

A20L-008

Capa[®] 3031 A NEW CHAIN EXTENDER FOR MDI ELASTOMERS

Capa[®] 3031 is a trifunctional polycaprolactone for use in a wide range of urethane applications.

Tests on a series of elastomers containing Capa[®] 3031 as one of the chain extenders are presented here.

The amount of Capa[®] 3031 used has been calculated to give an approximate molecular weight of 23,000 between urethane crosslinks and also at an NCO/OH index of 1.03. Limited comparisons have been made using Isonol 93 and TMP in place of the Capa[®] 3031.

In general, the advantages seen in using the Capa[®] 3031 in conjunction with butane diol are:

- a) Better mixing (helps to mix in BD) - certainly much better than Isonol 93 or TMP.
- b) Improved compression sets.
- c) Improved tear strength.
- d) Remarkable cold flexes.
- e) Very good looking rubbers.

These advantages are in soft elastomers.

Disadvantages:

- a) In present formulations it is only of use at 80 Shore A and below.
- b) Lower limit is 55-56 Shore A with use of BD.

Formulations Used

| | | | | |
|---|------------------|------------------|---------------------------------|---------------------------------|
| Hardness, Shore A | | 79 | 62 | 56 |
| % MDI | 29.77 | 24.82 | 19.86 | 14.89 |
| % Capa [®] 2201A (in prepolymer) (in resin mix) | 61.84 | 68.88 | 30.14 45.75 | 35.11 47.90 |
| % Capa [®] 3031 | 1.38 | 1.30 | 1.31 | 1.31 |
| % 1,4,BD | 7.02 | 5.00 | 2.94 | 0.89 |
| | Total Prepolymer | Total Prepolymer | Quasi Prepolymer | Quasi Prepolymer |
| Catalyst | Nil | Nil | 0.05 pphr 10% CoAA in DPG | 0.05 pphr 10% CoAA in DPG |
| Index | 1.03 | 1.03 | 1.03 | 1.03 |

Calculated Formulations for 55, 60, 70, 80 Shore A Elastomers

| | | | | |
|--------------------------------------|------------------|---------------------------------|---------------------------------|---------------------------------|
| Hardness, Shore A | 80 | 70 | 60 | 55 |
| % MDI | 25.32 | 21.84 | 18.86 | 12.91 |
| % 225 (in Prepolymer) (in Resin Mix) | 68.18 | 28.16 44.93 | 31.14 46.16 | 37.09 48.63 |
| % Capa [®] 3031 | 1.30 | 1.30 | 1.31 | 1.31 |
| % 1,4,BD | 5.20 | 3.76 | 2.53 | 0.07 |
| | Total Prepolymer | Total Prepolymer | Quasi Prepolymer | Quasi Prepolymer |
| Catalyst | Nil | 0.05 pphr 10% CoAA in DPG | 0.05 pphr 10% CoAA in DPG | 0.05 pphr 10% CoAA in DPG |
| Index | 1.03 | 1.03 | 1.03 | 1.03 |

Physical Test results are listed below (using Capa[®] 2201A).

| | | | | | | |
|--|-----------------------------|-----------------------------|-----------------------------|-------|-------|-------|
| % MDI | 14.9% | 19.9% | 24.8% | 20% | 20% | 26% |
| Chain extender | Capa [®] 3031 + BD | Capa [®] 3031 + BD | Capa [®] 3031 + BD | ED/BD | BD/ED | BD |
| Hardness Shore A | 56 | 62 | 79 | 50 | 60 | 80 |
| 100% modulus kg/cm ² | 22.1 | 22.1 | 34.7 | 15 | 16 | 17 |
| 300% modulus kg/cm ² | 25.2 | 43.2 | 89.7 | 16 | 19 | 96 |
| Tensile strength kg/cm ² (at break) | 283.7 | 385.3 | 429 | 124 | 172 | 449 |
| Elongation % | 500 | 485 | 400 | 640 | 675 | 515 |
| Tear strength kg/cm | 59.4 | 57 | 97.1 | 41 | 49 | 44 |
| Compression set % | 8.3 | 11.3 | 11.7 | 27% | 42% | 28% |
| Resilience at 25°C | 75% | 78% | 71% | 69% | 64% | 65% |
| Resilience at 70°C | 79% | 83% | 80% | 77% | 76% | 77% |
| Cold flex | -55°C | -52°C | -36.5°C | -34°C | -34°C | -38°C |

Comparisons with Isonol 93 (an ether triol) and trimethylol propane (TMP)

| % MDI | 14.9% | 14.9% | 15% | 34.8% | 34.8% | 35% | 33%* |
|---|-------------------------------|-------------------|-------------|-------------------------------|-------------------|-------------|-------|
| Chain extender | Capa [®] 3031+ BD | Isonol 93 + BD | TMP + BD | Capa [®] 3031+ BD | Isonol 93 + BD | TMP + BD | BD* |
| Hardness Shore A | 56 | 81 | 65 | 93 | 95 | 95 | 95* |
| 100% modulus kg/cm ² | 22.1 | 27.4 | 33.1 | 94.7 | 111 | 123 | 101* |
| 300% modulus kg/cm ² | 25.2 | 37 | 38.7 | 248 | 281.6 | 235.6 | 177* |
| Tensile strength kg/cm ² (at break) | 283.7 | 267 | 250.7 | 516 | 495.6 | 462.8 | 538* |
| Elongation % | 500 | 514 | 475 | 410 | 380 | 400 | 430* |
| Tear strength kg/cm | 59.4 | 33.3 | 30 | 85 | 96 | 97 | 110* |
| Compression set % | 8.3 | 5.9 | 3.75 | 23 | 8.2 | 11.5 | 20* |
| Resilience at 25°C | 75% | 74% | 78% | 51% | 52% | 75% | 55%* |
| Resilience at 70°C | 79% | 78% | 84% | 72% | 74% | 77% | 71%* |
| Cold flex | -55°C | -45.5°C | -47.5 °C | -28°C | -44°C | -49.5 °C | -30°C |

From these results it can be seen that the Capa[®] 3031 has advantages over TMP and Isonol 93 in low MDI content elastomers, but use of TMP or Isonol 93 in high MDI elastomers show advantages in compression set and cold flex!

Further work has also been carried out on Capa[®] 7201A at 1.03 index and ca. 23,000 urethane mw between triol crosslinks; results are reported in the following table compared to previously reported results:

Comparison using Capa[®] 7201A in the formulation

| % MDI | 34.8% | 35% | 14.9% | 15% | 15% | 15% |
|---|--------------------------------|---------|--------------------------------|-------|--------------------------------|---------------------------|
| Chain extender | Capa [®] 3031 + BD | BD | Capa [®] 3031 + BD | BD | Capa [®] 3031 + BD | Capa [®] 3031 |
| Index | 1.03 | 1.07 | 1.03 | 1.07 | 1.03 | 1.00 |
| Hardness | 93 | 95 | 55 | 50 | 49 | 60 |
| 100% modulus kg/cm ² | 119.9 | 108.4 | 18.4 | 15.1 | 20 | 20 |
| 300% modulus kg/cm ² | 238 | 183.5 | 28.5 | 15.9 | 21.4 | 32.5 |
| Tensile strength kg/cm ² (at break) | 480 | 482.9 | 114.8 | 58.6 | 75 | 57 |
| Elongation % | 400 | 580 | 500 | 820 | 660 | 420 |
| Tear strength kg/cm | 79.3 | 104 | 12.2 | 37 | 30 | 23 |
| Compression set % | 11.2 | 12.5 | 10.5 | 38.8 | 27 | 2.3 |
| Resilience at 25°C | 59% | 59% | 74% | 73% | 76% | 76% |
| Resilience at 70°C | 72% | 71% | 74% | 66% | 69% | 81% |
| Cold flex | -4°C | -48.5°C | -60°C | -57°C | -58.5°C | -57.5°C |

No real overall advantages can be seen when using Capa[®] 3031 in Capa[®] 7201A systems. There are some improvements in some properties but these have to be traded off against loss in some other property or properties.

For further information please contact:

Perstorp UK Limited
Baronet Road
Warrington
Cheshire WA4 6HB
United Kingdom

Telephone: +44 (0) 1925 643210
Fax: +44 (0) 1925 232207
E-mail: contact.capa@perstorp.com
Website: www.perstorpcaprolactones.com

The information given in this data sheet is given as a general guide and should not be taken to cover all cases. Each customer should ensure that the product concerned is suitable for the specific purpose and the manner in which it is intended to be used. The information given must not be taken in any way to form a specification. This data sheet does not form part of the Conditions of Sale of our products and is of a general nature.

FREEDOM FROM PATENT RESTRICTIONS SHOULD NOT BE ASSUMED