

CASE STUDY

Natural Fibers To Reinforce Plastics – Make Greener, Stronger and Lighter Products



Summary

Product type: Sappi Symbio cellulose fiber

Application: Automotive, Homeware, Lifestyle & Furniture, Industrial applications

Key benefits: Greener, stronger, lighter

The Challenge

With increasing pressure to turn the tide on global warming caused by CO₂ emissions and its consequent effect on climate change, the search and demand for greener and more sustainable materials has never been so large.

Whilst this once was the domain of NGO's and activists who have been at the forefront of raising the awareness to enforce change, today more and more manufacturers are actively searching to lower their environmental impact of their products. This push for change is not only because of effective legislation, but more and more because customers, brand owners and OEMs are asking for greener and more sustainable solutions driven by an increasing consumer demand.

But what is green, and what means more sustainable? A very relevant question which might be more difficult to answer and requires a clear definition to take the right decisions.

When it comes to plastics and compounds, there is a clear trend in finding alternatives to fossil-based materials. Quite often this implies incorporating recycled content replacing virgin (fossil-based) plastic, either partially or to the full extent. Alternatively fossil-based materials are replaced by their bio-based counterpart, often plant-based. Some good examples are bio-based polyethylene (PE), made from sugarcane to substitute oil-based polyethylene; or a completely new matrix solution like bio-based polylactic acid (PLA) or polyhydroxyalkanoate (PHA) polymers.

But there is more that can be done which might bring you even more benefits than expected. Polymer compounds are quite often and commonly filled with talc and glass fiber to provide mechanical strength to the material. These fillers are non-renewable and have a detrimental environmental consequence with respect to land depletion, accompanied by a high carbon footprint especially in case of glass fiber. At the same time, they are typically quite heavy, being a negative side effect in certain application fields.

Natural fillers and fibers have come to the attention of many compounders since they originate from renewable sources like grasses or are wood-based and are therefore perceived as green, but quite often these alternatives are not a straight drop-in to the incumbents. A key draw-back for natural fibers is that they cause discoloration to the polymer and have a strong tendency to provide an undesired, in some cases strong, odor and in many cases, they remain visible in the end-application.

If this has been stopping you from using natural fibers then we have some good news for you, as the solution is there, overcoming these hurdles.

The Solution

Sappi Symbio: The 100% natural Cellulose Fiber

At Sappi we recognize that around the world, people are seeking sustainable, scalable, and responsible alternatives to non-renewables. With our knowledge and competencies, we embrace that opportunity. Sappi has created Sappi Symbio, which is a cellulose fiber-based solution taken from wood. Sappi Symbio is a bio-based renewable alternative to reinforce (bio-)plastic materials like mineral fillers do today, but now more responsibly and more sustainable.

Sappi Symbio is a set of carefully selected and functionalized premium cellulose fibers, tailored for perfect dispersion in most common and biobased thermoplastics.

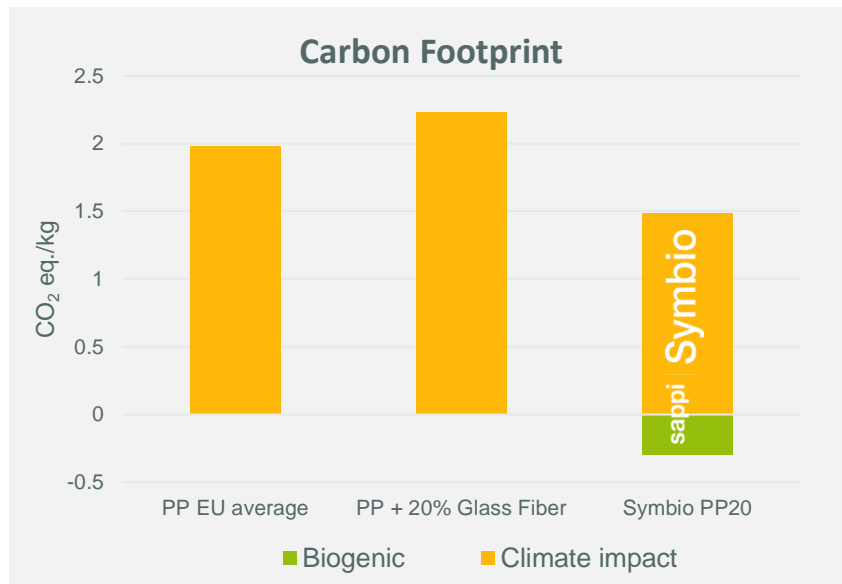
Symbio premium quality cellulose fiber is of consistent high-quality. Due to its high purity level, there is absence of any undesired odors or volatiles, outcompeting other natural fibers. Symbio disperses fully and is non-visible in the end application. This provides specific benefits such as a high brightness level and the possibility to compound into white and light colors.

Symbio not only meets stringent requirements set by OEM's, it also provides additional tactile benefits like the warm feel touch of wood combined with a great natural look. Symbio adds value to your products through its natural origin as well as through performance.

Greener and Renewable Solution

Cellulose, being the most abundant natural polymer on earth, is by default a green and renewable solution. Sappi Symbio cellulose fiber is wood-derived and originates from responsibly managed forest close to the Sappi production locations and is controlled through FSC™ forest certification (FSC C015022).

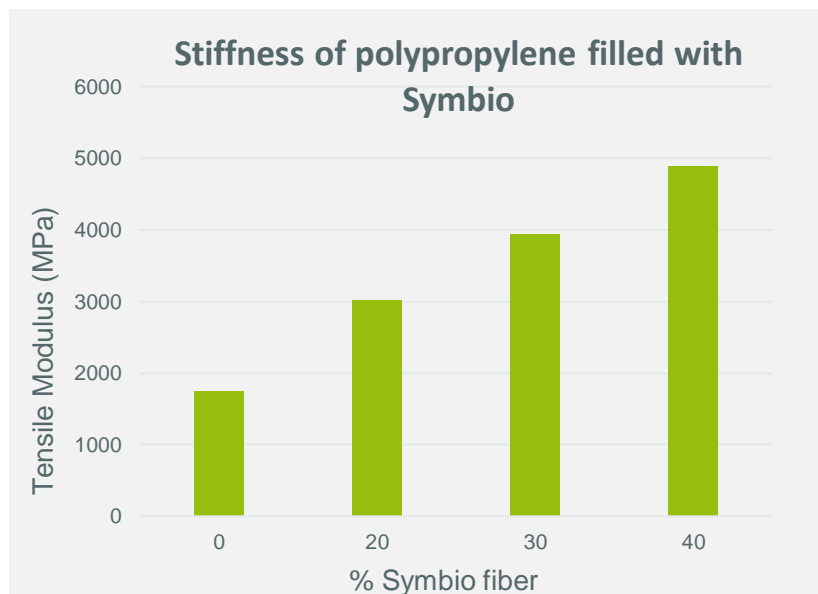
To be more explicit about the green character of Symbio used as a reinforcing agent in polypropylene (PP), a comparative carbon footprint calculation was prepared. When comparing a 20% glass filled PP compound to PP blended with 20% Symbio the carbon footprint is reduced by 33%. This is quite significant as this reduction happened by replacing 20% of filler component. This clearly provides an opportunity for carbon footprint reduction when addressing the reinforcing agent and fillers, and not only focusing on addressing the polymer matrix alone. In fact, it is a clear mandate for doing both.



Source Sappi: External conducted screening LCA study (2022)

Enhanced Stiffness with Reinforcement of Cellulose Fiber

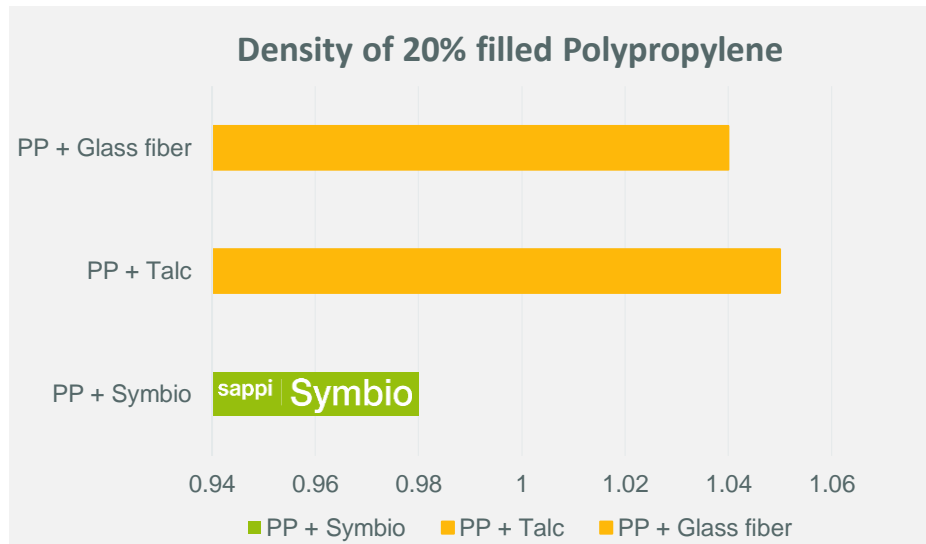
Sappi Symbio cellulose fiber acts as a reinforcing agent to the plastic. By adding Symbio to a polymer it will increase the stiffness compared to virgin plastic. As can be seen in the bar graph following: the tensile modulus of polypropylene increases when reinforced with Symbio cellulose fiber. As one can see, the material becomes three times stronger at a loading of 40% compared to unfilled material.



15% Weight Reduction Without Compromising Performance

Besides making the material stronger, stiffer and more rigid, the final product also will become lighter. This is a very interesting feature as we are taking out weight and making the product stronger and greener at the same time, unlike when classical mineral fillers like talc and glass

fiber are used. A 15% weight reduction can be achieved by adding 40% of Symbio compared to an equivalent amount of talc. This is an additional reason, aside from the greener aspects, as to why Symbio is a preferred material especially in application fields like automotive where Symbio materials have a long lasting and proven track record.



Brief Technical Information About the Product

Sappi Symbio products are offered in masterbatch form or as a pre-dispersed offering diluted in polypropylene (and other matrices on request). The benefit of the masterbatch is that compounders have full formulation freedom.

Below an overview of the typical product properties of Symbio cellulose fiber in pre-dispersed form in polypropylene.

Property	Test method	Unit	Symbio PP20	Symbio PP20 MI	Symbio PP20 HI	Symbio PP40
Fiber content	ISO 11358-1	Weight %	20	20	20	40
Density	ISO 1183-1 (method A)	g/cm ³	0.99	0.98	0.97	1.09
MFI (190°C/5kg)	ISO 1133-2	g/10min	15.3	27.1	8.2	1.7
Tensile modulus (1mm/min, 23°C)	ISO 527-2/1A	MPa	2800	2500	1500	4700
Tensile strength (50mm/min, 23°C)	ISO 527-2/1A	MPa	43	32	23	63
Flexural modulus (2mm/min, 23°C)	ISO 178	MPa	3070	2730	1660	5200
Flexural strength (2mm/min, 23°C)	ISO 178	MPa	66	50	31	93

Charpy notched impact strength (23°C)	ISO 179-1/1eA	kJ/m ²	2.4	4.0	10	4.0
Charpy unnotched impact strength (23°C)	ISO 179-1/1eU	kJ/m ²	25	29	49	29
HDT- A (1.80 MPa)	ISO 75-2	°C	84	77	58	124
HDT- B (0.45 MPa)	ISO 75-2	°C	140	135	121	153

Conclusion

Sappi Symbio is greener, stronger and lighter, and addresses the increasing need for more sustainable materials that reduce the overall carbon footprint of a product. Not only does it significantly increase the strength at a lower weight, but it also overcomes the challenges of other natural fillers due to its excellent dispersibility, resulting in a non-visible fiber in the end product that can be formulated in white and light colors. Above all, there is an absence of any undesired odor and meets the most stringent requirements set by OEMs, backed by a proven track record in the automotive industry. If you are looking for a greener solution that does what it should do, contact us now and let our technical team help you in finding the best solution for your needs.

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