IS CARBON FIBRE THE MATERIAL FOR OUR NEXT GENERATION?

MyStatement Paper

Master Thesis: FSAE Carbon Fibre Rims

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Is carbon fibre the material for our next generation?

In our blog, FSAE Carbon Fibre Rims, we have tried to make a discussion about carbon fibre and we dealt with the advantages and disadvantages from this material. The applications with carbon fibre are almost endless but carbon fibre isn’t the only composite available on the market. Although carbon fibre has a very high strength, it isn’t used as a standard product. Why would this be? And will this change in the future?

The material

When most people think about carbon fibre, they think about an exotic product, which is very expensive. Almost everyone knows carbon from the usage in bicycles. However, carbon fibre isn’t that exotic anymore. It founds it origin in 1958 and from 1970 it’s being used in industry. Nowadays more and more applications found their way to carbon fibre and the last 15 years it is used at a much more regular rate. Due to the modern computers it’s much easier to calculate, design and develop the different uses of carbon fibre and design products where carbon fibre really comes into its own. The material is used because of the high strength-to-mass ratio but it also has its disadvantages on technical, environmental and social level.

“Lighter and stronger is better”

“Lighter is better”. Under that motto carbon fibre is used in a lot of applications, especially in the transportation and the race sector. Everything that is lighter, needs less energy to move. This is the case in transportation sector, where carbon fibre is being used a lot in airplanes and also more and more in trucks (and cars). The use of carbon fibre in airplanes has a high impact on the environment. The new Airbus A350 is made of 52% carbon fibre, which makes the aircraft very light. Boeing had already an airplane (Dreamliner 787) on the market that was made out of 50% of carbon fibre. This 2% more carbon fibre, results in 7% less emissions than the Boeing and 20% on its aluminium equivalent.

But also in the energy sector carbon fibre has its advantages. Making lightweight turbines results in bigger wind turbines and more energy production and therefore less CO2 emissions. Also electrical cars take advantage of the lightweight of carbon fibre. Not only by making mechanical parts out of carbon fibre, but because the highest weight are still the batteries Volvo has developed batteries with a carbon fibre casing to reduces the weight. And the lower the weight, the less energy the cars need and the higher the range. Especially in the car industry this is a promising technique to reduce the weight and the space of big battery packets in the car. But carbon fibre can also save lives. It doesn’t only make cars lighter and faster, it also makes cars stronger and stronger cars, means safer cars.

The advantages of carbon fibre are also noticeable on social level. For example: nowadays they are able to make very light prosthetics out of carbon fibre which feels like a normal leg/arm and are much stronger than ordinary prosthetics. Also implants are made out of carbon fibre. These are much stronger, have an endless lifecycle and are also much more visible when using x-rays. Where x-rays can’t be used with aluminum or steel implants, it can with carbon fibre implants which is a very big advantage in the medical world to know if the fracture is healing well.

The “dark” side

Although carbon fibres have an almost endless life cycle, the products which are made with carbon fibre, haven’t. A big disadvantage is the recyclability of carbon fibre. You can’t just melt carbon fibre like glass and make a new material of it. The decomposition of carbon fibre is much more complicated and very energy intensive and you will never get the same strength as you got with new carbon fibre.

There is another disadvantage that often get overlooked. The production of carbon fibre is bad for human health. Carbon micro fibres have a similar effect as asbestos. Very fine micro tubes which can penetrate into the lungs and skin. This could lead to cancer or other diseases. Where asbestos has been prohibited for quite a number of years, carbon fibre is on the rise. Experiments with mouse have proven that breathing some carbon fibre can seriously effect health and causes lung diseases. The moment you work with carbon fibre, you wouldn’t notice a lot of this but you will find out the consequences later. But because carbon fibre isn’t used extensively for a very long time, there isn’t any proof about the effect on human health.

One of the big reasons why carbon fibre still isn’t chosen at a regular rate is the price. Carbon fibre is 80 times more expensive than steel and 15 times more expensive than aluminium. But prices are dropping and more and more people find their way to carbon fibres. 10 years ago, ordinary people weren’t able to buy a carbon fibre bicycle but nowadays they are much more affordable. But still, most people don’t want to pay much more for losing a few grams of weight. And not only the raw material is expensive. The production process for aluminium or steel products is much easier and therefore much cheaper than producing carbon fibre products. To make carbon fibre products, there aren’t any automation processes. It’s all manual labor, you need a mold, the products need finishing etc. and therefore the prices of these products are very high. In professional race sports, however lightweight is very important and therefore carbon fibre is a standard material in cycling, F1 etc. where money isn’t an issue.

Sometimes the applications where carbon fibre is being used are useless. You can see carbon fibre toilets, tables, seats, glasses etc. These products are only made out of carbon fibre because of the way they look. It gives them an exclusive and expensive look. We need to discourage people to buy these products because they don’t have any advantages.

The other way

Besides carbon fibre there are also some alternatives, which are used in some applications. There are a lot of bio composites on the market and although these haven’t got the same strength to weight ratio as carbon fibre, we still can use them for a lot of applications.

Alternatives:

Bio composite

“The demand for companies to use green materials is constantly growing.” But why aren’t we using natural fibre instead of carbon fibres? A big reason why a lot of companies still use carbon fibres is that the strength of bio composites is much less in comparison to carbon fibre composites. So for big structural pieces it isn’t possible to use natural fibres.
However, the market for natural fibres is every year increasing and a lot of companies are optimising the techniques to make them stronger. For example: Toyota uses a natural fibre called Tabwood. Tabwood is made of Japanese cedar and is produced in Japan. This local production has a positive effect on the environment and create also an sustainable relationship of equal partnership between Toyota and the local villages. They use Tabwood in

non-critical parts of the car, like lamp housings and door panels. These are components which don’t need to absorb any high forces and therefore they use Tabwood to make the components lighter.

Glass fibre

A very know alternative material is glass fibre. Glass fibre is much older than carbon fibre and very cheap in comparison with carbon fibre. Glass fibre has also a much easier recycling process. However, it has the same problem as natural fibre: carbon fibre is much stronger and lighter than glass fibre. Besides that, it is still used in several applications: it’s being used as an insulation material, to make tanks and vessels or bodies for cars. Or to make high speed data cables etc.

Our future for carbon fibre

In the future, we believe the use of this material will become more and more important. Aluminium was also a very rare product more than 100 years ago. The fact that carbon fibre has already had a lot of competitors and still is being chosen, proofs that the disadvantages doesn’t outweigh the advantages. Although carbon fibre still has some disadvantages, we believe that these will also be eliminated in the future. There are already different recycling processes developed and they are still developing new technologies to improve the quality of the recycled material.

Due to constant technological developments, the use of carbon fibre will increase rapidly. The global demand was valued at $10.8 billion in 2009 and $13.2 billion in 2012 and is suspected to reach $18.6 billion by 2015. This is an annual grow rate of about 7%. This growth will boost the economy, will create more jobs and will stimulate the development of new techniques to automate the production process, reduce waste to a bare minimum and limit the health problem. Therefore, also the prices of carbon fibres products will lower. The lightweight advantage of carbon fibre will results in lower energy consumption or higher energy production which has a direct impact on the environment by less CO2 pollution. The use of carbon fibre has in many applications a lot of advantages for nature, human and technologie, so we can only stimulate the use of carbon fibre! However, in some cases carbon fibre is only used to make products which are looking nice and we need to discourage these kind of products.

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