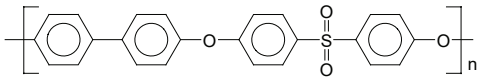
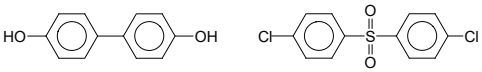
PPSU poly(phenylene sulfone)

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	poly(phenylene sulfone)	
CAS name	-	poly(sulfonyl-1,4-phenylene)	
Acronym	-	PPSU	
CAS number	-	31833-61-1; 877322-41-3	
Linear formula			
HISTORY			
Person to discover	-	Umezawa, M; Tsubota, T, Imai, S	Umezawa, M; Tsubota, T, Imai, S, US Patent 4,942,091, Toray Industries, Jul. 17, 1990.
Date	-	1990	
Details	-	PPSU fibers obtained by oxidation of PPS	
SYNTHESIS			
Monomer(s) structure	-		
Monomer(s) CAS number(s)	-	92-88-6; 80-07-9	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	186.21; 287.16	
Method of synthesis	-	PPSU can be prepared from PPS by oxidation with hydrogen peroxide	Tago, T; Kuwashiro, N; Nishide, H, Bull. Chem. Soc. Jpn., 80, 7, 1429-34, 2007.
Mass average molecular weight, M_w	dalton, g/mol, amu	61,000	
STRUCTURE	-		
Crystallinity	%	85	Robello, D R; Ulman, A; Urankar, E J, Macromolecules, 26, 6718-21, 1993.
Crystallite size	nm	1.0-2.7	Umezawa, M; Tsubota, T; Imai, S, US Patent 5,244,467, Toray industries, sep. 14, 1993.
COMMERCIAL POLYMERS			
Some manufacturers	-	BASF; Solvay	
Trade names	-	Ultrason P; Radel	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.29	
Color	-	light yellow to brownish	
Odor		odorless	
Decomposition temperature	°C	>400	
Thermal expansion coefficient, 23-80°C	$°C^{-1}$	0.55-0.56E-4; 0.18E-4 (30% glass fiber)	
Thermal conductivity, melt	W m^{-1} K^{-1}	0.30	
Glass transition temperature	°C	220	

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PARAMETER	UNIT	VALUE	REFERENCES
Heat deflection temperature at 0.45 MPa	°C	212-214	
Heat deflection temperature at 1.8 MPa	°C	196-207; 210 (30% glass fiber)	
Dielectric constant at 100 Hz/1 MHz	-	3.44/3.45	
Relative permittivity at 100 Hz	-	3.8	
Relative permittivity at 1 MHz	-	3.8	
Dissipation factor at 100 Hz	E-4	6-17	
Dissipation factor at 1 MHz	E-4	76-90	
Volume resistivity	ohm-m	>1-9E13	
Surface resistivity	ohm	>1E15	
Electric strength K20/P50, d=0.60.8 mm	kV mm^{-1}	15-44	
Comparative tracking index, CTI, test liquid A	-	150	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	70; 120 (30% glass fiber)	
Tensile modulus	MPa	2,270-2,340; 9,170 (30% glass fiber)	
Tensile stress at yield	MPa	74	
Tensile creep modulus, 1000 h, elongation 0.5 max	MPa	1,930	
Elongation	%	60-120; 2.4 (30% glass fiber)	
Tensile yield strain	%	7.2-7.8	
Flexural strength	MPa	105; 173 (30% glass fiber)	
Flexural modulus	MPa	2,410; 8,070 (30% glass fiber)	
Compressive strength	MPa	99	
Charpy impact strength, unnotched, 23°C	kJ m^{-2}	no break	
Charpy impact strength, unnotched, -30°C	kJ m^{-2}	no break	
Charpy impact strength, notched, 23°C	kJ m^{-2}	65	
Charpy impact strength, notched, -30°C	kJ m^{-2}	24	
Izod impact strength, unnotched, 23°C	J m^{-1}	no break; 640 (30% glass fiber)	
Izod impact strength, notched, 23°C	J m^{-1}	694-750; 75 (30% glass fiber)	
Shear strength	MPa	61	
Poisson's ratio	-	0.43	
Rockwell hardness	R	122	
Shrinkage	%	0.9-1	
Viscosity number	ml g^{-1}	71	
Intrinsic viscosity, 25°C	dl g^{-1}	0.73	
Melt volume flow rate (ISO 1133, procedure B), 360°C/10 kg	cm^3/10 min	20	
Water absorption, equilibrium in water at 23°C	%	0.7-1	

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Moisture absorption, equilibrium 23°C/50% RH	%	0.6	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	good	
Alkalis	-	good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Halogenated hydrocarbons	-	poor	
Good solvent	-	dichloromethane, ethylene dichloride	
FLAMMABILITY			
Autoignition temperature	°C	570	
Limiting oxygen index	% O_2	38-44	
NBS smoke chamber, Ds, 4 min	-	0.4	
Char at 500°C	%	38.4	Lyon, R E; Walters, R N, J. Anal. Appl. Pyrolysis, 71, 27-46, 2004.
Volatile products of combustion	-	CO, CO_2, SO_2; SO_3	
UL rating	-	V-0	
WEATHER STABILITY			
Spectral sensitivity	nm	<320, 365	
Excitation wavelengths	nm	245-255, 270, 320,	
Emission wavelengths	nm	310, 360, 450	
Depth of UV penetration	μm	50	
Important initiators and accelerators	-	residual monomer, copper stearate	
Products of degradation	-	products of photooxidation: chain scissions, free radicals, carbonyl groups, acetic acid, sulfoacetic acid, benzoic acid, crosslinks, unsaturations, hydroxyl groups, sulfonic acid, SO_2	
PROCESSING			
Typical processing methods	-	injection molding	
Preprocess drying: temperature/ time/residual moisture	°C/h/%	140/4/0.02	
Processing temperature	°C	350-390 (injection molding)	
Applications	-	aircraft interiors, cases and trays for healthcare, dental instruments, food service equipment, medical device components, pipe fittings and manifolds	
Outstanding properties	-	unlimited steam sterilizability, excellent resistance to hot chlorinated water	
BLENDS			
Suitable polymers	-	PSU	