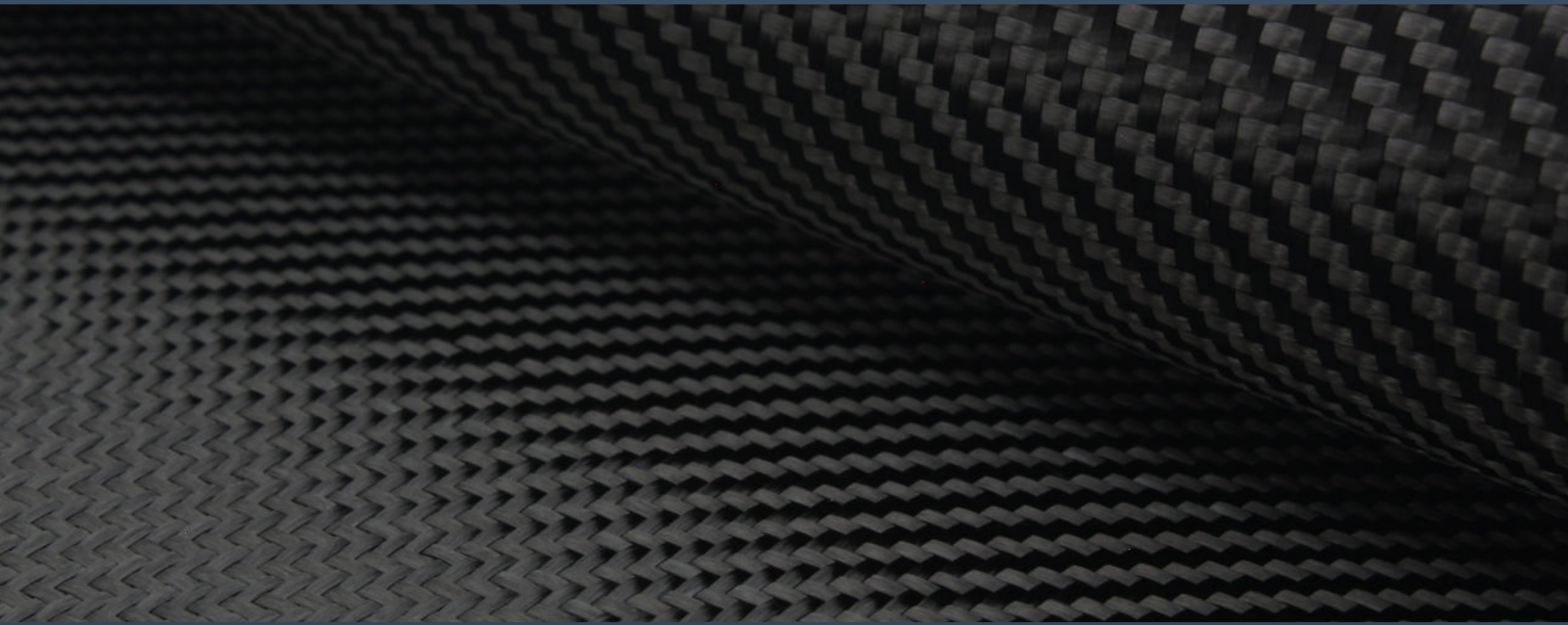
COMPOSITE ENVISIONS KNOWLEDGE CENTER
PRACTICAL AND INSIGHTFUL COMPOSITES INFORMATION



HISTORY OF CARBON FIBER

COMPOSITE ENVISIONS

ELECTRICITY, LIGHTBULBS, EDISON & BACON

Carbon Fiber was first utilized in 1860 to arc light between two electrically charged conductive carbon rods. Electricity was somewhat a circus show at the time and carbon fiber, as they knew it, had absolutely nothing to do with providing the high-performance characteristics we know today. However, Carbon fiber's resistivity to heat and conductivity was realized for lighting, thus helping found the building blocks of forming carbon fibers through "pyrolysis". In 1879 Thomas Edison used pyrolysis to produce the carbon fiber filaments that would then be used inside of the first lightbulbs as an electrode. These filaments, derived from burning impurities from cotton and bamboo fibers, resulted in the electrically conductive actual carbon fibers. But because early carbon fibers had weak mechanical properties and alternative advancements in electricity arose, carbon fibers went nearly unnoticed and were not used extensively for the next century.

It was not until 1958 that physicist Roger Bacon, produced the first high performance whiskers of carbon fiber through the Pyrolysis process. Through study of melting graphite under high temperatures and pressures, Bacon found the chemistry behind carbon fiber reinforcing hexagonal structure. This carbon rich structure was then multiplied, formed into sheets and rolled continuously throughout the length of the fiber. The result of Bacon's whiskers yielded the world's highest performing fiber known to man in terms of stiffness and strength. A few years later, Bacon used rayon-based precursors to produce a commercialized product. The mechanical possibilities of carbon fibers were finally taking hold. However, the discovery came at an astronomical cost to produce. To become viable, the laboratory experiment needed a more effective process to manufacture in a competitive market.

PITCH & PAN

The 1970s are where Carbon Fiber's imaginative properties began to take realization in an industrial setting. Leonard Singer discovered "Pitch" based carbon fibers through his study of carbonization of oil and coal-based materials. Pitch is a tar-like substance produced from heating petroleum (oil) into a highly carbonic substance. Through stretching the pitch molecules and working them at high temperatures, it is aligned into a highly crystalline carbon fiber. The unveiling of pitch-based carbon fibers produced ultra-high modulus (stiffness) and high thermal conductivity, all of which were desired in high heat applications exposed within aircraft. Though very expensive to process, Singer's pitch-based carbon fibers found use in high heat applications. Pitch based carbon fibers carry the stiffest and highest thermal and electrical conductivities of the manufacturing methods, making them still viable today.

Meanwhile, Japanese scientist Akio Shindo expanded Carbon Fiber research in Japan using highly pure forms of the petroleum based Polyacrylonitrile (PAN). PAN, today's most common precursor of carbon fiber, yielded high levels of crystallinity within the fibers, but were tougher than ever before seen in pitch or rayon-based carbon fibers. Shindo's PAN precursor process was also much more cost effective to produce quality Carbon Fibers versus the pitch or rayon-based fibers.

ENTERING THE MAINSTREAM

Throughout the 1980s and 90s, a global perspective for aviation and space applications from government to commercial customers were now clearly being recognized. This resulted in exponential growth of carbon fiber selection throughout these industries. This was due to the sheer weight savings that aircraft would have resulting in higher performance and fuel efficiency of the aircraft and even engine assemblies. Engineers went to work on the concept of lighter, stronger and faster. Replacement parts were now being designed in carbon fiber to replace parts made of steel-based alloys and aluminum. However, Carbon Fiber was a mountain to process versus the subtractive means of machining once known to metal fabrication. As time was spent learning and understanding the methods of carbon fiber fabrication, metal part counts dwindled and were less common in each newly designed aircraft. As fabrication methods advanced, so did the production of the fibers themselves. All causing a boom with this form of black gold, driving demand even higher.

Carbon Fiber has now been established into a vast number of industries worldwide due to its improved manufacture and processability. Steady gains in higher levels of Carbon, some with over 90% carbon, share the benefits of added strength while being more cost effective to the market. The cost factor of carbon fiber has significantly dropped due to engineering and process control perfections. Carbon fiber application has exploded beyond aerospace applications and are now viable solutions to ever expanding industries including auto racing, boating, sporting goods, construction, and even furniture. Fifty years ago, no one ever thought of having an office table made from carbon fiber. It would've cost millions of dollars to even produce that much raw carbon fiber. And today, carbon fiber's application is only limited to our own human imagination.

Composite Envisions LLC
8450 Development Court
Wausau, WI 54401 USA
+1 715-842-0101
info@compositeenvisions.com
https://compositeenvisions.com/

COMPOSITE ENVISIONS