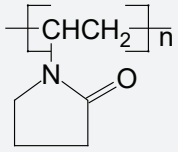
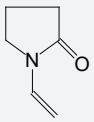
PVP poly(N-vinyl pyrrolidone)

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	poly(N-vinyl pyrrolidone)	
Acronym	-	PVP	
CAS number	-	9003-39-8	
EC number	-	201-800-4	
RTECS number	-	TR8160000, TR8170000, TR8180000, TR8250000, TR8300000, TR8350000, TR8360000, TR8370000,	
Linear formula			
HISTORY			
Person to discover	-	Reppe, W; Schster, C; Hartmann, A	Reppe, W; Schster, C; Hartmann, A, US Patent 2,265,450, IG Farben, Dec. 9, 1941.
Date	-	1941	
Details	-	high pressure reactions catalyzed by heavy metal acetylides, especially copper acetylide, or metal carbonyls are called Reppe Chemistry, which is behind synthesis of PVP	
SYNTHESIS			
Monomer(s) structure	-		
Monomer(s) CAS number(s)	-	88-12-0	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	111.14	
Monomer ratio	-	100% and copolymers	
Method of synthesis	-	monomer is thermally polymerized in the presence of hydrogen peroxide and ammonia	
Typical concentration of residual monomer	ppm	<100	
Number average molecular weight, M_n	dalton, g/mol, amu	2,000-400,000	
Mass average molecular weight, M_w	dalton, g/mol, amu	10,000-2,200,000	
Polydispersity, M_w/M_n	-	1.73-3.2	
End-to-end distance of unperturbed polymer chain	nm	2.2-7	
COMMERCIAL POLYMERS			
Some manufacturers	-	BASF	
Trade names	-	Kollidon, Luvitec, Luvicross (crosslinkable)	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.23-1.29	
Bulk density at 20°C	g cm^{-3}	0.2	

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Color	-	white to off-white to creamy to yellow	
Refractive index, 20°C	-	1.5300	
Odor	-	faint, specific	
Melting temperature, DSC	°C	100-140	
Decomposition temperature	°C	130	
Glass transition temperature	°C	175-180	
Hildebrand solubility parameter	$MPa^{0.5}$	exp.=25.6	
Surface free energy	mJ m^{-2}	46.0	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Water absorption, equilibrium in water at 23°C	%	80	
Moisture absorption, equilibrium 23°C/50% RH	%	40	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	non-resistant	
Alcohols	-	non-resistant	
Alkalis	-	non-resistant	
Aliphatic hydrocarbons	-	non-resistant	
Aromatic hydrocarbons	-	resistant	
Esters	-	resistant	
Halogenated hydrocarbons	-	non-resistant	
Ketones	-	resistant	
Θ solvent, Θ-temp.=10, 20, 20°C	-	dioxane, 2-propanol, water	
Good solvent	-	alcohols, amines, chlorinated hydrocarbons, glycols, water	
Non-solvent	-	hydrocarbons, ethers, esters, ketones, some chlorinated hydrocarbons	
FLAMMABILITY			
Ignition temperature	°C	>215	
Autoignition temperature	°C	420	
Volatile products of combustion	-	CO, CO_2, NO_x	
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	1/0-1/0-1	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
TLV, ACGIH	mg m^{-3}	3 (respirable), 10 (total)	
OSHA	mg m^{-3}	5 (respirable), 15 (total)	
Oral rat, LD_{50}	mg kg^{-1}	100,000; 1470	
Skin rabbit, LD_{50}	mg kg^{-1}	560	
ENVIRONMENTAL IMPACT			
Aquatic toxicity, *Daphnia magna*, LC_{50}, 48 h	mg l^{-1}	>100	

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Aquatic toxicity, *Bluegill sunfish*, LC_{50}, 48 h	mg l^{-1}	>10,000	
PROCESSING			
Additives used in final products	-	Plasticizers: acetyl triethyl citrate, dioctyl adipate, polyethylene glycol, dipropylene glycol dibenzoate, glycerin, tributyl citrate, triethyl citrate	
Applications	-	additive in various polymers, agriculture (seed coating, crop protection, fertilizer binder), batteries, coatings (antifogging, dispersant), cosmetics, emulsifier, glue sticks, hot-melt adhesives, medical devices, membranes, paper, photoresists, pressure-sensitive adhesives, printed circuit boards, sizing agent, tablet binder and excipient	
Outstanding properties	-	biodegradable, biocompatible, hygroscopic	
BLENDS			
Suitable polymers	-	CA, CAR, PA, PAA, PE, PC, PEG, PHEMA, PMMA, POM, PS, PSU, PU, PVC, PVOH	