Tech Facts

Presented by the University of Kentucky's Center for Applied Energy Research

Technology Timeline

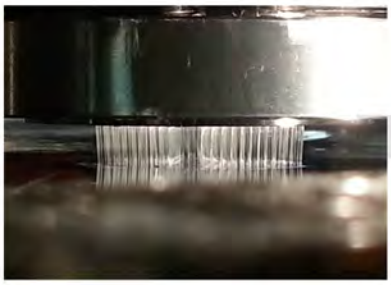
- Lab scale research into solution spinning of polyacrylonitrile (PAN) fiber led to commissioning a bench scale, solution spinning line for multifilament, continuous tow precursor fiber production in 2007.
- Wet-jet and dry-jet wet spinning of up to 500 filament count tows, utilizing a wide range of solvent and polymer compositions to produce novel precursor fiber.
- Processes developed on the line are highly adaptable to industrial scale spinlines

Precursor Spinning for Carbon Fiber

Due to its unique characteristics, carbon fiber is one of the leading materials for light weight, high strength and stiffness applications. The University of Kentucky Center for Applied Energy Research has developed a unique solution spinning facility, which can solution spin precursor fibers from a wide range of experimental precursor materials.

The scale of the line was purpose-built to balance the production of meaningful research quantities of multifilament, continuous precursor tow (> 1 km/day) while minimizing the time and effort necessary for line change-over. The line efficiently affords itself to test the "spinnability" of numerous experimental polymer spinning dopes, which we prepare in-house, as well as produces sufficient fiber for subsequent processing and analysis. Another of the unique values of the line is the ability to systematically vary processing parameters of experimental dopes on-the-fly.

Figure 1: (a) (below) bench scale solution spinline, (b) (right) air gap (dry-jet) wet spinning, (c) (bottom right) multifilament, continuous polyacrylonitrile (PAN) precursor tow, and (d) (bottom center) close up of multifilament precursor tow



Spinning solution (dope) formulation

Given a novel precursor material, CAER is able to utilize years of experience in precursor spinning and rheological testing to optimally formulate a spinning solution.

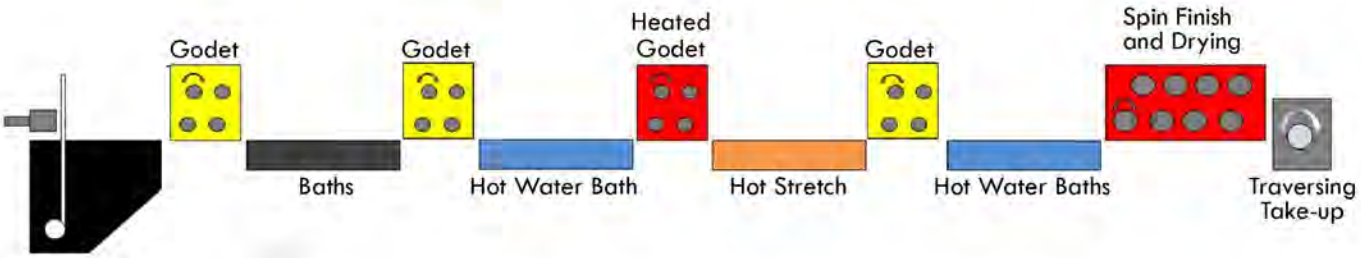
Spinning solution (dope) preparation

CAER uses a custom designed and built mixer to prepare the polymer/solvent spinning solution (dope). The mixer is designed to provide even heating and mixing for full dissolution of the polymer within the desired solvent, resulting in a homogeneous spinning solution.

Multifilament precursor fiber spinning

The line begins with a pressurized dope inlet system, which introduces the dope into the metering pump at a constant inlet pressure. The metering pump provides a constant flow of dope through a series of filters to remove gels and other agglomerates. At the extruder head, the dope flows through the breaker plate to the spinnerette plate. Nascent fibers emerge from the spinnerette face and enter the coagulant.

The tow then continues down a sequence of multiple coagulation/wash baths, which provide gentle coagulation of the fiber while inter-bath godet stations provide the appropriate stretch ratios. The line ends with several stretching baths and drying rollers prior to take-up winding.



On-site characterization capabilities (abbreviated):

- SEM/EDS
- LFA
- XRD/WAXD
- GC
- BET
- Parallel Plate Rheometer
- FTIR
- TGA/DSC/DMA/SDT
- MTS
- FT Raman

Contact

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