Greene Tweed

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Advanced Engineering Thermoplastics Solutions

For more than 150 years, Greene Tweed's customers have relied on the company's materials expertise and collaborative approach to the design and manufacture of elastomeric, thermoplastic, and thermoplastic composite solutions that deliver proven performance in extreme and demanding operating environments.

A global company with facilities across North America, Europe, and Asia, Greene Tweed serves customers throughout a diverse range of markets, including energy, aerospace, defense, industrial, life sciences, and semiconductor.

INTRODUCTION

For more than 30 years, Greene Tweed has solved tough industry challenges with our line of advanced engineering thermoplastics for the most extreme upstream, midstream, downstream, petrochemical, and power generation applications.

Our products – seals, connectors, and functional components – operate in field conditions that include cryogenic temperatures up to 260°C (500°F), pressures up to 2,413 bar (35,000 psi), and aggressive chemicals in all of our market segments.

Our customers turn to Greene Tweed for our advanced thermoplastics expertise when they cannot afford downtime, lost production, damaged equipment, or health, safety, and environmental issues. We solve application challenges with our best-in-class materials. At Greene Tweed, we understand a material's characteristics and properties, and how to best use these attributes to design, process, and manufacture finished parts.

Our portfolio features numerous specialty blends designed to deliver excellent performance in critical applications. We developed our flagship Avalon® fluoropolymers and Arlon® PEEK families of materials through close collaboration with chemical, curative, and filler suppliers, equipment manufacturers, service providers, and operators. We have been granted more than 80 U.S. and foreign patents, including those on thermoplastic compounds, processing, and products, as well as several recent patents on Arlon® 3000XT, which is the first and only commercially available cross-linked PEEK on the market. Our judicious material selection and attention to design and application have created fit-for-purpose solutions that reliably enable our customer's technology in the field.

Greene Tweed's Advanced Technology Group (ATG) focuses on new material development to solve our customers' current and future problems. The ATG includes scientists and engineers with PhDs in diverse disciplines such as Polymer Science, Chemistry, Mechanical Engineering, and Coatings. Once we formulate an experimental compound, we initiate an extensive testing process to characterize the new material, including in-house testing capabilities for material characterization, fluid aging, rapid gas decompression (RGD), high-pressure and high-temperature (HPHT) cycling, and more.

We rigorously batch test our compounds at our ISO 17025-accredited materials lab before manufacturing these materials into products, using industry-leading compression and injection-molding capabilities at our ISO 9001-certified manufacturing facilities. All Greene Tweed finished products must pass strict quality inspection testing prior to shipping.

Our applications engineering team has experience designing equipment at OEMs and service companies in the industries we serve. As such, Greene Tweed engineers understand the needs of the energy industry, and the failure modes of materials, in a wide range of operating environments. We collaborate with our customers to select and provide the best material for safe and reliable operation, while providing the necessary technical support.

THE CASE FOR THERMOPLASTICS

Advanced thermoplastic materials are the ideal solution when conditions preclude the use of elastomeric or metallic parts. Thermoplastics are capable of withstanding the demanding environments that are common in the energy industry, including aggressive chemicals, extreme pressures, and severe temperatures. Thermoplastic compounds deliver structural integrity despite environmental conditions such as wear, abrasion, shock, and vibration. Engineered thermoplastic materials provide critical electrical insulation for connectors while offering a weight advantage when used in place of metallic parts.

Advanced thermoplastics are used in:

- Pumps to replace metallic parts such as bearings, bushings, wear rings, and liners
- Valve seats in demanding ball valve applications
- Labyrinth seal applications to provide excellent mechanical strength and chemical resistance
- Valve assemblies in high-temperature reciprocating compressors
- Many other applications

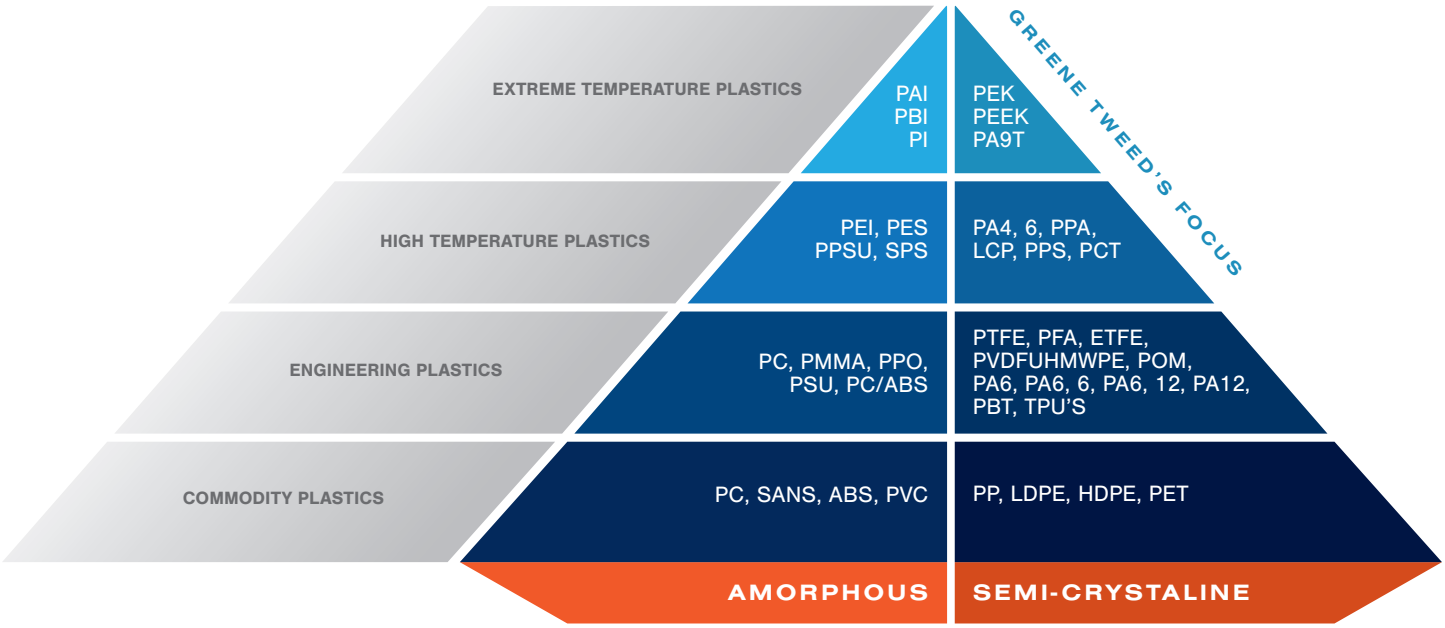
MATERIALS DEVELOPMENT

When conventional non-metallic materials fail to deliver their intended performance, customers call on Greene Tweed to recommend a thermoplastic to meet their needs. Our scientists have extensive knowledge selecting the proper base polymers, optimal cure systems and fillers, and the processing and design parameters required to achieve optimal performance for specific application needs.

As a technology market leader with a long-standing R&D reputation, Greene Tweed collaborates with leading chemical and polymer suppliers to develop new-to-the-market and even new-to-the-world materials. You can trust that our thermoplastics perform under specified conditions because our methodical development of new compounds is supported by numerous studies on processing variability to ensure a consistent, quality product.

PROCESSING CAPABILITIES

Greene Tweed compounds our thermoplastics from raw polymers and delivers advanced thermoplastic products and finished assemblies from our worldwide ISO 9001-certified manufacturing facilities. We process our best-in-class thermoplastics using injection molding, compression molding, isostatic molding, extrusion, and CNC-controlled machining equipment, enabling us to deliver parts with unusual and complex geometries.



AVALON® MATERIALS FAMILY

Greene Tweed initially developed the Avalon® family of materials for use in aerospace applications and through technology transfer, made these leading-edge materials available for use in the energy industry.

Avalon® fluoropolymers provide superior low friction for seal types including MSE®s, back-up rings for the G-T® ring, V-rings for V-packings, and valve seats. Base fluoropolymers provide excellent lubricity and sealing characteristics while fillers provide enhanced creep resistance, increased high-temperature capabilities, and outstanding wear characteristics. Avalon® is suitable for a variety of applications, including those requiring nonabrasive contact surfaces, high-temperature wear resistance, low deformation under load, good chemical resistance, and high-surface speeds.

Avalon® Compound	Features and Benefits
02	• Virgin, unfilled PTFE • A cost-effective material for low-friction needs
56	• Virgin, unfilled PTFE • Modified for improved gas permeability and cold flow properties
09	• Graphite-filled PTFE • Self-lubricating for lower breakout friction than virgin PTFE
59	• Carbon- and graphite-filled PTFE • Improved wear resistance and compressive strength as well as low breakout friction, though higher dynamic friction than virgin PTFE • Good for applications which require higher thermal conductivity
69	• Thermoplastic- and carbon-filled PTFE • Improved wear resistance and compressive strength while maintaining low static and dynamic friction
89	• Thermoplastic- and carbon-filled PTFE • Superior wear resistance to Avalon® 69 • Certified by an independent lab as resistant to sour service per ISO 23936-1 and NORSOK M-710 testing standards
87	• Glass-filled PTFE • Higher strength than virgin PTFE while maintaining chemical inertness
29	• Bronze-filled PTFE • Good for thermal and electrical conductivity • Improved wear resistance • Attenuates the non-stick and chemical inertness of the PTFE
57	• Thermoset-resin-filled PTFE • Lowest friction filler option; supports dry-running and stop-start applications • Non-abrasive for softer mating surfaces like aluminum or plastic
Specialty Grades	• High-performance materials including other fluoropolymers and/or polymers • Specialty fillers for specific functional attributes

ARLON® MATERIALS FAMILY

Arlon® materials are proprietary PAEK (polyaryletherketone) thermoplastic compounds, which include the PEEK (polyetheretherketone) and PEK (polyetherketone) subsets of compounds that provide high strength and wear resistance, and are well suited for use in harsh or extreme environments and highly dynamic applications. The operating temperature range of our Arlon® portfolio extends from low temperatures to 260°C (500°F). With excellent thermal stability, low wear, and high-impact resistance, Arlon® is suitable for tough, long-life applications.

Arlon® 3000XT, our newest proprietary Arlon® offering, is a best-in-class polyketone. It is the only commercially available cross-linked PEEK material, resulting in significantly enhanced chemical compatibility in high temperatures along with excellent creep resistance and improved insulation resistance properties when compared to unfilled grades of PEEK.

Arlon® Compound	Features and Benefits
1000	• Virgin PEEK • Certified by an independent lab as resistant to multi-phase, sour, aromatic fluids per ISO 23936-1 and NORSOK M-710 testing standards
1160	• Glass-filled PEEK • Improved strength versus virgin PEEK
1260	• Carbon-filled PEEK • Improved strength and wear resistance compared to Arlon® 1160
1330	• PTFE-filled PEEK • Lower friction than virgin PEEK
1555	• Carbon-, graphite-, and PTFE-filled PEEK • Improved strength and wear resistance compared to virgin PEEK • Self-lubricating for low breakout friction and low dynamic friction
2000	• Unfilled PEK • Higher temperature than PEEK with similar chemical compatibility
3000 XT	• Modified, unfilled PEEK for higher strength and higher temperature capabilities • The glass transition (TG) temperature is 178°C (352°F), approximately 30°C higher than virgin PEEK • Certified by an independent lab as resistant to multi-phase, sour, aromatic fluids per ISO 23936-1 and NORSOK M-710 testing standards
4020	• Carbon- and mineral-filled PEEK for use in labyrinth seals
Specialty Grades	• High-performance materials including other PAEKs • Specialty fillers for specific functional attributes

SOCIAL PROOF & MARKETS

Day after day, Greene Tweed thermoplastic solutions are placed into service in the energy industry's most demanding applications. Our premium materials run the gamut of applications, with a focus on enhancing reliability, improving safety, and reducing cost of ownership. Our flagship thermoplastics, Arlon® and Avalon®, are widely specified in multiple industries.

When it comes to drilling operations, our thermoplastics are used in conjunction with sensors in the drillstring for applications such as logging and measuring while drilling. Our thermoplastic solutions are specified and used in subsurface safety valves, drilling and completions tools, electrical submersible pumps, liner hangers, chokes, blowout preventers, and more. Greene Tweed thermoplastic solutions are relied upon in critical facilities around the world.

Greene Tweed's thermoplastics are used as seals in valves, compressors, and pumps in the midstream industry, refineries, and petrochemical plants. Our thermoplastics are used in multiple applications ranging from valve seats to compressor poppets to labyrinth seals in the largest refineries and petrochemical facilities in the world.

In the power generation industry, Greene Tweed delivers thermoplastics for demanding applications such as critical control valves, mechanical seals, and boiler feed pumps at nuclear power plants.

Contact Greene Tweed to discuss how an advanced thermoplastic solution can solve your critical application requirements.

GLOBAL PRESENCE, LOCAL SERVICE.

With more than 1,600 employees across 11 countries, Greene Tweed offers material, design, engineering, and manufacturing expertise worldwide, collaborating with customers to meet their critical challenges through the development of custom-designed, leading-edge components.

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