

BUILDING

Polymer-based composites

47_BUILD_PBC_LoCaBaFi

TITLE: Low Carbon dioxide emitting Basalt fibre production for composite material

Description Carbon fiber reinforced polymers (CFRP) have a negative environmental impact due to the fossil-based manufacturing process of the carbon fibers, and the inefficient waste recovery at the end-of-life phase. The concept of the LoCaBaFi includes several approaches that will achieve a substantial reduction of CO₂ emission of at least 30 % in the life cycle assessment of basalt fiber reinforced polymer (BFRP) and reinforced ceramics (BFRC).

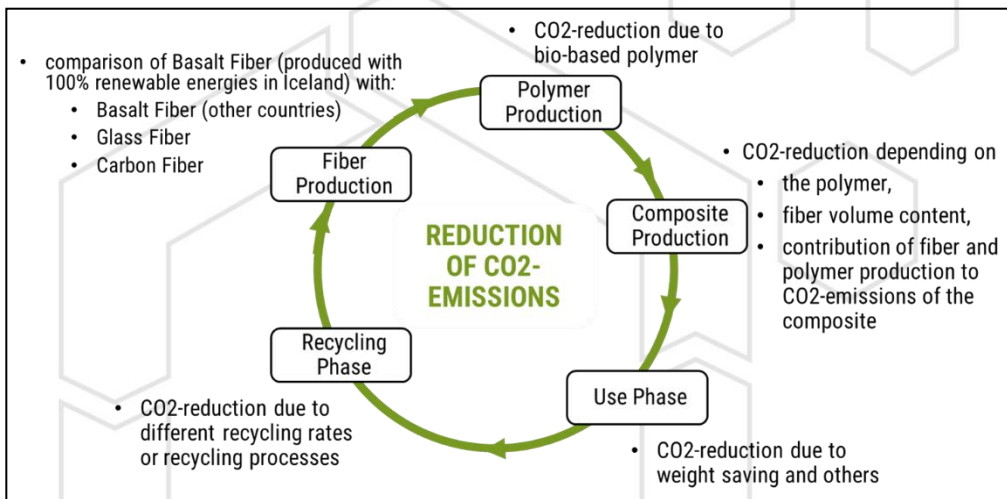


Figure: Potential for reduction of CO₂ emissions.

Iceland is a world leader in using renewable energies summing to over 99% of its total electricity consumption. Iceland has also plentiful of natural basalt resources from which basalt fibers (BF) can be produced using renewable energies. Nowadays, raw basalt rock is mainly mined in Russia, Ukraine and Georgia. The long transportation distance to Europe and the use of fossil-based energy to produce the fibers accounts for a negative environmental impact. Additionally, a risk of time-to-market shortage could become possible upon changes in political partnerships or due to political conflicts.

The matrix of the lightweight BFRP developed in this project will be made of a 100 % bio-based thermosetting polymer or CO₂ neutral Geopolymers for BFRC compared with concrete leading to a further reduction in CO₂ emission. Concerning environmental impact, BF is a natural material, eco-friendly, non-toxic and can be easily processed and recycled. Regarding mechanical properties, BF bridge the gap between glass and carbon fibers and offer the advantage of cost effectiveness, resistance to elevated temperatures and to chemical environments.



The outcome of the project of reducing the CO₂ emission has an enormous positive environmental impact and has a direct positive impact on the society. Additionally, it contributes to the goal of reaching a circular industrial value chain and a resilient Europe.

Scope of the challenge

The aim of the LoCaBaFi challenge is to develop a low CO₂ footprint FRP / FRC made of BFs of natural raw materials reinforcing a fully bio-based thermosetting polymer and or Geopolymer. This sustainable BFRP / BFRC paves the way to a substantial reduction in CO₂ emission of lightweight composites and to support the effort of the EU to combat global warming. The concept of the project is based upon the following approach combinations to achieve this exceptional contribution of CO₂ reduction:

I. Mining natural basalt in Iceland

Iceland is an important source of natural basalt and lava rock originating from the volcanic activity over the past thousands of years. Additionally, basalt and lava rock are continuously formed due to the frequent volcanic activity encountered in the region. These natural resources could then be used as an alternative to currently used sources coming from remote countries (e.g. Russia, Ukraine and Georgia), ensuring resilience, economic flexibility and a shorter time-to-market for European lightweight producers.

II. Fiber production using renewable energy

Iceland generates over 99 % of its electricity production using hydropower and geothermal power. Producing the BFs using renewable energy, instead of using the energy-intensive fossil-based manufacturing process, reduces dramatically the emission of CO₂ upon production of the fibers. As fiber production accounts for an intensive energy consumption process, this will be an immensely beneficial to circular economy of lightweight composites.

III. Melt-Spinning prototype machine

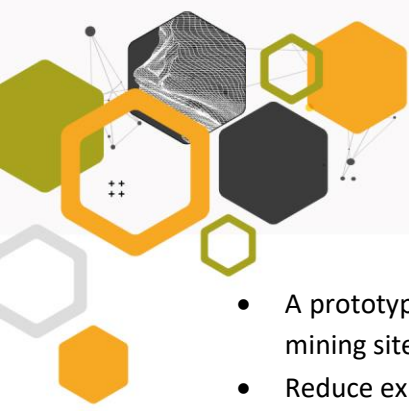
One of the project partners will build a prototype melt-spinning machine validated to TRL 5 with a 20-50 bushings capacity and will lend / give it to another project partner for fibre spinning. The machine will be the base for an industrial up-scaling prototype plant. This introduces two important benefits: (1) reduction of CO₂ emission by the low transportation distance between the mining site and the location at which the melt-spinning plant for fiber production will be established, (2) reduction of export control regulations and reduction of EU dependency on producers of BFs from countries outside the EEA.

IV. Prepreg / semi-finished products

Semi-finished products based on commercial bio-based polymers like tubes or rods for building - reinforcement of concrete – or aerospace & aeronautics.

Objectives

- A reduction of CO₂ emission of at least 30 % in the LCA of the new BFRP in comparison to commercially available CFRP and GFRP.
- Development of semi-finished products out of these new basalt fibres based on bio-based polymers.
- Development of a composite with over 50 vol.% of bio-based materials.
- Usage of 100 % renewable energy sources for manufacturing natural BFs.



- A prototype melt-spinning machine validated to TRL 5 will be established at the main basalt-mining site.
- Reduce export control regulations, secure time to market of lightweight solutions and reduce EU dependency on producers of BFs from Russia and other countries outside the European Economic Area (EEA).

