

PSR polysulfide

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polysulfide	
IUPAC name	-	poly(oxyethylenedisulfanediyethylene)	
ACS name	-	polysulfide	
Acronym	-	PSR	
CAS number	-	9080-49-3	
Formula		$\left[\text{CH}_2\text{CH}_2\text{S}_x \right]_n$	
HISTORY			
Person to discover	-	Joseph Cecil Patrick	
Date	-	1926	
Details	-	invented as side product of development of antifreeze	
SYNTHESIS			
Monomer(s) structure	-	$\text{ClCH}_2\text{CH}_2\text{Cl}$ $\text{Na} \left[\text{S} \right]_x \text{Na}$	
Monomer(s) CAS number(s)	-	107-06-2; 1344-08-7	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	98.96	
Method of synthesis	-	condensation polymerization reaction between organic dihalides and alkali metal salts of polysulfide anions	
COMMERCIAL POLYMERS			
Some manufacturers	-	Morton, Toray	
Trade names	-	Thiokol	
PHYSICAL PROPERTIES			
Density at 20°C	g cm ⁻³	1.28-1.29	
Refractive index, 20°C	-	1.6423	
Decomposition temperature	°C	200	
Glass transition temperature	°C	-20 to -55	
Maximum service temperature	°C	150	
Long term service temperature	°C	90	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	1-17	
Elongation	%	30-500	
Flexural strength	MPa	30	
Compressive strength	MPa	124	
Abrasion resistance (ASTM D1044)	mg/1000 cycles	70	
Shore A hardness	-	25-50	
Shore D hardness	-	65-75	
Melt viscosity, shear rate=1000 s ⁻¹	Pa s	1-110	

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CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	good	
Alkalis	-	good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	poor	
Esters	-	poor	
Greases & oils	-	good	
Halogenated hydrocarbons	-	fair	
Ketones	-	poor	
FLAMMABILITY			
Ignition temperature	°C	93.3	
BIODEGRADATION			
Typical biodegradants	-	reductases from <i>Wolinella succinogenes</i> and <i>Clostridium</i> ; sulfate reducing bacteria (<i>Desulfuromonas</i>) and some spirilloid bacteria (<i>Thermotoga</i>)	Takahashi, Y; Suto, K; Inoue, C, J. Biosci. Bioeng., 109, 4, 372-80, 2010.
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	0/1/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Oral rat, LD ₅₀	mg kg ⁻¹	3,000	
Skin rabbit, LD ₅₀	mg kg ⁻¹	>2,000	
ENVIRONMENTAL IMPACT			
Aquatic toxicity, <i>Daphnia magna</i> , LC ₅₀ * 48 h	mg l ⁻¹	>1,000	
Aquatic toxicity, <i>Bluegill sunfish</i> , LC ₅₀ * 48 h	mg l ⁻¹	>10,000	
Aquatic toxicity, <i>Rainbow trout</i> , LC ₅₀ * 48 h	mg l ⁻¹	>10,000	
PROCESSING			
Typical processing methods	-	compounding, moisture or chemical curing of premixed compounds, vulcanization	
Additives used in final products	-	Fillers: calcium carbonate, calcium hydroxide, calcium oxide, carbon black, polymeric beads, polystyrene particles, zinc oxide; Plasticizers: 1-isobutyrate benzyl phthalate, 2,2,4-trimethyl-1,3-pentanediol, alkyl sulfonic acid esters of phenol and/or cresol, benzyl butyl phthalate, chlorinated paraffins, hydrogenated perphenyl, isooctyl benzyl phthalate; Curatives: metal peroxides, oxy salts (e.g., dioxides of lead, manganese, calcium, etc.)	
Applications	-	additives to epoxy, coatings, electrical potting compounds, fuel-contact sealants, fuel hoses and tubing, insulating glass, linings, rocket propellant binders, sealants	
Outstanding properties	-	chemical resistance, adhesion	

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BLENDS			
Suitable polymers	-	PPy	
Incompatible polymers	-	vinylidene-hexafluoropropene copolymer (Viton A) participates in degradation of syndactic PSR	Vance, A L; Alviso, C T; Harvey, C A, Polym. Deg. Stab., 91, 1960-63, 2006.
ANALYSIS			
FTIR (wavenumber-assignment)	cm ⁻¹ /-	C=O – 1723, S-H – 2560	Mahon, A; Kemp, T J; Coates, R J, Polym. Deg. Stab., 62, 15-24, 1998.
NMR (chemical shifts)	ppm	H NMR and C NMR: peak assignments in ref.; C=O – 7.95 and 8.02 (H NMR) and 160-49 and 162.02 (C NMR)	Mahon, A; Kemp, T J; Coates, R J, Polym. Deg. Stab., 62, 15-24, 1998.