Council of Scientific and Industrial Research
National Aerospace Laboratories

CSIR-NAL

# Centre for Carbon Fiber and Prepregs

## Development of aeronautical grade carbon fibers and development of continuous process for the preparation of standard modulus grade carbon fibers

Indigenization of process technologies involved in manufacturing of aerospace grade carbon fiber was the main activity in the division. In the year 2016-2017, continuous and prolong processes (namely polymerization, fiber spinning and heat treatment) for manufacturing of precursor and aeronautical grade carbon fiber were demonstrated to certification agencies successfully.

Effect of comonomer compositions on mechanical properties of resulting carbon fibers has been evaluated. Batches of PAN copolymers with 2.5-2.7 polydispersity index have been synthesized under the strict control on pH and temperature during reaction. Processes for the preparation of polymer solution with enhanced stability and spinnability have been developed. Series filters have been designed and fabricated for efficient filtration of spinning solution up to micron level. Design of Spinnerette has been developed for extrusion without coalescence of filaments. Prolong runs for precursor fiber have been conducted and converted into carbon fibers under optimized time-temperature-stress profile. Processing speed of heat treatment processes has been increased significantly by accelerating the stabilization kinetics for PAN fiber.

Process control standards including calibration, operation and maintenance of equipment in polymer, fiber spinning and heat treatment area have been documented. Synthesis of PAN copolymer, preparation of special acrylonitrile fiber and three runs of conversion of SAF into carbon fiber including characterization of intermediates and product have been successfully demonstrated to CEMILAC and DGAQA team.

## Development of shape memory polymers and composites

Shape memory epoxy polymers (SMEP) with tunable shape memory transition temperatures were synthesized using aromatic/aliphatic resins. The tailored transition temperatures were obtained by varying aromatic to aliphatic content in the shape memory materials. Shape memory materials have been evaluated for differential scanning calorimetry and X-ray diffraction, shore hardness and shape memory performance by fold deploy test. These shape memory materials showed enhanced shape memory properties with shape fixity of 98 - 99 % and shape recovery of 93–98 %.

Carbon Fiber

Design, Development & Certification

**For more information please contact:**
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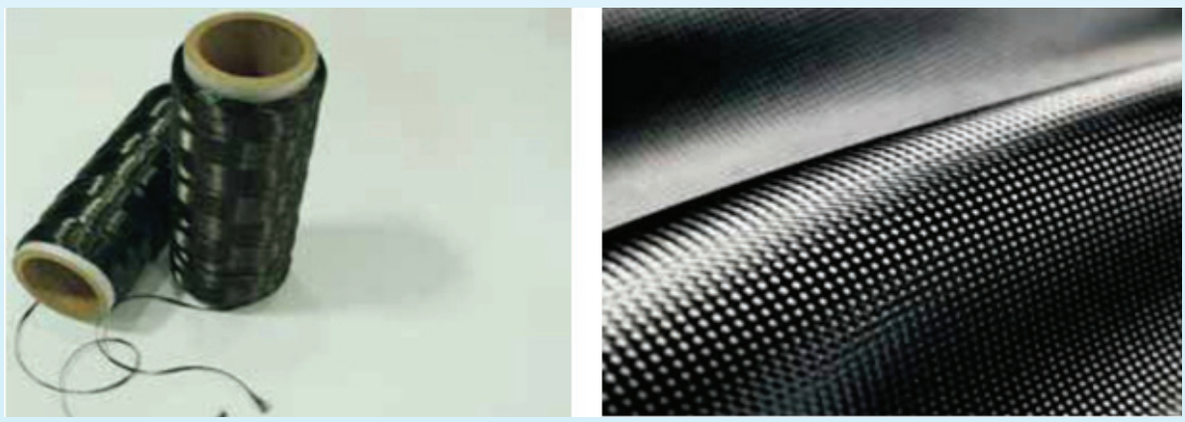
# Development of Indigenous Carbon Fibre Technology - Self Sufficiency

Carbon fiber is a high strength, high-stiffness but low weight material, used extensively in manufacture of aircraft, missiles, launch vehicles and satellites. It is also an important raw material in many vital industrial applications such as wind energy, infrastructure, sports and transportation, to name a few.

CSIR-NAL established carbon fibre Facility in 2003. This facility is an integrated facility and is capable of producing special acrylic precursor fibres (SAF), carbon fibres and carbon/epoxy prepregs. The carbon fibre R&D activity was started in CSIR-NAL at a time when carbon fibres were not easily available due to sanctions and denial regimes. CSIR-NAL pioneered the development of carbon fiber technology and demonstrated the same on a pilot plant of 10 TPA capacity. Subsequently, CSIR-NAL successfully transferred the technical know-how to Kemrock Industries and Exports Limited, Vadodara, for the production of carbon fiber on commercial scale up to 300 TPA; Kemrock commissioned India's first commercial scale carbon fiber manufacturing facility on May 9, 2010. Type certified by Centre for Military Airworthiness and Certification (CEMILAC), Bangalore on September 21, 2011.

MoU with MIDHANI, Hyderabad for development of production technology for aeronautical grade carbon fibers.

*Carbon fibre plant at NAL*



*Carbon fibre*

Technical details:

**Base material :** Carbon Fibre **Grade:** 3K, 6K and 12K

**End Use:** Manufacturing of prepregs commonly employed in the construction of aeronautical structures.

**Storage life:** 12 months (from date of application of sizing/finish) when stored at room temperature with adequate protection from dust.

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