LIFE BG4US

Biobased Guardrail 4 your safety LIFE 2015

Layman's Report



Project Details

Project Title: Biobased Guardrail 4 your safety LIFE 2015

Project Acronym: BG4US LIFE 2015

Duration: 1st of September 2016 – 31st of January 2025

EU Financial Contribution: 1,025,161 EUROs

Sector: Resource Efficiency

Partners

Millvision
Partners in Strategy and Business Innovations

RODENBURG
Biopolymers

KIEM
INNOVATION

Naftex GmbH

This project is financially supported by the EU LIFE program:

LIFE15 ENV/NL/000173.

Life

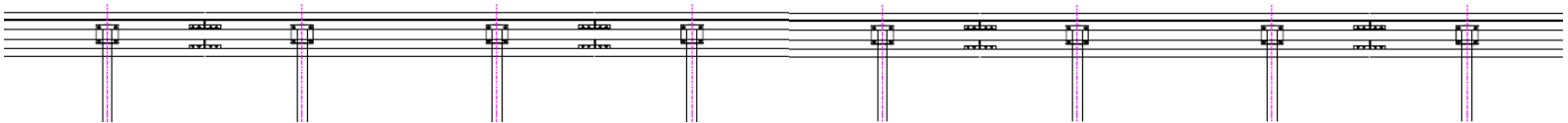
1. Introduction

Nowadays, quite some zinc is leaching into the soil at the roadsides due to rain getting in contact with our currently used galvanised steel guardrails within Europe. This leads to high concentrations of zinc in the ground water near these galvanised steel guardrails, having a great impact on flora and fauna near those locations.

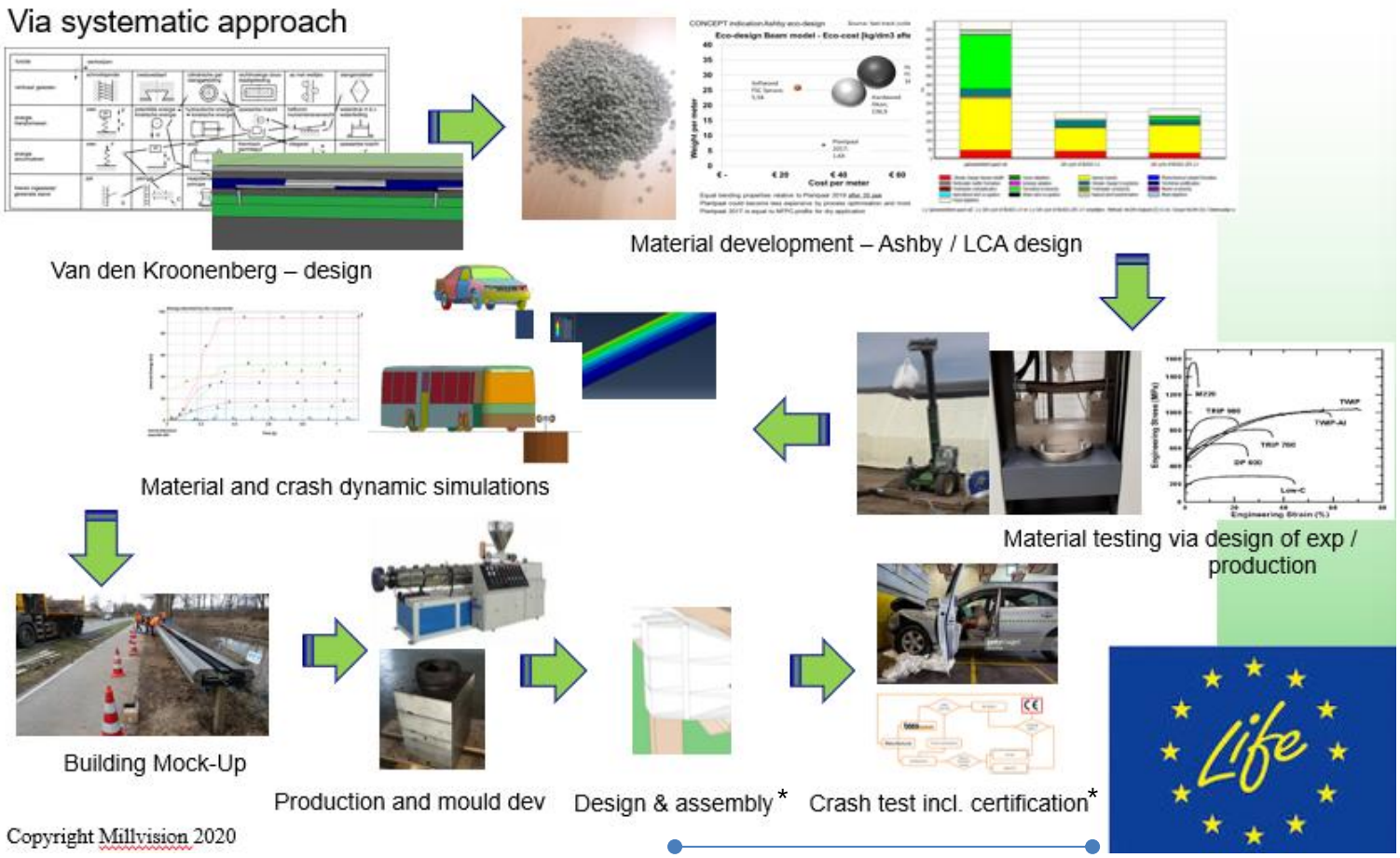
Some figures:

A meter of steel galvanised guardrail contains about 38 kg of steel which is treated with about 0,7 kg of a zinc layer. At locations were these galvanised steel guardrails are installed, only in The Netherlands about 19 tons of zinc per year leaches into the soil near these safety barriers. Extrapolating this number throughout Europe, about 850 tons of zinc leaches into the soil, contaminating ground water, effecting flora and fauna at those locations.

The BG4US LIFE2015 project aimed to produce a certified guardrail leading to a demonstration at a provincial road or a highway, ending up in a PAN-EU environmentally friendly alternative to the zinc galvanized steel guardrail. The proposed solution was a safe guardrail made from a combination of natural fibres and polymer matrix. In several stages, a Mock up prototype was built, followed by producing lengths to perform pre-crash tests and this concept has been patented. While several important milestones were achieved, including material development and pre-crash testing, not all objectives were fully realized. Notably, the composite mock-up deteriorated after prolonged outdoor exposure, and the extrusion-based production of the composite rail component was not successfully completed.



Presenting the BG4US LIFE2015 project in an summarising overview

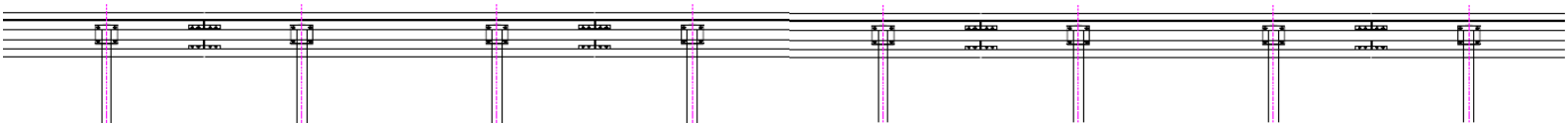


Through systematic design and collaboration with road authority stakeholders, the BG4US LIFE2015 project explored the feasibility of a composite safety barrier capable of absorbing crash energy. Material development included mechanical testing and simulations, which informed the design of a hybrid barrier combining composite materials with a steel frame.

A mock-up prototype was constructed and monitored over time. A production mould for the composite rail was ordered, and multiple production attempts were made. However, consistent production of 4-meter straight lengths via extrusion was not achieved, leading to a pause in the project for re-evaluation.

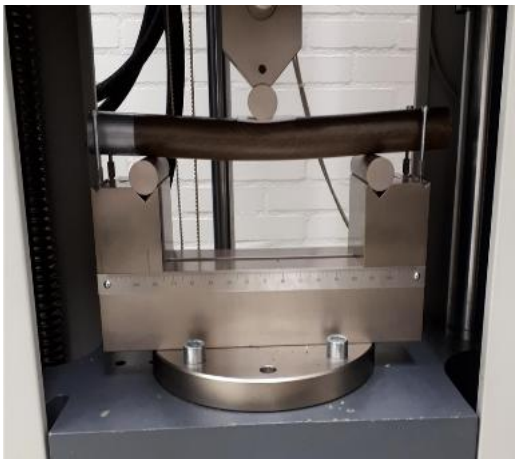
Additionally, long-term monitoring revealed that the mock-up's top and bottom of not optimal extruded rail components became disengaged after 2,5 years of outdoor exposure, compromising the intended crash performance.

Despite these challenges, the project successfully developed and tested composite materials, performed crash simulations, and conducted pre-crash tests that suggested the potential for meeting official crash test standards under optimal conditions.



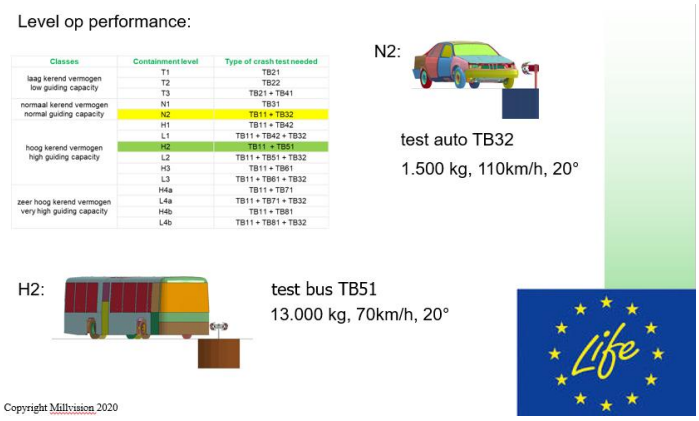
2. Impression of project results

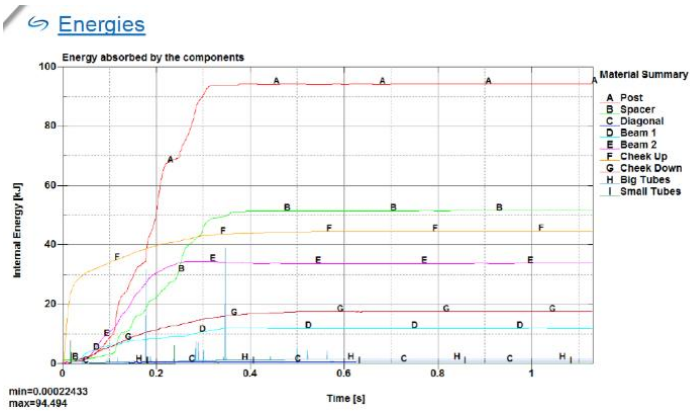
After composite material was developed using a combination of wood and grass-fibers with a polymer matrix, simplistic profiles were made and tested on mechanical properties. In the parallel, steel was selected and tested on connection principles based on calculations made.



Impression of material testing

In the parallel material composite and crash test simulations were performed further optimising the BG4US LIFE2015 crash test barrier, examining divers crash performance levels, using different vehicles, including the test conditions required.





Impression crash test simulations, including testing conditions

A BG4US LIFE2015 Mock up at a Provincial road N272 – Noord Brabant -The Netherlands was realised in 2018, monitoring its behaviour in time. At a later stage of the project, a part left after a pre-crash test executed was also monitored in time.



Impression of the Mock up's monitored (two pictures left at the N272, and picture right at the pre-crash test location)

In the parallel, a mould was ordered to produce the composite guided rail needed


Mould purchased and impression of production attempts producing the guided rail profiles needed

However, stable production of extrusion profiles (with long time stability and durability) was not achieved. This led to a pause in the project for re-evaluation. Based on the projects learnings, special attention needs to be taken towards composite material behaviour in combination with mould design and downstream processing (including stress introduced by process and product shrinkage and warping). This will lead to improved properties when under severe weather influence (heat, cold and moist circumstances).

To learn more about assembling the BG4US LIFE2015 guardrail and its behaviour during a crash test, several pre-crash test were performed using a car similar for testing at Provincial road level.

Impression pre-crash test car used and part of BG4US LIFE2015 to be tested at site

Impression pre-crash tests performed

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 August 2022 (18.08.2022)

WIPO | PCT

(10) International Publication Number
WO 2022/173287 A1

(51) International Patent Classification:
E01F 15/04 (2006.01)

(72) Inventors: VAN DER PLAS, Ronald Johannes Norbertus; Godfried Schaickenstraat 48, 4921 CS Made (NL).

Patent application 2022

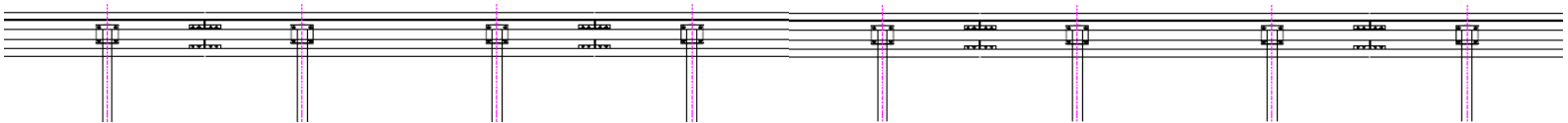
Lessons learned / results gained:

Triumphs gained

- Optimal composite material has been developed, and it can be made of biopolymer or recyclate polymer origine.
- Steel connections were developed, that passed a preliminary crash test performed.
- Crash test and material simulations were performed helping us with the initial design of the BG4US LIFE2015 guardrail; the final design and connection principles were further developed performing pre-crash tests using a relevant car leading to proof of performance.
- Performing these pre-crash tests indicated that an official crash test may be passed successfully, when all guardrail parts needed for the BG4US LIFE2015 are in place. Indicative, as a result of these pre-crash testing, a ASI-class A and a W-factor W5 is to be expected.
- Material testing, BG4US versus the galvanised steel guardrail, showed that much less zinc is leached out using our composite guardrail. Zinc leached out of the composite material is below the threshold value of the Dutch building government. End of life, aged composite guardrail can be recycled to more than 95% producing new composite profiles.
- Initial fire testing indicated a fire class B, however, not being a prerequisite for a guardrail application!
- A business plan was made, and this document made clear that the guardrail barrier regulations may change from country to country throughout Europe. Furthermore, this study has led to different scenario's how to get a guardrail barrier onto the market.
- The BG4US LIFE2015 guardrail developed has been filed in EU-patent

Challenges and setbacks faced

- After many revisions of the extrusion based mould to produce the composite guided rail needed, successful production of this material product part in straight lengths of 4-meter could not be obtained. Therefore, the decision was taken to stop the project for now; taking a re-thinking phase how to solve this challenge.
- Monitoring of the left over part of the BG4US guardrail of the last pre-crash test made clear, that since a couple of months the top and bottom guided rail parts were no longer interlocked being a part of the crash/impact mechanism, due to weather influences over of a period of 2,5 years.



3. Environmental benefits

Looking at the environmental assessment of the BG4US LIFE2015 project, the following first indicative positive impacts were concluded:

Life Cycle Analysis:

The BG4US LIFE2015 guardrail showed a lower Environmental costs indicator when compared with the currently used galvanised steel guardrail; “cradle-to-gate”. This indicated that the BG4US LIFE2015 guardrail is less polluting for the environment. Even that the BG4US LIFE2015 guardrail is more expensive, with green procurement rules (based on Environmental costs indicator in combination with valuation factor of a Tender) this guardrail is price competitive.

Recyclability:

End of life, the aged BG4US LIFE2015 composite guardrail parts can be recycled for 95%; to be reused in new profiles produced.

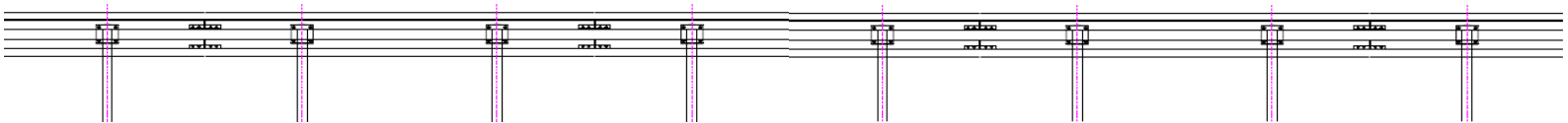
CO_2-capture:

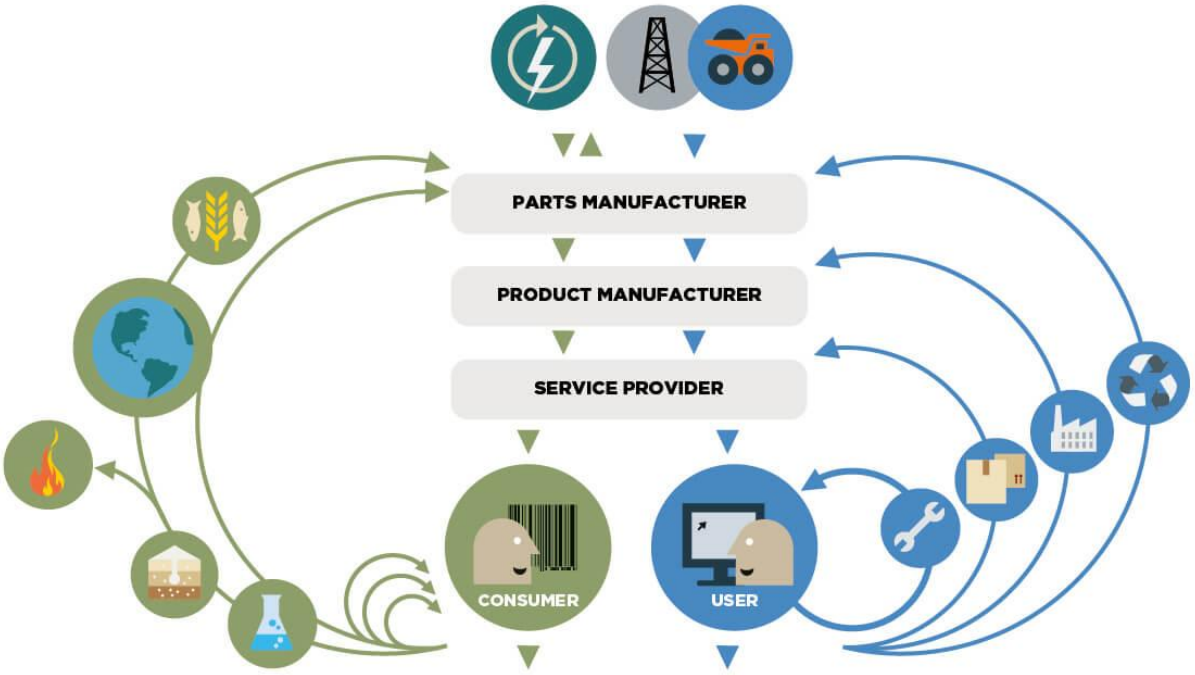
By using fibers in the composite profiles, they will capture biogenic CO_2. One meter of BG4US guardrail contains ca. 22kg biomass; per kg of biomass it contains about 1,8 kg of CO_2. This prevents emissions of methane and CO_2-gasses! This in the light of the **Climate Act**, being Carbon neutral in 2050, and the **Paris climate agreement** regarding global warming

Looking at Zinc emissions and its influence on biodiversity, it was concluded that:

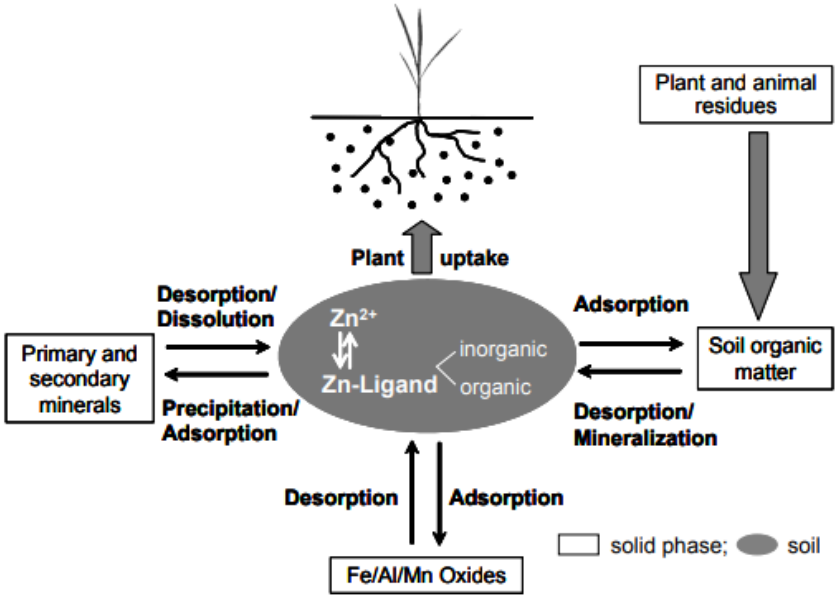
Zinc Leaching:

Annual zinc leaching was found to be between 1,7 and 6,1 gram per square meter of galvanized guardrail, giving an estimated total zinc run off of 850 ton in Europe. Of this zinc, approximately 90% ends up in the soil surrounding of the guardrail, and approximately 10% in surface waters. Soil zinc concentrations have a negative effect on both plant growth and animals. It is expected that using the composite BG4US LIFE2015 guided rail, zinc leaching is reduced by at least 95% resulting in a reduction of about 800 ton in Europe, in case all guardrail could be replaced with BG4US LIFE2015 guardrail!





Technical and bio-product life cycle [Ellen Mac Arthur Foundation]



Impression of effects zinc leaching (schematic process overview) and effects on leaves

4. Communication and Awareness activities

Throughout the execution of the project there always were close contacts with stakeholders on National, Dutch Ministry of Infrastructure and Water Management, and regional level, Province of Noord-Brabant.

In total 31 work sessions / workshops – 1.450 participants, 30 events (project info via presentations were given or people were able to see the BG4US LIFE2015 demonstration mock-up) – at least reaching 20.000 participants, and via general project communication and dissemination activities another >70.000 participants were informed. In this latter category of communication, the effect of the articles, television broad casting could not be quantified in real numbers of participants.

In the field of stakeholders, there is a lot of interest in our circular composite BG4US LIFE2015 guardrail. On a regular basis, big Dutch contractors were informed regarding the status of the BG4US LIFE15 guardrail development, so that they can make a judgement to see if they can include this guardrail in their road infra work tender offers. Due to the amount of contacts made, it is clear that both stakeholders and general public are looking forward for this kind of new innovative guardrail development.

Highlights have been the opening of the Mock up in Elsendorp – Noord Brabant in 2018, having representatives present of The Dutch Ministry of Infrastructure and Water Management and the Province of Noord Brabant, together with pre-crash tests performed at the pre-crash test location.

Impression of pre-crash testing site

Impression of the Mock up BG4US LIFE2015 guardrail

Contacts with road authorities in Germany and Belgium have learned that demonstrations of new circular biobased innovative products are hardly developed and introduced within these countries. Within The Netherlands, circular biobased prototypes and demonstrations are quite often initiated in cooperation with potential stakeholders. From this perspective, the consortium sees the Dutch market, as a frontrunner in circular biobased innovations. Therefore it would be the most suitable environment for the development and introduction of the BG4US LIFE2015 guardrail, once the technicalities have been overcome.

For further information about the project, please contact:

Harm Jan Thiewes

+31 6 13135669

welcome@millvision.eu

or visit the project website: www.bg4us.eu