E. Carbon Fiber Systems Integration

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Objectives

- Develop a subscale, modular test facility for carbon-fiber conversion technology.
- Provide capability to test conversion subsystems or modules.
- Provide a capability for converting a range of polymer precursors into finished carbon fibers
- Provide the capability to produce small quantities of finished carbon fiber.

Approach

- Procure and install a conventional carbon-fiber pilot line.
- Construct advanced technology carbon-fiber pilot line using equipment and process specifications developed in other carbon-fiber conversion projects.
- Highly instrument the pilot line for process characterization.
- Locate the advanced technology and conventional lines adjacent to each other, and equip them with versatile fiber transport equipment.

Accomplishments

- Acquired and installed a used conventional pilot line.
- Commenced installation of MAP-carbonization, advanced-technology module.

Future Direction

- Complete conventional pilot line acceptance testing.
- Complete installation and commissioning of MAP carbonization module.
- Procure, install, and commission other advanced-technology modules when the processes and equipment designs are sufficiently mature.
- Perform precursor studies and parametric process studies.

- Investigate and demonstrate stable operating envelope, as well as system reliability, availability, and maintainability.
- Develop partnership(s) to commercialize the technology.

Introduction

The purpose of this project is to develop a user facility for testing and demonstrating new carbon-fiber conversion technology. The facility will be designed specifically for processing tows of commercial-grade (large tow) fiber, but will be sufficiently versatile that it can also process some aerospace-grade fibers. It will be designed to process a variety of polymer precursors; it may be adaptable to pitch precursors, but that is not a project requirement. As a user facility, it will be made available for use by government laboratories, universities, and industry partners.

The heart of the facility will be two adjacent, subscale, carbon-fiber conversion lines. One line will be based on conventional pre-treatment, conversion, and post-treatment processes and the other will embody advanced technology processes. The facility will be highly instrumented for characterizing fiber properties and process parameters. It will also be highly modular, and will be equipped with versatile tow transport equipment, so that tows can be routed through any combination of conventional and advanced technology conversion, pre-treatment, or post-treatment modules. The pilot line will be capable of running a single tow or any number of tows up to its maximum capacity, which will be at least five 50k tows. The pilot line may eventually be mated with upstream or downstream processes. The facility is shown schematically in Figure 1.

Project Deliverables

At the end of this project, a modular, flexible, and highly instrumented user facility for testing carbon-fiber conversion technology will be operational. The user facility will embody all pre-treatment, conversion, and post-treatment processes in parallel pilot lines for both conventional and advanced technologies, with the ability to route one to at least five large tows through any combination of the available processing modules.

Current Status

During FY2005, ORNL acquired a used conventional pilot line from Toho Carbon Fibers Inc. in Rockwood, TN and installed it in the 7625 building at ORNL. This pilot line has the capability to convert eight large tows at line speed of 0.2 m/min. The speed limit is the oxidation units; if oxidation is bypassed, the maximum line speed is 0.5 m/min. Acceptance testing will be conducted in early FY 2006.

Also in FY 2005, the MAP carbonization equipment was moved from the Y-12 site to its new home in ORNL building 7625 and installation was completed except for some minor piping connections. MAP carbonization installation will be completed and testing commence in early FY 2006.

Conclusions

The development of a DOE “carbon-fiber systems integration” facility for testing and demonstrating new carbon fiber manufacturing technology has commenced. A conventional carbon-fiber pilot line has been acquired and installed. The MAP-carbonization, advanced-technology module is being installed in the same laboratory. The end goal is to operate adjacent complete, subscale conventional- and advanced-technology pilot lines that will allow testing of either new precursors or new conversion technology.

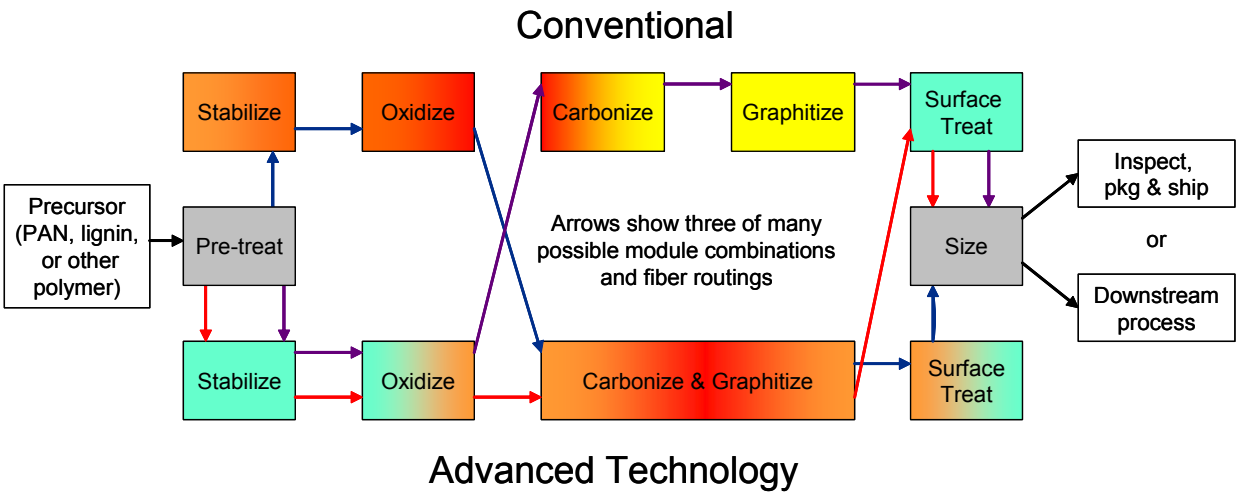

Figure 1. Schematic of carbon-fiber pilot lines