

PMP polymethylpentene

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polymethylpentene, Nalgene	
CAS name	-	pentene, methyl-, homopolymer	
Acronym	-	PMP	
CAS number	-	9016-80-2	
Formula		$\left[\begin{array}{c} \text{CH}_2\text{CH} \\ \\ \text{CH}_2 \\ \\ \text{H}_3\text{C}-\text{CH} \\ \\ \text{CH}_3 \end{array} \right]_n$	
HISTORY			
Date	-	1965	
Details	-	introduced by ICI	
SYNTHESIS			
Monomer(s) structure	-	$\text{H}_2\text{C}=\text{C} \begin{array}{c} \\ \text{CH}_2\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	
Monomer(s) CAS number(s)	-	763-29-1	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	84.16	
Method of synthesis	-	dimerization of propylene	
Catalyst	-	Ziegler-Natta	
Mass average molecular weight, M_w	dalton, g/mol, amu	200,000-700,000	
Polydispersity, M_w/M_n	-	2.8-4.1	
Molar volume at 298K	cm ³ mol ⁻¹	92.0 (crystalline); 100.2 (amorphous)	
Van der Waals volume	cm ³ mol ⁻¹	61.4 (crystalline); 61.4 (amorphous)	
STRUCTURE			
Crystallinity	%	55-85	
Cell type (lattice)	-	tetragonal	
Cell dimensions	nm	a:b:c= 1.86:1.86, 1.38	
Unit cell angles	degree	$\alpha=\beta=\gamma=90$	
Tacticity	%	60-90 (isotactic)	
Chain conformation	-	7/2 (isotactic); 24/7 (syndiotactic)	
COMMERCIAL POLYMERS			
Some manufacturers	-	Mitsui, RTP	
Trade names	-	TPX, Polymethylpentene	
PHYSICAL PROPERTIES			
Density at 20°C	g cm ⁻³	0.83-0.84	
Refractive index, 20°C	-	1.463	
Transmittance	%	80-93	

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Haze	%	1-2	
Melting temperature, DSC	°C	235-240; 245 (isotactic)	
Softening point	°C	47-52	
Thermal expansion coefficient, 23-80°C	°C ⁻¹	1.2E-4	
Thermal conductivity, melt	W m ⁻¹ K ⁻¹	0.167-0.17	
Glass transition temperature	°C	23-50	
Specific heat capacity	J K ⁻¹ kg ⁻¹	1,970-2,180	
Heat of fusion	kJ mol ⁻¹	5.3	
Maximum service temperature	°C	170	Hainberger, R; Bruck, R; Kataeva, N; Heer, R; Koeck, A; Czepl, P; Kaiblinger, K; Pipelka, F; Bilenberg, B, Microelectronic Eng., 87, 821-23, 2010.
Long term service temperature	°C	75	
Heat deflection temperature at 0.45 MPa	°C	80-90	
Heat deflection temperature at 1.8 MPa	°C	48-50	
Vicat temperature VST/A/50	°C	145-178	
Enthalpy of melting	J g ⁻¹	26.9	Danch, A; Osoba, W; Wawryszczuk, J, Radiation Phys. Chem., 76, 150-2, 2007.
Hildebrand solubility parameter	MPa ^{0.5}	15.1-16.4	
Surface tension	mN m ⁻¹	25	Lee, L H, J. Polym. Sci. A-2, 5, 1103, 1967.
Dielectric constant at 100 Hz/1 MHz	-	2.12	
Dielectric loss factor at 1 kHz	-	0.0003	
Volume resistivity	ohm-m	1E14	
Electric strength K20/P50, d=0.60.8 mm	kV mm ⁻¹	42-65	
Permeability to oxygen, 25°C	cm ³ mm m ⁻² day ⁻¹ MPa ⁻¹	12,000	
Speed of sound,	m s ⁻¹	1080-2180	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	16-33; 67 (30% glass fiber)	
Tensile modulus	MPa	1,520-2,000	
Tensile stress at yield	MPa	15-30	
Elongation	%	50-120	
Flexural strength	MPa	19.6-46; 97 (30% glass fiber)	
Flexural modulus	MPa	1170; 5,900 (30% glass fiber)	
Young's modulus	MPa	1,900	
Izod impact strength, unnotched, 23°C	J m ⁻¹	534	
Izod impact strength, notched, 23°C	J m ⁻¹	267	
Poisson's ratio	-	0.34-0.43	

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PARAMETER	UNIT	VALUE	REFERENCES
Rockwell hardness	R	35-85	
Shrinkage	%	1.6-3	
Melt index, 230°C/3.8 kg	g/10 min	22-26	
Water absorption, 24h at 23°C	%	<0.01	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	good	
Alcohols	-	very good	
Alkalis	-	very good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Esters	-	poor	
Greases & oils	-	good	
Halogenated hydrocarbons	-	poor	
Ketones	-	good	
⊖ solvent, ⊖-temp.=194°C	-	diphenyl	
Good solvent	-	cyclohexane, decalin, tetralin, xylene (above 100°C)	
Non-solvent	-	all organic solvent	
FLAMMABILITY			
Burning rate (Flame spread rate)	mm min ⁻¹	25.4	
UL 94 rating	-	HB	
WEATHER STABILITY			
Spectral sensitivity	nm	>350 (some absorption)	
TOXICITY			
HMIS: Health, Flammability, Reactivity rating	-	0/1/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
PROCESSING			
Typical processing methods	-	blow molding, extrusion, injection molding	
Preprocess drying: temperature/time/residual moisture	°C/h/%	79.4/2	
Processing temperature	°C	266-304	
Applications	-	animal cages, chemical tubes, cosmetic caps and tubes, fibers, heat resistant nonwoven, LED molds, laboratory wares, mandrels and sheaths for rubber hose production, medical equipment, nanopatterned photonic materials, release film, release paper for synthetic leather, syringes, tubing	
Outstanding properties	-	chemical resistance, clarity, gas permeability, heat resistance, transparency	
BLENDS			
Suitable polymers	-	PP	