PEEK (Polyetheretherketone)

General information

Overview

The main differences in the commercial types of PEEKs arise from differences in melting temperature. Higher Tm leads to higher heat distortion temperature but also higher required processing temperature. Has been used to replace aluminum and other metals in various applications (particularly in aviation).

Strengths

Excellent chemical resistance (except conc. acids), good hydrolysis resistance (particularly relative to PEIs), excellent UV and radiation resistance. Very high maximum service temperature (260 °C (500 °F)), high degree of oxidative stability to high temperatures (only PPS and LCP comparable), inherently fire-retardant, low smoke generation - claimed to have the lowest toxic gas and smoke emissions of any plastics material. Good dynamic fatigue resistance, good tracking resistance, excellent toughness and wear resistance, good resistance to cutting when used as wire covering, excellent fatigue resistance, higher strength to weight ratio than many metals.

Limitations

Attacked by concentrated acids. Difficult to process, expensive, limited supplier base, suffers from stress cracking in conc. sodium hydroxide, glycerol, sodium carbonate solution, ethyl acetate, and aniline. Moderate susceptibility to stress cracking in ethanol, cyclohexanone, and chloromethane. Notch sensitive.

Designation

Polyaryl ether (name for the class as an alternative to polyether ketones).

Tradenames

Ketron PEEK, Thermocomp, Victrex, PEEK-Optima

Typical uses

Aerospace applications, medical implants, wire covering, injection molded engineering products, film for flexible PCB, resin in fiber prepregs, radiation environments, piping. Filled grades: lightweight structural members in aerospace, ground transport and sporting goods, springs, pressure vessels.

Composition overview

Compositional summary

(-C6H4-O-C6H4-O-C6H4-(C=O)-)n

Material family	Plastic (thermoplastic, semi-crystalline)
Base material	PEEK (Polyetheretherketone)
CAS number	31694-16-3

Effect of composition

Grades containing 10-20% PTFE can have very low coefficients of friction (similar to PTFE itself). Static and dynamic coefficients of friction tend to converge, reducing slip-stick effects. Completely miscible with other polyether ketones with a keto-content within 25% of PEEK - i.e. 8-58%, therefore is miscible with PEK but not PEKK. Completely miscible with PEI, with blends showing higher impact resistance than either of their components.

Processing properties

First commercial production	1983

Available forms

Pellets, powder, rods, and plates available for machining (from Solvay).

Forming

Compression molding, extrusion and vacuum-forming. Injection molding difficult. Very high melt temperatures required (370 °C (700 °F) or above). Pre-drying essential for the high mold temperatures required. Fine powder may be used to coat metal substrates in depths up to 2mm (vortex sintering).

Machining

Very easy to machine. Though carbide/diamond tipped tools/bits with cooling water recommended. Annealing should be carried out before machining.

Joining

Difficult to solvent bond but suitable for bonding with a wide range of adhesives. Surface treatment, e.g. with laser greatly improves bond strength. Suitable for all types of welding except radio freq. Hot gas welding difficult. Due to the high melting temperatures, considerable amounts of energy are needed for welding. Suitable for laser welding, can be welded to PEI, welds to aluminum have also been carried out with some success. Heat sealing of films is possible though requires high temperatures.

Surface treatment

Suitable for painting.

Geo-economic data for principal component

Annual world production	1.38e3	-	2.36e3	ton/yr

Notes

Other notes

Naturally beige/brown. Ultra-pure grades suitable for medical implants.