

PAAm polyacrylamide

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polyacrylamide	
IUPAC name	-	polyacrylamide	
CAS name	-	2-propenamide, homopolymer	
Acronym	-	PAAm	
CAS number	-	9003-05-8	
RTECS number	-	AS3700000	
HISTORY			
Person to discover	-	Ornstein & Davis; Harper, Bashaw, Atkins	
Date	-	1959; 1966	
Details	-	first use of gel for electrophoresis; soil hydrators patented by DOW	
SYNTHESIS			
Monomer(s) structure	-	$H_2C=CHC(O)NH_2$	
Monomer(s) CAS number(s)	-	79-06-1	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	69.08	
Monomer(s) expected purity(ies)	%	100%	
Monomer ratio	-	amine:aldehyde:acrylic acid:isocyanide=1.2:1:1.2:1	
Method of synthesis	-	a mixture of amine, aldehyde and methanol was stirred at room temperature for 30 min. Acrylic acid and isocyanide were added and reaction conducted for 24 hrs, after which methanol was removed	Sehlinger, A; Ochsenreither, K; Bartnick, N; Meier, M A R, Eur. Polym. J., 65, 313-24, 2015.
Heat of polymerization	J g ⁻¹	1146	Joshi, R M, Makromol. Chem., 55, 35, 1962.
Mass average molecular weight, M_w	dalton, g/mol, amu	>5,000,000; 8,000,000-15,000,000	Bessaies-Bey, H; Baumann, R; Schmitz, M; Radler, M; Roussel, N, Cement Concrete Res., 76, 98-106, 2015.
Polymerization degree (number of monomer units)	-	>150,000	Sojka, R E; Bjorneberg, D L; Entry, J A; Lentz, R D; Orts, W J, Adv. Agronomy, 92, 75-162, 2007.
Molar volume at 298K	cm ³ mol ⁻¹	calc.=56.5; exp.=54.6	
Van der Waals volume	cm ³ mol ⁻¹	38.15	
STRUCTURE			
Entanglement molecular weight	dalton, g/mol, amu	calc.=4847	
PHYSICAL PROPERTIES			
Color	-	white to off-white	
Refractive index, 20°C	-	calc.=1.5207-1.5252; exp.=1.52	
Odor	-	odorless	
Melting temperature, DSC	°C	246	
Softening point	°C	208	
Decomposition temperature	°C	160	

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Thermal conductivity, melt	W m ⁻¹ K ⁻¹	calc.=0.1863	
Glass transition temperature	°C	calc.=93-148; exp.=153-165	
Surface tension	mN m ⁻¹	calc.=50.7-52.3	
Dielectric constant at 100 Hz/1 MHz	-	-/5	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	66.2; 0.04-0.08 (5% gel)	Abdurrahmanoglu, S; Can, V; Okay, O, Polymer, 50, 5449-55, 2009.
Elongation	%	214-265	Abdurrahmanoglu, S; Can, V; Okay, O, Polymer, 50, 5449-55, 2009.
Elastic modulus	MPa	0.0181 (8% gel)	Gautreau, Z; Griffin, J; Peterson, T; Thongpradit, P, Characterizing Viscoelastic Properties of Polyacrylamide Gels, Worcester Polytechnic Institute, 2006.
Young's modulus	MPa	0.031-0.035 (8% gel)	Gautreau, Z; Griffin, J; Peterson, T; Thongpradit, P, Characterizing Viscoelastic Properties of Polyacrylamide Gels, Worcester Polytechnic Institute, 2006.
Poisson's ratio	-	calc.=0.399; exp.=0.45	Gautreau, Z; Griffin, J; Peterson, T; Thongpradit, P, Characterizing Viscoelastic Properties of Polyacrylamide Gels, Worcester Polytechnic Institute, 2006.
Ball indentation hardness at 358 N/30 S (ISO 2039-1)	MPa	0.00541-0.00973 (5% gel)	Gautreau, Z; Griffin, J; Peterson, T; Thongpradit, P, Characterizing Viscoelastic Properties of Polyacrylamide Gels, Worcester Polytechnic Institute, 2006.
Swelling	%	6,800	Ortega-Gudino, P; Sanchez-Diaz, J C; Becerra, F; Martinez-Ruvalcaba, A; Gonzalez-Alvarez, A, Antec, 1479-82, 2007.
Water absorption, equilibrium in water at 23°C	%	15	
CHEMICAL RESISTANCE			
Alcohols	-	good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Esters	-	good	
⊖ solvent	-	methanol/water=2/3	
Good solvent	-	ethylene glycol, morpholine, water	
Non-solvent	-	alcohols, diethyl ether, DMF, esters, hydrocarbons, THF	
FLAMMABILITY			
Ignition temperature	°C	>200	
Autoignition temperature	°C	>400	
Char at 500°C	%	8.3	Lyon, R E; Walters, R N, J. Anal. Appl. Pyrolysis, 71, 27-46, 2004.

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WEATHER STABILITY			
Spectral sensitivity	nm	325	Sojka, R E; Bjorneberg, D L; Entry, J A; Lentz, R D; Orts, W J, Adv. Agronomy, 92, 75-162, 2007.
BIODEGRADATION			
Typical biodegradants	-	<i>Bacillus cereus, Bacillus flexu, Pseudomonas stutzeri, Rhodococcus spp., Xanthomonas spp.</i>	Wen, Q; Chen, Z; Zhao, Y; Zhang, H; Feng, Y, J. Hazardous Mater., 175, 955-59, 2010.
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	1/0/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Oral rat, LD ₅₀	mg kg ⁻¹	>5,000	Sojka, R E; Bjorneberg, D L; Entry, J A; Lentz, R D; Orts, W J, Adv. Agronomy, 92, 75-162, 2007.
Skin rabbit, LD ₅₀	mg kg ⁻¹	>5,000	Sojka, R E; Bjorneberg, D L; Entry, J A; Lentz, R D; Orts, W J, Adv. Agronomy, 92, 75-162, 2007.
ENVIRONMENTAL IMPACT			
Aquatic toxicity, <i>Daphnia magna</i> , LC ₅₀ , 48 h	mg l ⁻¹	150-230	Acharya, K; Schulman, C; Young, M H, Water Air Soil Pollut., 212, 309-17, 2010.
PROCESSING			
Typical processing methods	-	gel synthesis and modification	
Additives used in final products	-	alumina, graphene, starch, titanium dioxide	
Applications	-	drilling fluids, gel for chemical analysis, irrigation water treatment for erosion reduction, soft tissue filler, soil hydration	
Outstanding properties	-	flocculating properties	
BLENDS			
Suitable polymers	-	chitosan, CR, PANI	
ANALYSIS			
FTIR (wavenumber-assignment)	cm ⁻¹ /-	NH ₂ – 3352, 3180, 1353, 1282, 991, 708; C=O – 1675, 490; C=C – 1650; C-N – 1430	Murugan, R; Mohan, S; Bigotto, A, J. Korean Phys. Soc., 32, 4, 505-12, 1998.
Raman (wavenumber-assignment)	cm ⁻¹ /-	NH ₂ – 3342, 3163, 1350, 1280, 990, 708; C=O – 1685, 490; C=C – 1639; C-N – 1432	Murugan, R; Mohan, S; Bigotto, A, J. Korean Phys. Soc., 32, 4, 505-12, 1998.