The Department of Polymer and Fiber Engineering at Auburn University’s state-of-the-art equipment is available for contract testing and joint research projects, whether the collaboration takes place across Auburn’s campus, the state of Alabama or the nation.

**THERMAL, MECHANICAL and RHEOLOGICAL CHARACTERIZATION OF POLYMERS**

**Differential Scanning Calorimetry (DSC)**
Used to determine characteristics, such as degradation temperature, absorbed moisture content, level of inorganic and organic components, decomposition points of explosives and solvent residue of polymers and other materials.

**TA Instruments – Q2000**
Operating range: -70ºC to 350ºC
Equipped with both modulated and high-resolution capability.

**Thermal Gravimetric Analysis (TGA)**
Used to determine characteristics of materials, such as polymers, to determine degradation temperatures, absorbed moisture content, levels of inorganic and organic components, decomposition points of explosives and solvent residue.

**TA Instruments – Q500**
Operating range: Room temperature to 950ºC
Equipped with multiple gas inputs for testing under both pure thermal and oxidative degradation modes.

**Dynamic Mechanical Analysis (DMA)**
Dynamic Mechanical Analysis provides information that can be used to measure thermo-mechanical properties of a polymer, such as glass transition, modulus, viscosity, softening temperature, gelation, degree of cure and impact resistance.

**TA Instruments – RSA III**
Strain controlled
Temperature range: -150ºC to 500ºC
Maximum force: 35 N
Three point bending used to flex solid samples. Tension used to test thin films. Equipped with parallel plate.

**Seiko EXSTAR 6000 (DMS)**
Stress controlled
Temperature range: -150ºC to 500ºC
Maximum load: ±5N
Elasticity measurement range: Young’s Modulus (Bending) 1x105-1012 Pa
Rigidity Modulus (Shear) 1x103-108 Pa

**Rheology**
Used to characterize the viscoelastic behavior of polymers and polymer solutions, such as viscosity, both steady and complex, as well as steady and complex storage and loss modulus, damping factors, flow index, melt index and yield point.

**TA Instruments – AR G2**
Stress controlled rheometer
Operating range: -160ºC to 800ºC
Equipped with air bearing gas pressure system (air or nitrogen), ultra-low, nano-torque control with minimum torque oscillation resolution of 0.003 μN.m, and can be equipped with ETC camera viewer to visualize material behavior.

**HAAKE Rheo Stress**
Strain controlled rheometer
Operating range: -140ºC to 200ºC

**Universal Testing**
Used to measure the mechanical strength of materials in tension compression and bending modes. Both frames have clamps for three point, fiber, yarn, wire and fabric, as well as standard tensile bars.

**Instron – Model 4505**
Equipped with environmental chamber: -100 ºC to 100 ºC
Load cells to 20,000 lbs

**Instron – Model 5500**
Load cells to 1,000 lbs

**Impact Testing**
Used to measure the impact load and energy required to puncture or break materials. Can also provide information on the type of failure mode for both brittle and ductile failure.

**Instron Model 8250**
Applied load up to 3,500 lbs

**STRUCTURAL AND CHEMICAL CHARACTERIZATION**

**Particle Sizing**
Used for measuring particle size in colloidal suspensions.

**Nicomp 380/zls &x**
Equipped with 35 mw laser diode, an avalanche photodiode detector for sizing and a second detector for zeta potential. Includes both a goniometer platform for multi-angle detection and autodilution.

**FTIR Units**
FTIR is used to detect molecular groups and provide chemical identification of polymers, including copolymer content. Raman measurements can provide details on surface chemistry and local environment.

**FTIR – Nicolet 6700**
Equipped with both transmission and ATR sampling geometries. Also equipped with Raman NXR-FT Module.

**FTIR – PerkinElmer 2000**
Equipped with transmission.

**GPC**
Viscotek 300 TDA
Used to obtain polymer structural information, such as molecular weight, molecular size (radius of gyration, Rg), conformation, branching, copolymer composition and aggregation.

**Equipped with:**
1) Refractometer
2) Viscometer
3) Light scattering

**Atomic Force Microscope (AFM)**
Veeco Dimension 3100
Used to measure surface properties on the nanoscale, nanoroughness and local distributions in modulus.

**Automated Capillary Flow Porometer** – Porous Materials, Inc.
Used to measure pore-size distribution, mean flow pore diameter, pressure hold, gas permeability and bubble point (maximum through pore diameter). Pore size from 0.03 Micron to 80 Micron.

**GC/MS Instrument, G 300 – Griffin Analytical Technologies, LLC**
Used to measure elemental composition of a sample or molecule and for elucidating the chemical structures of molecules, such as peptides and other chemical compounds. Operating range: 10ºC to 30ºC, relative humidity less than 85 percent

**FTIR Units**
FTIR is used to detect molecular groups and provide chemical identification of polymers, including copolymer content. Raman measurements can provide details on surface chemistry and local environment.

**FTIR – Nicolet 6700**
Equipped with both transmission and ATR sampling geometries. Also equipped with Raman NXR-FT Module.

**FTIR – PerkinElmer 2000**
Equipped with transmission.
Auburn’s polymer and fiber research laboratories maintain testing equipment used for coloration, finishing and polymer processing, including injection molding, fiber extrusion, nonwovens and other engineered fibrous structures.


Researchers and faculty members in Auburn’s Department of Polymer and Fiber Engineering conduct top-notch projects that examine and explore protective, composite and biomedical materials; fiber enzyme technology; geotextiles; fuel cell membranes; nanofibers; nanotubes; nonwovens; polymers; polymer and colorant-related chemistry; and waste reutilization.

Additional Testing Capabilities
- UV-Vis Spectrophotometer used to measure concentration of solutions and identify UV absorbing compounds. Wavelength range: 190-1095 nm.
- CSI-135 Gas Permeability Tester used to measure volumetric gas permeation rate through materials (film, membrane) as a function of pressure per ASTM D1434. Temperature range: 0 - 100 °C
- Dynamic contact angle analyzer
- Thermal conductivity: ALAMBETA thermal conductivity tester and a DYNAFIL-M
- Dimensional properties: AFIS, HVI, VIBROSPECT
- Mechanical properties: TENSORAPID, FAFEGRAF, ELMENDORF tear, MULLEN burst tester, bending length and circular bending, mil folding endurance tester
- Abrasion resistance: TABER rotary abrader, SCHIEFER uniform, universal FLEX WEAR tester, DURANT carpet abrader, ZWEIGLE abrasion tester, SULZER RÜTI abrasion tester
- Permeability testing: FRAZIER, GURLEY, CSI, LYSSY

Sample Preparation and Pilot Scale Production Capabilities
- Injection molder: 50-ton clamp force with 100 ml shot maximum shot size, full electric operation
- Wayne extrusion line: monofilament and multi-filament capabilities and a 6-inch film die
- 18 mm Liestritz twin screw extruder equipped vacuum vents and single strand die. Can be configured in either co- and counter-rotation mode and with side stuffer

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