

A20L-004

Capa[®] 7201A IN CAST POLYURETHANE ELASTOMERS

This note describes the preparation and properties of cast polyurethane elastomers made from MDI and Capa[®] 7201A.

The outstanding virtue of elastomers produced from Capa[®] 7201A

- a low melting block copolymer derived from Caprolactone
- is their ability to maintain elastomeric properties down to temperatures as low as -50 °C.

Elastomers from 95 to 80 Shore A are made by a total prepolymer system; at lower hardness, a quasi prepolymer system is recommended, since a total prepolymer becomes too viscous to allow good mixing to be achieved.

1. Prepolymer Preparation

The required amount of Capa[®] 7201A is placed in a reactor fitted with a stirrer, heating and cooling facilities and a means of applying vacuum. The diol is heated to 95 °C and the required amount of flake MDI at 20 °C is added, (alternatively the diol is heated to 80 °C and molten MDI at 45 ° - 50 °C is added) and the mixture is stirred. Initially, the temperature will drop but will rise again after about one minute; the temperature should be controlled to a maximum of 80 °C by heating or cooling, for one hour. It is advantageous if the reaction is carried out under vacuum to ensure that the prepolymer is degassed. The prepolymer is then maintained at 80 °C for immediate use, or can be run to storage for later use. (The prepolymer is stable for up to six months at 20 °C).

2. Urethane Preparation

2.1 Elastomers from 95 to 80 Shore A

The required amount of degassed prepolymer at 80 °C is weighed into a suitable mixing vessel, into which is then weighed or measured by volume the required amount of dry butane 1,4 diol at 20 °C. The mixture is then stirred carefully to avoid entraining air bubbles.

Mixing should be continued for at least one minute, or until the butane diol has mixed and reacted or dispersed into the prepolymer. The resultant liquid urethane is then poured into a heated mould at 110 °C and cured at 110 °C for 30 minutes. On demould the resultant elastomer should be cured for 24 hours at 110 °C and subsequent post cured at a room temperature for at least 14 days.

2.2 Elastomers below 80 Shore A

For elastomers below 80 Shore A, a quasi prepolymer system is used, in which part of the Capa[®] 7201A is used to make the prepolymer and part is mixed with the 1,4 butane diol, to form a resin mix. Quantities are chosen such that the volumes of prepolymer and resin mix required to form the polyurethane are equal.

The required amount of degassed prepolymer at 50° - 80°C is weighed into a suitable mixing vessel, into which is then weighed the required amount of degassed resin mix, also at 50° - 80°C.

This mixture is then stirred, carefully avoiding the entrainment of air, for at least one minute.

The resultant liquid urethane is then poured into a mould, preheated at 110°C and cured at 110°C for 30 minutes. After demould, the resultant urethane should be cured for a further 24 hours at 110°C and subsequently post cured at room temperature (20°C) for a further 14 days.

When very soft urethanes of 60 Shore A and below are to be made, it will be necessary to catalyse the system. The addition of a suitable cobalt salt, at a level of about 0.01 phr Co, to the resin mix prior to degassing is recommended in these cases.

3. Cast Urethane Formulations

NCO/OH Index 1.07

HARDNESS	% MDI	% Capa [®] 7201A	% BD	PARTS MDI	PARTS Capa [®] 7201A	PARTS BD
95 Shore A	35	55.72	9.28	62.81	100	16.65
90 Shore A	29.5	63.42	7.08	46.52	100	11.16
80 Shore A	22.3	73.50	4.20	30.34	100	5.71
70 Shore A	19	78.12	2.88	24.32	100	3.69
60 Shore A	16	82.32	1.68	19.44	100	2.04
50 Shore A	15	83.72	1.28	17.92	100	1.53

For the 95, 90 and 80 Shore A formulations, method described in section 2.1 is used.

For the softer elastomers, the two components should be made up as follows.

Hardness Shore A	Prepolymer		Resin Mix	
	MDI	Capa [®] 7201A	Capa [®] 7201A	BD
70	19.0	31.0	47.12	2.88
60	16.0	34.0	48.32	1.68
50	15.0	35.0	48.72	1.28

Method described in section 2.2 is then used.

4. Properties of Elastomers

Property	Hardness Shore A					
	95	90	80	70	60	50
100% Modulus, Kg/cm ²	108.4	79.3	40.7	30.7	18.4	15.1
300% Modulus, Kg/cm ²	183.5	134.4	74.3	46.5	23.7	15.9
Tensile Strength, Kg/cm ²	482.9	512.9	462	>244	148	58.6
Elongation, %	580	535	550	>610	640	820
Resilience, % at 25°C	59	68	76	77	71	73
Resilience, % at 70°C	71	79	81	75	63	66
Compression Set, %	12.5	27.5	43.1	49.4	21.7	38.8
Cold Flex, °C (Clash & Berg) 200°C	-48.5	-52.5	-57	-57	-56	-57

5. Hydrolysis Resistance

Test pieces were immersed in flowing, aerated distilled water at 100°C. The times taken to halve the tensile strength and to reduce tensile strength to 100 kg/cm², for the 90 Shore A elastomer were 10 days and 17 days respectively.

These compare with figures of 8¼ and 10 days respectively for a 90 Shore A elastomer prepared from Capa[®] 2201A and MDI and 3½ and 5½ days for a similar product based on Capa[®] 2201.

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