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CARBON FIBERS: DIAMONDS OF THE 21ST CENTURY TEXTILE INDUSTRY

Teijin is investing $600 million in a carbon fiber manufacturing facility in Greenwood, South Carolina.

The U.S. textile industry is innovative and resilient. It has persevered through economic downturns, changing global market conditions and offshore pressures. The industry, as one of the most significant sectors of the U.S. manufacturing base, fuels the economy, sustains communities and supports some 1.5 million jobs across the United States.

From 2006 to 2016, the U.S. textile industry invested $20 billion in new plants and equipment, with $2.4 billion invested in 2016 alone. In recent years, U.S. manufacturers have opened new facilities throughout the textile production chain. But American textile manufacturing and its highly efficient supply chain — one long associated with quality and performance — is also attracting foreign investment.

"Not so long ago, headlines were replete with news of textile and apparel manufacturers offshoring their production," said National Council of Textile Organizations President and CEO Auggie Tantillo. "Today, the reverse is true. The United States has become a popular destination for large scale textile investment on the part of foreign companies, and in many cases from Asian companies."

One such foreign company investing in the American textile industry is Tokyo-based Teijin Limited — a leading global technology-driven company operating in the areas of advanced fibers, plastics and films, composites, healthcare and IT businesses. Teijin Carbon Fibers Inc. (TCF), a wholly-owned subsidiary of Teijin Limited, recently broke ground on a new $600 million carbon fiber facility in Greenwood, South Carolina.

CARBON FIBER — AN ADVANCED MATERIAL

Carbon is a very versatile element that can exist in a variety of natural forms from graphite to diamonds. State-of-the-art, man-made carbon fibers possess a variety of properties, but are especially prized for their high strength and low weight. In fact, carbon fiber is 10 times stronger than steel, which makes it an ideal engineering material to replace metals in high-tech applications. Some of the most common uses of carbon fiber today include airplane and automobile components, where reduced weight and high strength can translate into fuel savings. Other applications include wind turbine blades, pressure vessels, medical devices bicycle frames and tennis racquets *(see box on page 12)*. In theory, the possibilities for carbon fiber are limited only by the imagination.

Carbon fibers can be manufactured using a variety of starting materials. Teijin uses a specifically engineered high-quality polyacrylonitrile (PAN) as a precursor in its Tenax® carbon fiber production process. According to the company, Tenax fibers consist of 1,000 to 48,000 filaments each featuring a micro graphite crystal structure. The small diameter — between 5 and 7 micrometers — of these carbon

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Shukei "Daniel" Inui
Teijin Group Corporate Officer, General Manager, Carbon Fibers Business Unit

fibers makes them flexible enough to be processed using traditional textile manufacturing methods such as knitting, weaving or braiding. When combined with a resin, carbon fibers can be turned into composite materials.

"Carbon fiber is a next-generation fiber," said Wayne Trotter, director of government relations, Teijin Holdings USA Inc. "We have only scratched the surface with the applications and we see endless possibilities. Every industry I can think of is going to benefit from the textile composites industry. It's very interesting and very dynamic."

SIGNIFICANT INVESTMENT PUTS TCF ON HIGH-TECH GROWTH PATH

Teijin's decision to invest in carbon manufacturing in the United States was a result of demand from the aerospace and automotive industries, as well as Teijin's desire to manufacture carbon globally.

"There is demand for carbon fiber here in the United States," said Shukei "Daniel" Inui, Teijin Group corporate officer, and general manager, Carbon Fibers Business Unit at Teijin Limited. "We have a carbon fiber plant in Japan, and also in Europe based in Germany, but [we] were missing capacity in the United States. Carbon fiber demand is global, and we have been eager to have a plant in the United States for many years."

Teijin considered several locations for its U.S.-based carbon fiber plant, but ultimately decided on Greenwood, South Carolina. "People here in South Carolina always are very supportive of our business. Not only with the incentives and the infrastructure, but also with support of the people, we decided on South Carolina," Inui said.

The $600 million investment will occur in stages. By the end of the fiscal year 2020, one carbon production line will be in operation and the facility will employ approximately 70 people. TCF will

Teijin executives and local dignitaries held a ground breaking ceremony to celebrate the $600 million carbon fiber plant investment in Greenwood, South Carolina.

CARBON FIBER

is used in a myriad of products today with yet more still to be discovered. Here are just some of the products that can benefit from the use of carbon fibers.

1. **AERONAUTICS & AEROSPACE PARTS** including fuselage panels, wings and engine blades for commercial aircraft, military planes, helicopters and unmanned aerial vehicles
2. **HIGH-END AUTOMOBILE COMPONENTS** such as body parts, wheel rims, seat shells, door sills, braking discs and protective crash structures
3. **INDUSTRIAL APPLICATIONS** including robotic arms and high-precision engineering parts
4. **RENEWABLE ENERGY APPLICATIONS** such as wind turbine blades and rotors, solar panel frames, fuel cells and batteries, and natural gas pressure vessels
5. **SPORTS & LEISURE ITEMS** including bicycle frames, fishing rods, skis, surfboards, golf clubs, baseball bats, tennis racquets, shoes, protective headgear, musical instruments, and protective cases for laptops and smartphones
6. **CONSTRUCTION PRODUCTS** including concrete and asphalt reinforcement, as well as rebar
7. **MEDICAL APPLICATIONS** including x-ray and magnetic resonance imaging equipment, implantable devices, surgical implements, and medical aids like artificial limbs and braces, wheelchairs and access ramps
8. **MARINE PRODUCTS** including masts, sail cloth, hulls, drive shafts and propellers

import its precursor material, PAN, from Japan initially, but may invest in equipment to produce PAN in Greenwood, if the demand is there. By 2030, the company hopes to have several carbon fiber production lines running with 220 associates in place.

"We have enough land so it's not necessary to limit to the three lines," said Inui. "If necessary we can invest more."

Different grades of carbon fiber can be manufactured depending on the end use and required properties, and the lines at TCF will have the flexibility to produce various grades of fiber depending on demand. Capacity at the plant will be determined by the product mix because of process variations for the different grades. Teijin hopes to have its highest-grade fiber qualified by the aerospace industry, but this process can take several years. In the meantime, TCF will focus on producing grades of fiber used by other industries and expand sales to other markets.

"I think the United States' demand for carbon fiber increases more and mainly for aerospace and automotive, so we have to follow this demand," Inui said. "But we are not limited to just these applications, and will manufacture for other industries including pressure vessels, wind energy and any other applications we are open to also."

THE FUTURE OF CARBON FIBER

"I see synergies between the carbon fiber industry and the traditional textile industry," Trotter commented. "Carbon fiber is in fact the next-generation fiber, and I think there are multitudes of yet-to-be-identified opportunities to work in conjunction with textile companies particularly here in the Southeast. The folks in the textile industry are very proud of their craft, their workmanship. That's something we were looking for as well, and we saw that in the rich heritage, the textile heritage that exists here in this part of the country."

Inui added: "As a supplier, we have been expecting new applications for carbon fiber for many years, and we want to create new applications and new demand with our customers. While it's very difficult, together with our customers, we can develop these new applications. Our customers and partnerships are very important — people here in South Carolina can support us, and we will grow together here in the United States."

Teijin's goal is to become a leader in the composites industry in the United States according to Inui. The company's commitment and $600 million investment undoubtedly set them on a path to achieve this goal.