-processing in cement brings benefit to other LCA indicators as it reduces the need for extraction and manufacturing of virgin mineral raw materials and fossil fuels. (Details are included in the SGS report).

# Appendix B Review statement

experts in sustainability
nibe

## Review statement

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|---|---|---|
| Opdrachtgever | Bob Roijen | SGS INTRON |
| Opgesteld door | Mantijn van Leeuwen | NIBE |
| Datum | 29 September 2024 | |
| Ons kenmerk | | |
| **Subject** | **Review statement LCA report "LCA of Composite Waste Processing"** | |

Dear Sir,

I hereby confirm that the methodology and data collection as described in the background report "LCA of Composite Waste Processing" comply with the demands set forth in ISO 14040/140444 and the EN 15804:2019+A2. The background report dates September 6th 2024.

The findings have been reported in "Review tabel_sgs_NIBE_sgs.xlsx" dated September 29th 2024.

The results are used to make a comparison with other fuel types in a cement kiln operation. Secondly the presented processes could be used as end of life processes in modelling composite structures for declaration in an EPD, when doing so chapter 4 applies and the data shown in the appendix of the report.

Dr.ir. M.L.J. van Leeuwen
Director NIBE
Acknowledged verifier by Foundation NMD

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## ABOUT SGS

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