PEX silane-crosslinkable polyethylene

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	silane-crosslinkable polyethylene	
Acronym	-	PEX	
HISTORY			
Person to discover	-	Ishino, I; Ohno, A; Isaka, T in 1987; Giacobbi, E; Miglioli, C in 2007	Ishino, I; Ohno, A; Isaka, T, US Patent 4,689,369, Mitsubishi Petrochemical, Aug. 25, 1987. Giacobbi, E; Miglioli, C, US Patent 2007/0117933 A1, Solvay, May 24, 2007.
Date	-	1987; 2007	
Details	-	patent for copolymerization; polyethylene grafting	
SYNTHESIS			
Monomer(s) structure	-	CH_2CHSiH_3	
Monomer(s) CAS number(s)	-	7291-09-0	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	55.1307	
Method of synthesis	-	these copolymers can either be produced in a reactor by polymerizing ethylene with vinyl-silane, or by extruder grafting of polyethylene with the vinyl-silane; these methods replace previously used peroxide or irradiation methods both leading to crosslinking. Two methods are used: Monosil, which is one step process with grafting taking place during fabrication of the product (e.g., pipe), Sioplas, which is two step process (first step is that of grafting silane, the second step is that of its moisture cure to obtain crosslinking)	Wu, T-S, Plastics Additives Compounding, 9, 6, 40-3, 2007.
Gel content	%	65-78	
STRUCTURE			
Crystallinity	%	22-41; decreases with crosslinking and gel content increase	Rahman, W A W A; Hoong, C C; Fareed, A, J. Teknologi, 46A, 73-86, 2007.
COMMERCIAL POLYMERS			
Some manufacturers	-	PolyOne; Solvay	
Trade names	-	Synkure; Polidan	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	0.900-1.01	
Bulk density at 20°C	g cm^{-3}	0.59	
Color	-	white	
Odor		very faint	
Melting temperature, DSC	°C	110	
Decomposition temperature	°C	255-285 (PE 245)	
Maximum service temperature	°C	250 (a few seconds)	
Long term service temperature	°C	130	
Surface tension	mN m^{-1}	31	
Dielectric constant at 100 Hz/1 MHz	-	2-2.31	
Dielectric loss factor at 1 kHz	-	3E-4	

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Volume resistivity	ohm-m	1E14	
Electric strength K20/P50, d=0.60.8 mm	kV mm^{-1}	21-38	
Power factor	-	0.0003-0.0017	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	9-26	
Elongation	%	350-600	
Shrinkage	%	<2	
Brittleness temperature (ASTM D746)	°C	-76	
Melt index, 190°C/2.16 kg	g/10 min	0.35-8	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	resistant	
Alcohols	-	resistant	
Alkalis	-	resistant	
Aliphatic hydrocarbons	-	resistant/non-resistant	
Aromatic hydrocarbons	-	resistant	
Esters	-	non-resistant	
Greases & oils	-	resistant	
Ketones	-	non-resistant	
FLAMMABILITY			
Autoignition temperature	°C	260-320	
Limiting oxygen index	% O_2	17.5; 29 (flame retarded)	Wang, Z; Hu, Y; Gui, Z; Zong, R, Polym. Test., 22, 533-38, 2003.
Heat release	kW m^{-2}	930; 151-319 (80-150 phr of magnesium hydroxide)	Wang, Z; Hu, Y; Gui, Z; Zong, R, Polym. Test., 22, 533-38, 2003.
Char at 500°C	%	2.4; 33.4-48.5 (flame retarded)	Wang, Z; Hu, Y; Gui, Z; Zong, R, Polym. Test., 22, 533-38, 2003.
Volatile products of combustion	-	CO,CO_2, NO_x, aldehydes	
UL 94 rating	-	VW-1	
PROCESSING			
Typical processing methods	-	coextrusion, extrusion, film, injection molding	
Preprocess drying: temperature/ time/residual moisture	°C/h/%	60/8 (color masterbatches)	
Processing temperature	°C	160-180 (Syncure, two step process)	
Additives used in final products	-	catalyst masterbatch for moisture curing (Sioplast method); magnesium hydroxide as flame retardant	
Applications	-	engineering systems, gas distribution, geothermal and district heating, industrial, offshore and onshore, plumbing and heating, pressure pipe, signal and power cables, wire & cable	
Outstanding properties	-	high and low working temperatures, chemical resistance, abrasion resistance, memory effect, thermal and aging stability	Wu, T-S, Plastics Additives Compounding, 9, 6, 40-3, 2007.

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ANALYSIS			
FTIR (wavenumber-assignment)	cm^{-1}/-	peak area from 1200-1000 correlates with gel content	Giacobbi, E; Miglioli, C, US Patent Application 20070117933, Solvay, 2007.