Mainstream of Carbon Fiber Reinforced Polymer in Automotive World

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Abstract

Carbon Fiber Reinforced Polymers (Hereinafter "CFRP") are composite materials comprised of carbon fiber and polymer matrix. Essentially, the presence of the former is to provide stiffness and strength and the latter is to cohere the reinforcement together. CFRP is a fiber reinforced plastic positively indulged with high strength and less weight. They are ten times stronger than steel and eight times stronger than aluminum and yet are significantly weightless. In the current scenario, the need for materials with such composites to diminish fuel consumption while sustaining the safety standards is elevated. CFRP is one of many materials that provides such advantage and has eventually achieved successful position in an automotive world. Keeping this in mind, CFRPs have been increasingly used over the past decades to replace metal in applications where light weight has outsized value, primarily for fuel consumption reductions.

CFRPs confront a fragmented path: well-established in high-value sectors such as sporting goods, aircraft, armed forces and racing cars. However, it is excluded from most large-volume markets, especially the automotive industry. The continuance of the situation will remain the same until the new method and materials are used to produce CFRPs and eventually lead to reduction of prices. The use of carbon fiber in automotive industry is projected to nearly double from 2015 to 2020, according to recent published reports. According to these estimates, global vehicle production is projected to grow to over 110 million units in 2025 over the next few years, up from an estimated 88.7 million units in 2015. Most of the growth will come from China's rapidly growing economy. One study says the average car would contain almost 350 kilograms of plastics, up from 200 kilograms in 2014. Additionally, although metal and metal alloys continue to be critical to automotive design, automakers are uncovering creative ways to incorporate plastics and composites into their designs to help lower vehicle weight and improve performance. The possibility of the progress in the use of plastics is only expected when there is improvement in materials and reduction in the cost of production. Further, this is prompted by highly aggressive policy targets of the Governments to achieve the Corporate Average Fuel Efficiency (CAFE) standards of 54.5 mpg by 2025. However, to make the targets achievable, fuel economy across the passenger vehicle fleet needs to be increased by around 50 percent. The usage of carbon fibers and polymer matrix composites in a car allows the car to have an estimated reduction of 25 to 70 percent in its body mass compared to the competing materials.

According to Lux Research, CFRPs will constitute a $35 billion market in 2020 across all applications, including $6 billion in CFRPs for automotive except the use of cars would be restricted to luxury vehicles and race vehicles. Analysis suggests that the introduction of large-scale, mainstream CFRP cars before 2020 is impossible. Nevertheless, after 2020, CRFP's potential proportion used in cars and trucks will overshadow all other uses, approaching potentially hundreds of billions of dollars. As a result, several major automakers and carbon fiber manufacturers form alliances, establish consortia and conduct work to get automotive CFRPs closer to commercial existence. The Carbon Fiber Composites Consortium of Oak Ridge National Laboratory (Hereinafter "ORNL") remains the most associated organization on the automotive partnership board, with 23 OEMs, Tier 1, and major supplier partners. The Carbon Fiber Manufacturing Facility of ORNL, a 25-ton/yr pilot carbon fiber production line, is pursuing fiber processing methods at lower cost. The facility demonstrated two years ago that using a precursor of textile-grade polyacrylonitrile (PAN) it can churn out normal modulus carbon fibers with tensile strengths of 500 ksi and modulus as high as 36 msi. ORNL actually costs less than half that of fiber-grade PAN. Carbon Nexusan, in collaboration with Dow, Quickstep, Volkswagen and Australia's national development agency CSIRO, is designing its own alternative counterpart, tensile strength enhancements and energy-efficient innovations, all of which may be implemented using ORNL 's techniques. In addition to developments in fiber production, manufacturers are producing faster, more efficient machines, resins engineered for CFRP use in the automotive industry and flexible CFRP recycling methods across the value chain.

The automotive world has been fixated on carbon fiber in the long run, since the time the McLaren MP4/1 Formula One race car turned into the first to feature a carbon fiber chassis in 1981. BMW stands out as a pioneer in the use of CFRP by automotive companies. In 2009, it first invested in carbon-fiber producer SGL, a partnership that continues with BMW investing 200 million more last year to increase production volume from 6,000 tons to 9,000 tons/yr. BMW will use the components in its i-Series electric and plug-in hybrid cars which is reportedly rolling off manufacturing plants at a rate of 100 vehicles per day. More prominently, BMW has been working with Boeing, a global leader in order to manufacture aircraft using CFRPs. The two intend to enhance the production and recycling of CFRP. Through exploiting both upstream fiber infrastructure investment and expertise from seasoned players like Boeing, BMW is preparing itself to lead the way in the CFRP production of large-scale automobiles. Nevertheless, the future remains unknown. Technology developments in the manufacture of plastic, resin and composite components clearly indicate that it would be technologically and commercially viable for

automotive OEMs to produce mainstream vehicles using large quantities of CFRPs by the mid-2020s. CFRP technology, however, is not the sole determinant of how, whether and how often CFRPs can eventually be used in cars and trucks. The speed and penetration would be significantly impacted by external influences within and outside the industry. The drive toward automotive composites is essentially based on the premise that weight loss is a cost-effective way of reducing fuel consumption. (Typically, a 10 percent weight loss results in a 6 to 8 percent decrease in fuel consumption.) As a result, cars can eventually get lighter as fuel economy requirements become stricter. Besides that, CFRPs, the products with the maximum defined strength, will wait to be used until its reduction in price.

To conclude the present pattern clearly suggests a substantial automotive acceptance of CFRPs in the mid-2020s and businesses will prepare themselves to take advantage of the emerging changes in the supply chain. However, those advancing such innovations should recognize that there could be a restrictive long-term window to enter the automotive market.

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