

## **Basalt fiber: a new Class of sustainable reinforcements for the next generation of Circular Economy Composite manufacturing**

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### **Abstract:**

Basalt fiber can be proposed to the EU composite industry as the sustainable reinforcement of choice and aim for a substantial share of the the market by positioning itself as the best solution to address the growing need for Circular Economy. This short positioning paper is a call to Basalt fiber manufacturers to join forces and investigate re-melting of end of life recycled basalt fibers to set a new standard for certified Cradle to Cradle sustainable reinforcements.

### **Basalt fiber: a new Class of sustainable reinforcements for the next generation of Circular Economy Composite manufacturing**

We are living pretty exciting times. This is the time of maturity for a technology that for too long in Europe has been considered just an alternative to other technologies, without a clear identity on the market. About fifty years ago the Global composite industry promoted fiberglass as the solution for pretty much everything. GRP was promoted as cheap, light, stiff, and nearly indestructible. There was a known problem with recycling but at the time this wasn't a priority and the general perception was that in 40 years people would figure out a way to recycle it. Well we haven't. The choice of cheap over sustainable didn't pay off and now we are being presented with the bill of decades of non sustainable development in the form of millions of tons of composite waste and beautiful islands submerged with plastic. Sustainability is now a major concern at any level and the World is looking for solutions that could support industrial development and minimize the environmental footprint at both short (manufacturing) and long (end of life) term. Basalt fiber can be the answer to all these needs. The adoption of Basalt fiber was for many years jeopardized by the dependency of fiber's quality from raw material and the subsequent lack of consistency of mechanical properties the market required. These issues are now being addressed and the sustainability of Basalt fiber is being Globally recognized offering new marketing opportunities.

As Glass, Basalt can cover different needs and respond to these needs with the best solution for each application, what I would like to propose to this audience is a common front to jointly investigate end of life re melting of recycled Basalt fiber once cleaned up from the matrix to guarantee Cradle to Cradle recyclability. This could position Basalt fiber as the reinforcement of choice for Circular Economy. At GS4C we completed this investigation along with Isomatex, the Belgian manufacturer of Filava™, a special enriched mineral fiber based on Basalt. We would like to see more manufacturers of pure Basalt fiber completing the loop and we are very keen to share our experience about the process. Mechanically we all know that Basalt can compete with both E-Glass and S-Glass and in some specific application it

can compete with Carbon fiber too. The Carbon Fiber industry is investing a lot of resources on recycling solutions but given the process to obtain Carbon fiber it is very unlikely that Cradle to Cradle loop could be achieved. Positioning Basalt fiber as sustainable and recyclable composite reinforcement and focusing the value proposition on this aspect of the product would offer a clear and tested solution to the legislators in charge of making the rules for waste management, opening up new opportunities with sectors like automotive, construction, marine, architecture and design. The EU has already introduced the concept of “producer extended responsibility” and is very keen on any technology supporting Circular Economy. This is also an opportunity for Basalt fiber manufactures to foster stronger relationships with customers. Each basalt fiber is different due to the chemistry of the material, so offering composite waste and end of life recycling service for composite producers would be a strong case for customers to focus on a specific product in the long term to minimize logistics and administration costs.

Natural fibers are growing fast and could be considered the most interesting alternative given their reputation of sustainability. Flax, Hemp and Bamboo are probably the most mature competitors in the sustainable reinforcements area, but they could never offer technological Cradle to Cradle recycling. Glass fiber has a huge established market but apparently the focus of that industry is to reduce costs rather than investigating ways to rise the sustainability of the product. This is again where the adoption of Basalt fiber as sustainable solution could be proposed given the similar weight and mechanical properties, hence minimizing the need for re-engineering the product.

Today, a wide adoption of Basalt fiber in Europe is still jeopardized by the lack of vision for sustainable development of most of the composite manufacturers and Basalt fiber is seen as more expensive alternative to E glass which in a margin driven market this is a hard obstacle to overcome.

At GS4C we have a strong commitment for sustainable development and we embarked in the challenge of producing a small sail racing boat that would be sustainable and Cradle to Cradle recyclable. Supported by a Grant from Lombardy Region and along with a team of researchers we investigated few products and finally focused our development on an innovative enriched Basalt fiber coupled with a bio based epoxy resin. The lamination layout was sandwich with balsa core. We worked in infusion, and we obtained an impressive fiber to matrix ratio of 79%. This number is very promising for a solution aiming for a total recover of the fiber at end of life to be re-melted into new virgin fiber.

Both fiber and bio based epoxy have a very low embodied energy and the sandwich configuration minimizes the need for fiber to achieve the required stiffness. In collaboration with an established research center we completed a recycling and re-melting process at lab scale to verify that we could clean up the fiber from both single skin and sandwich configuration for the composite. We successfully verified the cradle to cradle loop, obtaining new pure enriched basalt from the composite with no noticeable residuals from the pyrolysis process. We will complete an LCA soon to verify the energy balance of the entire process, but the initial data are definitely encouraging. On the manufacturing waste management side, all the scraps throughout the construction were collected and recovered to be true to our claim of zero landfill process. Along with an industrial partner we devised a way to convert the cuttings into chopped strand mat or insulating felts with high insulating value. This was obtained without any contamination with different fibers, hence maintaining the Cradle to Cradle recyclability for the secondary semi-finished products too.

A new culture of environmental awareness needs to be fostered and supported and this again is an area where EU funds could be available to promote Circular Economy for the composite Industry. A clear end

of life solution and industrial waste management will be soon demanded by EU directives and this would definitely facilitate the penetration process of a fiber that could address these issues. Again it is very important that the Basalt manufacturers join forces to position Basalt as the best sustainable solution money can buy.

The transition to Circular Economy for the composite industry is possible and is a responsibility for all the players in this vital sector at the base of so many markets. We are at the beginning of an industrial revolution that could be compared to the advent of digital stores in the retail sector. Basalt fiber manufacturers could take the lead in a new era of sustainable and recyclable composite materials that could facilitate a wide adoption of sustainable practices. Once that is established, new business models can be developed to exploit the complete recyclability of both pure Basalt fibers and mineral fibers based on Basalt to guarantee that in 40 years new generations will not have to deal with unresolved issues of composite waste disposal.