

PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CARBON MATERIALS

Solution Spinning of PAN Precursor Capabilities

The UK CAER is one of the few research centers to maintain and operate, on-site, a fully commissioned (2007), bench-scale (100 ft long) multi-filament polyacrylonitrile (PAN) precursor fiber spinning line housed in a secure 5000 ft² facility. This scale of the line was purpose-built to balance the production of meaningful research quantities of precursor tow (up to 1 lb/working day) while minimizing the time and effort necessary for line change-over. In this way, the line efficiently tests the “spinnability” of numerous experimental precursor dopes, which we prepare in-house, as well as produces sufficient fiber for subsequent thermal processing. These spinning technologies are readily transferrable to industry.

The line has the ability to dial-in processing parameters of experimental dopes on a small scale. Other parameters that can be investigated include: dope preparation, composition, filtration sequence, spinnerette geometry, wet spinning, air-gap spinning, spinning temperature, coagulation and wash bath(s) temperature, composition and residence time, cold stretching, hot water drawing, steam drawing.

The line begins with a pneumatically pressurized dope inlet system (2 – 200 mL stainless steel syringes – enabling continuous dope charging), which pre-filters, and introduces the dope into the metering pump at a constant inlet pressure. The metering pump (Zenith PEP-II polymer gear pump, 0.16cc/rev) operates from 3 to 70 rpm (up to 10,000 psi), and provides a constant flow of dope through a sintered metal filter cup to remove gels and other agglomerates. At the extruder head, the dope is again filtered through a screen pack, and flows through the breaker plate to the spinnerette plate. Filtration sizes can be adjusted to meet the needs of the application. All spinnerette plates are machined to order.

The line then continues in a sequence of seven coagulation/wash baths, also containing a DMAc/DI water solution, which provide coagulation of the fiber while the godets provide the appropriate stretch ratios. The line ends with a hot water stretch bath containing DI water heated to 85°C and a keyhole furnace fitted with a steam generator to provide a steam stretch before final take-up onto a traversing winder.

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