

CG Rail GmbH Press Release

Aerospace engineering for the railway: world's first CFRP lightweight train launched at InnoTrans 2018

CG Rail GmbH Dresden was involved in development work as part of Chinese rolling stock manufacturer CRRC's "Next Generation Metro Train" project – The results demonstrate Saxony's unique expertise in lightweight design and technologies

Berlin/Dresden. The world's first train to be constructed almost entirely of CFRP components is being presented to global experts for the first time today (September 18, 2018) in Berlin at InnoTrans, the international trade fair for transport technology. The innovative lightweight vehicle has been developed by a Chinese-German team of engineers from CG Rail GmbH – the Chinese-German Research and Development Center for Rail and Traffic Engineering Dresden – in collaboration with national and international network partners, on behalf of the world's largest rolling stock manufacturer, CRRC, from the People's Republic of China.

The development work undertaken in Saxony formed part of CRRC's overall "Next Generation Metro Train" project, which aims to redesign public transport, and underground systems in particular, making it more effective and more environmentally-friendly. CG Rail designed key modules for the new generation metro, running the front cabin, car body, equipment cabinet and bogie frame sub-projects, and creating innovative and groundbreaking lightweight rail vehicle components in the process.

To take the car body as an example, it is made of 70 percent carbon-fiber-reinforced plastic (CFRP), which reduces its weight by 30 percent when compared with conventional aluminum structures. In addition to the use of special simulation methods to design the lightweight structures, the true expertise here lies in the innovative and novel manufacturing technologies for unique lightweight CFRP-components. CG Rail has succeeded in

developing pultrusion processes that allow for the efficient manufacture of large, single-piece multi-chamber CFRP profiles with walls up to 25 mm thick using different fiber types and fiber orientations. This technique was deployed on a special line at the Dresden company's Rail Innovation Center (RIC) to manufacture the 22-meter CFRP profiles required for the project. "Technically speaking, we can now manufacture components of any length. We are currently limited to 77 meters, but this is only due to space constraints," says Dr. Andreas Ulbricht, who is joint CEO of CG Rail GmbH with Mr. Sansan Ding. Dr. Ulbricht points out that the specialized equipment required for the precision joining and assembly of the large CFRP car body structures were also developed in-house by the CG Rail team and built by Saxony-based companies.

Innovative process technologies have also been used to produce the lightweight bogie frame, whose four main components, the longitudinal and cross beams, are made from CFRP. The beams' textile-reinforced structures are initially produced using braiding or winding technology, or a combination of the two, before being impregnated with resin and then hardened using the RTM injection method. The processes are highly automated and allow for extremely efficient, reproducible production. They draw on the lightweight design expertise of the Institute of Lightweight Engineering and Polymer Technology (ILK) at TU Dresden. The CFRP bogie frame, which is more than 40 percent lighter as its steel equivalent, can withstand the highest loads and meets all driving dynamics requirements. "The CFRP bogie frame was really put through its paces at one of our recognized partners in Dresden, successfully withstanding twelve million load cycles up to 60 percent in excess of its normal operating load in a cyclic test. This equates to a service life of more than 33 years," noted Dr. Ulbricht, describing the first fatigue test of its kind to be carried out in the world. "The CFRP bogie frame is a true leap innovation."

The front cabin and equipment cabinet represent another new benchmark: comprised of up to 90 percent CFRP, they are around 30 percent lighter than comparable metal designs. This has enabled the CG Rail team to tackle other issues, including reducing the number of components through improved functional integration. The degree of innovation involved is reflected in the number of applied patents, which currently stands at 16.

In addition to the skills of the 35 German and Chinese employees of CG Rail, progress from initial outline designs to the completion of four front cabins, three car bodies, five bogie frames and seven equipment cabinets in under two years had a great deal to do with the high level of scientific,

research and industrial expertise in lightweight design in Dresden, the cradle of modern-day lightweight design. “We are able to draw on an exceptional network of partners, from TU Dresden, one of Germany's eleven Universities of Excellence, and its institutes and outstanding graduates, to Dresden’s many non-university research institutes (over ten Fraunhofer Institutes, three Leibniz and Max Planck Institutes and a Helmholtz Center), to partners within the lightweight “family” (ILK, LZS GmbH and LSK GmbH). The concentration of expertise here compared with other locations was a key reason for foundation of CG Rail GmbH in Dresden,” reports Dr. Ulbricht.

Professor Werner A. Hufenbach’s distinguished international reputation also played a significant role in this. At the start of the 1990s, he established the Dresden model of “functionally integrated system lightweight construction in multi-material design”, which has since become a national and international industry benchmark. Founding and expanding the Institute for Lightweight Engineering and Polymer Technology at TU Dresden, Professor Hufenbach and his team were the driving force behind the renaissance of lightweight design in Saxony. He was also organizing symposia, lectureships and research projects as long ago as 1981 to promote intensive exchange of scientific and research knowledge with China. This long-standing collaboration led not least to the founding of CG Rail GmbH. In January 2017, he was awarded by Chinese president Xi Jinping with the International Scientific and Technological Cooperation Award, the highest Chinese award for science and technology, in recognition of his commitment to the field of modern system lightweight design.

The new-generation metro development represents a benchmark project for world-leading rolling stock manufacturer CRRC, enabling it to follow in the footsteps of the aircraft industry and force the application of CFRP lightweight structures in railway technology, which will further improve the quality of urban public transport. “Reducing weight as far as possible through the use of resource-efficient lightweight structures is a vital prerequisite for increasing the loading capacity of trains with limited axle load. It allows more passengers to be transported in the same space, shortens operating cycles and increases interior comfort – as well as using less energy. And the results of research and development being generated in this field will have a synergetic impact on other sectors,” emphasizes Sansan Ding, Chinese CEO of CG Rail GmbH.

The Next Generation Metro Train project can be seen at InnoTrans in the outdoor exhibition area, stand 4/109

Overview of CG Rail – Chinese-German Research and Development Center for Rail and Transport Technology Dresden GmbH

CG Rail GmbH develops new lightweight construction methods, materials and technologies for rail and transport technology, specifically the high-speed and underground trains sector. Founded in 2015, the company works closely with other renowned Dresden-based research and industrial partners in the field of lightweight construction to broaden international collaboration on cutting-edge rolling stock projects, particularly with China. The company employs 35 people at two sites in the Dresden area. CG Rail is certified to DIN EN ISO 9001:2015 standard.

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