CPVC chlorinated poly(vinyl chloride)

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	poly(vinyl chloride), chlorinated	
CAS name	-	ethene, chloro-, homopolymer, chlorinated	
Acronym	-	CPVC	
CAS number	-	68648-82-8	
Linear formula		F01930000	
HISTORY			
Person to discover	-	Schoenburg, C of IG Farbenindustrie	Schoenburg, C, US Patent 1,982,765, IG Farbenindustrie, 1934.
Date	-	1934	
Details	-	product containing 64-68% chlorine was obtained	
SYNTHESIS			
Monomer(s) structure	-	PVC, chlorine	
Monomer(s) CAS number(s)	-	9002-86-2; 7782-50-5	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	variable; 35.453	
Chlorine content	%	63-74	
Method of synthesis	-	chlorination is performed by free radical process; initiation occurs due to thermal or UV energy which decomposes chlorine gas to radicals	
Pressure of polymerization	Pa	pressure affects diffusion of chlorine and thus the rate of chlorination	Barriere, B; Glotin, M; Leibler, L, J. Polym. Sci., B: Polym. Phys., 38, 3201-9, 2000.
COMMERCIAL POLYMERS			
Some manufacturers	-	PolyOne	
Trade names	-	Geon	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.47-1.56	
Bulk density at 20°C	g cm^{-3}	0.64-0.68	
Melting temperature, DSC	°C	199-212	
Thermal expansion coefficient, 23-80°C	10^{-4} $°C^{-1}$	0.8	
Thermal conductivity, melt	W m^{-1} K^{-1}	0.14-0.48	
Glass transition temperature	°C	103-135	Merah, N; Al-Qahtani, T; Khan, Z, Plast. Rubber Composites, 37, 8, 353-58, 2008.
Specific heat capacity	J K^{-1} kg^{-1}	900	
Long term service temperature	°C	80	
Heat deflection temperature at 1.8 MPa	°C	100-110	
Vicat temperature VST/B/50	°C	106-115	
Relative permittivity at 60 Hz	-	3.7	
Volume resistivity	ohm-m	$3.4x10^{15}$	

PARAMETER	UNIT	VALUE	REFERENCES
Electric strength K20/P50, d=0.60.8 mm	kV mm^{-1}	49	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	50-80	
Tensile modulus	MPa	2,590-3,030	
Tensile stress at yield	MPa	49-56	
Elongation	%	20-40	
Flexural strength	MPa	92-108	
Flexural modulus	MPa	2,700-3,500	
Elastic modulus	MPa	2,900	Merah, N, J. Mater. Process. Technol., 191, 198-201, 2007.
Compressive strength	MPa	69-100	
Young's modulus	MPa	2,900-3,400	
Izod impact strength, notched, 23°C	J m^{-1}	80-450	
Shore D hardness	-	80-84	
Rockwell hardness	-	R110-119	
Water absorption, equilibrium in water at 23°C	%	0.03-0.4; 5-15 (pipes in hot water)	Barthelemy, E; Munier, C; Verdu, J, J. Mater. Sci. Lett., 20, 1143-45, 2001.
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	good	
Alcohols	-	fair	
Alkalis	-	good	
Aliphatic hydrocarbons	-	poor	
Aromatic hydrocarbons	-	poor	
Esters	-	poor	
Greases & oils	-	good	
Halogenated hydrocarbons	-	poor	
Ketones	-	poor	
Good solvent	-	acetone, aromatic hydrocarbons, butyl acetate, chlorobenzene, chloroform, cyclohexanone, dioxane, DMF, DMSO, nitrobenzene, THF	
Non-solvent	-	aliphatic and cycloaliphatic hydrocarbons, carbon tetrachloride, methyl acetate, nitromethane, organic and inorganic acids	
FLAMMABILITY			
Ignition temperature	°C	482	
Autoignition temperature	°C	>399	
Limiting oxygen index	% O_2	53-60	
Volatile products of combustion	-	HCl, CO, CO_2	
UL 94 rating	-	V-0	
WEATHER STABILITY			
Important initiators and accelerators	-	24 month exposure in Saudi Arabia decreased tensile strength by 43% and in Florida by 26%	Merah, N, J. Mater. Process. Technol., 191, 198-201, 2007.

PARAMETER	UNIT	VALUE	REFERENCES
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	2/1/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
TLV, ACGIH	mg m^{-3}	10	
PROCESSING			
Typical processing methods	-	extrusion; injection molding; pipe extrusion	
Processing temperature	°C	190-210 (extrusion)	
Additives used in final products	-	Plasticizers: seldom used (e.g., 1,4-cyclohexane dimethanol dibenzoate (Benzoflex R 352)) and phthalates and phosphates; Release: ester of fatty acid, oxidized polyethylene	
Applications	-	fittings, industrial (ducts, pumps, scrubers, strainers, tanks, valves), pipes	
Outstanding properties	-	frame resistance, thermal resistance	
BLENDS			
Suitable polymers	-	ABS polyester, PMMA, PVC, PVP, SAN	Kang, J S; Kim, K Y; Lee, Y M, J. Membrane Sci., 214, 311-21, 2003.