

Technical Article

PPS: When Aggressive Chemical Resistance Isn't Enough
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For over three decades, polyphenylene sulfide, PPS, has been acknowledged and accepted as a high performance material with exceptional high temperature and aggressive chemical resistance characteristics. There have been hundreds of applications manufactured from fabricated stock shapes and injection molders have fulfilled thousands of applications for custom molded products. PPS is heavily specified and approved by almost all global manufacturers requiring high performance thermoplastics.

The ability of PPS to withstand aggressive chemicals and harsh environments is well known and documented. A complete manual of chemical resistance levels for both short and long term exposures of varying grades of PPS is available upon request. Although the information available is too extensive to list, a few highlights provide a broad picture for review. PPS is not dissolved by any known solvents, even in long term exposure, at temperatures up to 200°C. The chemical resistance of PPS includes all automotive fluids such as gas or fuels, antifreeze, brake and hydraulic fluids, and hot oils or greases. In addition, PPS exhibits exceptional resistance to organic and inorganic solutions, acids and alkali solutions, and a wide array of miscellaneous chemicals.

The recent availability of PPS products in thin section and thermoformable grades have opened new markets for this material in the chemical tank and lining markets. Previously, most of these applications have been dependent upon fluoropolymer materials that could offer the chemical resistance and the flexibility of fabrication and thermoforming. The new PPS offerings meet or exceed the resistance levels of fluoropolymers with much higher continuous operating temperatures at very competitive costs. It has been estimated that PPS can, in some cases, reduce costs by as much as 30% when compared to high performance fluoropolymers.

Many of the chemical tank and lining applications for fluoropolymers require that the material is extruded with fabric backings for adhesive applications. The backed material is either fabricated or thermoformed into tank configurations and applied as a dual laminate or strengthened with a FRP outer shell. The fabric backing acts as an adhesive substrate for the fluoropolymers. PPS is available with these same fabric backings as required but early indications are that they may not be a necessity as with fluoropolymers. PPS may be directly bonded with urethane and epoxy adhesives without the need for backing fabrics. Trials with some European processors have shown that unbacked PPS exhibits peel strength equal to or greater than fabric backed materials. Further developments that utilize fabric backings to create high strength composites is ongoing at this time.

As aggressive environments often contain more elements than just chemical reactions, the superior service temperatures of PPS are of great value. Most fluoropolymers have resin manufacturers recommendations for continuous service not to exceed 150°C (302°F). PPS is unique in that it will operate continuously up to 240°C (464°F) and will sustain peak excursions to 270°C (518°F). These extended heat ranges make PPS a viable alternative for many applications that employ stainless steel when fluoropolymers cannot meet temperature requirements.

As chemical handling applications vary widely, so does the offering of thin section PPS. PPS is currently offered in both sheet and roll forms, with and without fabric backings, in thicknesses that range from .010in. (.25mm) to .250in. (6.35mm). Standard widths of 24 and 48in. are available as well as custom widths for specific applications. Lengths on sheets and rolls can also be in standard increments or cut to customer specifications for best yield in custom applications.

PPS resins are provided in both powdered and pellet forms in branched and linear formulations. The linear formulations offer greater mechanical properties and product consistency. Both branched and linear materials share common traits that offer extended benefits beyond chemical resistance. PPS is inherently flameproof and is UL94 V0 rated, some grades offer extended ratings to UL94 V5. PPS offers high dimensional stability and low creep at elevated temperatures. PPS has a very low moisture vapor transmission rate and a high strength to weight ratio.

PPS is available in a wide variety of formulations to best match requirements in all applications. Neat, unfilled, natural, formulations are available when purity is of the utmost importance. These non-shedding grades are desirable in clean room and semiconductor applications. When strength to weight ratios are an issue PPS is available with glass reinforcement up to 40%. Impact modified and impact modified/glass filled grades have been developed for situations where excessive handling requirements present a demand. A complete and complimentary selection of formulations is available to both the fabricator and the thermoformer.

As with fluoropolymers, PPS is now a broadly processed material where components may be matched for product continuity. Fittings and valves may be injection molded to accommodate extruded PPS tube and pipe applications. Welding rod is available for each grade of PPS in a variety of diameters for fabrication projects. Extruded and compression molded heavy section rings, tubes, plates, and rods continue to serve the fabrication markets. Engineered profiles of PPS include edge trim and joints for lining applications. Strips from .250in. to 24in. wide, up to .125in. thick is available as are stamped washers and spacers. One global leader in the manufacturing of PPS can provide all of these products and processes in controlled environments that would even allow for lot and batch consistency throughout an entire product line.

In summary, PPS has exceptional chemical resistance characteristics, coupled with higher heat capacities and an expanded availability to meet all aggressive environments. With the advent of thin section and thermoformable formulations PPS is quickly gaining renewed interest in chemical handling applications across a broad market spectrum.

A complete chemical resistance brochure is available via email in PDF format by contacting marketing@pennfibre.com. For specific application and formulation data contact David Pincin, National sales Manager for Ensinger/PennFibre at 800-662-7366.