



Big scale thinking.

Harper is the pioneer of the Microline™ concept, based on the flexibility to change and modify for the needs of customers in the development of advanced fiber processing techniques.

The first and only choice for Carbon Fiber research.

Harper's fully integrated and extensively outfitted Microline™ systems are configured for customization with advanced performance equal to our world-leading production lines, but in a modest scale for research and development customers. The system can accommodate line speeds ranging from 0.1 m/min to over 1 m/min and tows from 10 filaments to 48000 filaments. Most lab-scale testing is performed in discontinuous batch processing steps; the Harper International system provides continuous conversion of filamentary material. This revolutionary system is equally suited for both potential industry clients as well as national and academic research institutes.

Harper systems allow for maximum manipulation of key process parameters, including controlling tension after each unit operation and multiple zones of temperature control in oxidation, pre-carbonization and carbonization. Our drive systems are designed for precision control of the forces imparted to the fiber, allowing for flexibility in tow counting, loading, and drive position. This flexibility yields greater customization of oxidation, with adjustability zone by zone, pass by pass, and carbonization.

Harper's recent contracts for research scale carbon fiber lines prove our leadership position in this area, including several systems for well-known research institutions in the USA as well as many international clients. Additionally, our advanced piloting line at Oak Ridge National Laboratory's Carbon Fiber Technology Center, designed with flexibility to handle multiple precursor types with a unique material handling solution, is a first-of-its-kind line focused on helping industry partners to demonstrate technology scalability in carbon fiber.



Harper's Microline system includes these highly customizable operations:

- Creel: Up to (8) positions
- Advanced Oxidation Oven: Up to 300°C, with multiple Zones of Control
- Drive Stands: Multiple locations throughout the system
- LT & HT Furnace Pre-carbonization and Carbonization: Up to 1000°C and 1600°C respectively, with multiple Zones of Control
- Integrated Control Systems
- Optional Pretreatment System
- Optional Surface Treatment System
- Optional Sizing System
- Optional UHT Furnace for Carbonization: Up to 2800° C
- Overall Plant Footprint approximately 40m L x 10m W x 4m H



System Enhancements

For investment and technical configuration considerations, the system can also be designed with:

- configuration of control system for preferences regarding remote access and data historian
- material handling for emerging precursors including those requiring belt transport
- advanced HT furnace designs for up to 1800°C
- optional UHT furnace for investigation of high modulus fibers up to 2800°C
- single or multiple dip systems for surface treatment

Example System Sizes

Small Scale Microline System ~ 100 kg / year

- Best Suited for Mono-Filament (Few Filament) Operation and Rapid Cycle PAN Formulation Research

Large Scale Microline System ~ 1.5 TPY

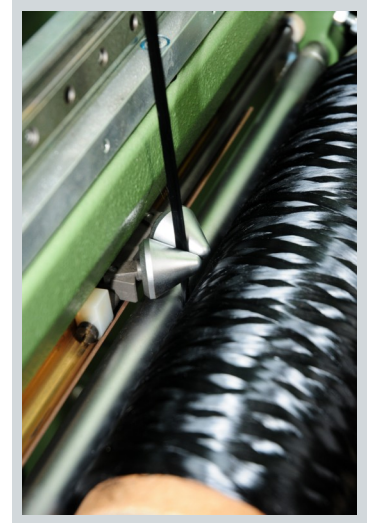
- Mini Production for Material Trials in Composites

Start up / Shut down

Start-up for Harper equipment from ambient conditions takes 8 – 12 hours. Shut down can occur in a shorter time frame. To optimize the life of the equipment and minimize thermal cycling, we recommend that the LT and HT furnaces be at idled at temperature for short downtime durations (i.e. over a weekend). This also optimizes power, when considering the requirements for heat-up.

Maintenance & Support

As always, Harper offers customized training, service and maintenance options based on the needs of the client. Beyond training, Harper's commitment to ongoing and rapid response to keep the client and their operations running smoothly and meet evolving / emerging system requirements is well known in the industry.



Spark the future.™

Harper is a global leader in complete thermal processing solutions and technical services essential for the production of advanced materials.

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