

# HPMM poly(methacrylic acid-co-methyl methacrylate)

PARAMETER	UNIT	VALUE	REFERENCES
<b>GENERAL</b>			
Common name	-	poly(methacrylic acid-co-methyl methacrylate)	
ACS name	-	2-propenoic acid, 2-methyl-, polymer with methyl 2-methyl-2-propenoate	
Acronym	-	HPMM	
CAS number	-	25086-15-1	
<b>HISTORY</b>			
Person to discover	-	Brubaker, M M	Brubaker, M M; US Patent 2,244,704, DuPont, June 10, 1941.
Date	-	1941	
Details	-	HPMM synthesized for application as textile sizing material	
<b>SYNTHESIS</b>			
Monomer(s) structure	-	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_2\text{C}=\text{C}-\text{COH} \\   \\ \text{CH}_3 \end{array} \quad \begin{array}{c} \text{O} \\ \parallel \\ \text{H}_2\text{C}=\text{C}-\text{COCH}_3 \\   \\ \text{CH}_3 \end{array}$	
Monomer(s) CAS number(s)	-	79-41-4 ; 80-62-6	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	86.06 ; 100.12	
Monomer ratio	-	1:1 (Eudragit L100); 1:2 (Eudragit S100)	Dong, W; Bodmeier, R, Int. J. Pharmaceutis, 326, 128-38, 2006.
Methacrylic acid content	%	1.6-25	
Formulation example	-	MMA - 13.7, MAA - 1.3, potassium persulfate - 0.20, water - 285	Okubo, M; Inoue, M; Suzuki, T; Kouda, M, Colloid Polym. Sci., 282, 1150-54, 2004.
Method of synthesis	-	methacrylic acid and methyl methacrylate are polymerized in the presence of benzoyl peroxide	
Number average molecular weight, $M_n$	dalton, g/mol, amu	15,000-26,000	
Mass average molecular weight, $M_w$	dalton, g/mol, amu	34,000-626,000	
Polydispersity, $M_w/M_n$	-	1.7-2.3	
<b>STRUCTURE</b>			
Crystallinity	%	0, amorphous	
<b>COMMERCIAL POLYMERS</b>			
Some manufacturers	-	Lucite; Evonic	
Trade names	-	Elvacite; Eudragit L & S	
<b>PHYSICAL PROPERTIES</b>			
Density at 20°C	g cm <sup>-3</sup>	0.831-.852	
Color	-	white	
Refractive index, 20°C	-	1.390-1.395	
Decomposition temperature	°C	170-186	Lin, S-Y; nYu, H-L, J. Polym. Sci. A, 37, 2061-67, 1999.
Glass transition temperature	°C	105-140	

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Acceptor number	-	$K_A$ : 128.2 (L100); 119.2 (S100)	Ohta, M; Buckton, G, Int. J. Pharmaceutics, 272, 121-128, 2004.
Donor number in chloroform	$\text{kJ mol}^{-1}$	1.76 (Eudragit L100); 2.75 (Eudragit S100)	Ohta, M; Buckton, G, Int. J. Pharmaceutics, 272, 121-128, 2004.
<b>MECHANICAL &amp; RHEOLOGICAL PROPERTIES</b>			
Tensile strength	MPa	15.6-25.4	Obara, S; McGinity, J W, Int. J. Pharmaceutics, 126, 1-10, 1995.
Elongation	%	1.0-2.3	
Melt viscosity, shear rate=1000 $\text{s}^{-1}$	$\text{mPa s}$	50-200	
<b>CHEMICAL RESISTANCE</b>			
Alcohols	-	soluble	
Ketones	-	soluble	
Good solvent	-	ethanol (96%), isopropanol, acetone	Dong, W; Bodmeier, R, Int. J. Pharmaceutis, 326, 128-38, 2006.
<b>FLAMMABILITY</b>			
Ignition temperature	$^{\circ}\text{C}$	300	
Volatile products of combustion	-	toxic, irritant vapors	
<b>WEATHER STABILITY</b>			
Degradation rate coefficient (365 nm)	$\text{mol g}^{-1} \text{min}^{-1} \times 1\text{E}7$	3.57	Vinu, R; Madras, G, Polym. Deg. Stab., 93, 1440-49, 2008.
<b>TOXICITY</b>			
HMIS: Health, Flammability, Reactivity rating	-	0/0/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Mutagenic effect	-	no data	
Teratogenic effect	-	no data	
Reproductive toxicity	-	no data	
OSHA	$\text{mg m}^{-3}$	5 (respirable), 15 (total dust)	
<b>PROCESSING</b>			
Typical processing methods	-	spraying, hot melt extrusion	Bruce, C; Fegely, K A; Rajabi-Siahboomi, A R; McGinity, J W, Int. J. Pharmaceutics, 341, 162-72, 2007.
Processing temperature	$^{\circ}\text{C}$	60-90	
Processing pressure	MPa	7	
Additives used in final products	-	Plasticizer: triethyl acetate; Crystallization inhibitor	
Applications	-	pharmaceutical (controlled and transdermal delivery, site-specific peroral delivery)	Carelli, V; Di Colo, G; Nannipieri, E; Poli, B; Serafini, M F, Int. J. Pharmaceutics, 202, 103-12, 2000; Pinto, J F, Int. J. Pharmaceutics, 395, 44-52, 2010.
Outstanding properties	-	enteric (insoluble in gastric juice)	de Oliveira, H P; Albuquerque, J J F; Nogueiras, C; Rieumont, J, Int. J. Pharmaceutics, 366, 185-89, 2009.

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PARAMETER	UNIT	VALUE	REFERENCES
<b>BLENDS</b>			
Suitable polymers	-	POE, PVP	
<b>ANALYSIS</b>			
FTIR (wavenumber-assignment)	cm <sup>-1</sup> /-	CH <sub>2</sub> – 1486, 1480; CH <sub>3</sub> – 1454, 1447, 1385; C-O – 1150; C=O – 11730	Vinu, R; Madras, G, Polym. Deg. Stab., 93, 1440-49, 2008.