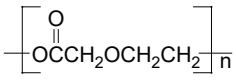
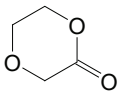
PDS polydioxanone

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polydioxanone	
CAS name	-	poly[oxy(1-oxo-1,2-ethanediyl)oxy-1,2-ethanediyl]	
Acronym	-	PDS	
CAS number	-	31621-87-1	
Formula			
HISTORY			
Person to discover	-	Weipert, E A; Schultz, H S	Weipert, E A, US Patent 3,020,289, Wyandotte, Feb. 6, 1962. Schultz, H S, US Patent 3,063,967, General Aniline & Film Corp., Nov. 13, 1962.
Date	-	1962 (filed 1960); 1962 (filed 1959)	
Details	-	Weipert patented polymerization of dioxanone in the presence of sulfuric acid; Schultz patented dioxanone polymerization in presence of organoaluminum catalyst	
SYNTHESIS			
Monomer(s) structure	-		
Monomer(s) CAS number(s)	-	3041-16-5	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	102.09	
Monomer(s) expected purity(ies)	%	99.5	
Method of synthesis	-	ring-opening polymerization of p-dioxanone in the presence of organometallic catalyst (e.g., zirconium acetylacetone)	Li, Y; Wang, X-L, Yang, K-K; Wang, Y-Z, Polym. Bull., 57, 873-880, 2006.
Temperature of polymerization	°C	room temp.	
Catalyst	-	organoaluminum	
Yield	%	60-78 (reactive extrusion)	Raquez, J-M; Degee, P; Dubois, P; Balakrishnan, S; Narayan, R, Polym. Eng. Sci., 45, 622-29, 2005.
Typical impurities	ppm	500 (solvents); 10 (heavy metals); 100 (catalyst)	
Typical concentration of residual monomer	ppm	<1	
Mass average molecular weight, M_w	dalton, g/mol, amu	58,000-175,000	
Polydispersity, M_w/M_n	-	1.6-1.7	
STRUCTURE			
Crystallinity	%	40-57	Liu, Z-P; Ding, S-D; Sui, Y-J; Wang, Y-Z, J. Appl. Polym. Sci., 112, 3079-86, 2009.
Cell type (lattice)	-	orthorhombic	Jaidann, M; Brisson, J, J. Polym. Sci. B, 46, 406-17, 2008.
Cell dimensions	nm	a:b:c=0.97:0.742:0.682	Jaidann, M; Brisson, J, J. Polym. Sci. B, 46, 406-17, 2008.
Chain conformation	-	2/1 helix	Jaidann, M; Brisson, J, J. Polym. Sci. B, 46, 406-17, 2008.

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PARAMETER	UNIT	VALUE	REFERENCES
Lamellae thickness	nm	7	Gesti, S; Lotz, B; Casas, M T; Aleman, C; Puiggalli, Eur. Polym. J., 43, 4662-74, 2007.
Avrami constants, k/n	-	n=3.2-4.0	Zheng, G-C; Ding, S-D; Zeng, J-B; Wang, Y-Z; Li, Y-D, J. Macromol. Sci. B; 49, 269-85, 2010.
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.34-1.38	
Color	-	colorless	
Odor	-	light	
Melting temperature, DSC	°C	106-115	
Decomposition temperature	°C	130-190	
Storage temperature	°C	-20	
Glass transition temperature	°C	-16 to 0	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	6.3-48.3	McClure, M J; Sell, S A; Barnes, C P; Bowen, W C; Bowlin, G L, 3, 1, 1-10, 2008; Boland, E D; Coleman, B D; Barnes, C P; Simpson, D G; Wnek, G E; Bowlin, G L, Acta Biomater., 1, 115-123, 2005.
Tensile modulus	MPa	30	McClure, M J; Sell, S A; Barnes, C P; Bowen, W C; Bowlin, G L, 3, 1, 1-10, 2008.
Elongation	%	60-600	McClure, M J; Sell, S A; Barnes, C P; Bowen, W C; Bowlin, G L, 3, 1, 1-10, 2008.
Elastic modulus	MPa	2,100	Boland, E D; Coleman, B D; Barnes, C P; Simpson, D G; Wnek, G E; Bowlin, G L, Acta Biomater., 1, 115-123, 2005.
Intrinsic viscosity, 25°C	dl g^{-1}	1.5-2.2	
Water absorption, equilibrium in water at 23°C	%	0.5	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	good	
Aliphatic hydrocarbons	-	good	
BIODEGRADATION			
Typical biodegradants	-	lipase	Gesti, S; Lotz, B; Casas, M T; Aleman, C; Puiggalli, Eur. Polym. J., 43, 4662-74, 2007.
TOXICITY			
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
PROCESSING			
Preprocess drying: temperature/ time/residual moisture	°C/h/%	extrusion, injection molding, spinning	
Processing temperature	°C	100-115	

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PARAMETER	UNIT	VALUE	REFERENCES
Processing pressure	MPa	3-10 (injection)	
Additives used in final products	-	Dye (C. I. Solvent Violet 13(=C. I. # 60725))	
Applications	-	adhesives, coatings, foams, laminates, medical (bone fixation devices, cardiovascular, drug delivery, orthopedics, plastic surgery, sutures, tissue engineering)	
Outstanding properties	-	biodegradable	
BLENDS			
Suitable polymers	-	PCD, PCL	
ANALYSIS			
Raman (wavenumber-assignment)	cm^{-1}/-	C=O – 1730; C-C – 1050; C-O-C – 868	Jaidann, M; Brisson, J, J. Polym. Sci. B, 46, 406-17, 2008.