A20L-010

POLYCAPROLACTONE FOR RIGID FOAMS

Capa® 3022 is a polyol designed specifically for rigid polyurethane foams and has been developed by Solvay Interox Ltd. It is based on Caprolactone and offers foam producers integral skin products of unusually high quality, having the following merits:-

- A good combination of heat distortion temperatures and impact strength.
- Low viscosity materials giving good flow characteristics and mould reproduction.
- Foams with durable skins having excellent resistance to weathering, solvents and chemicals.
- Self extinguishing foams.

Caprolactone based rigid foams combine the toughness and excellent physical properties normally associated with polyesters, combined with a hydrolytic stability approaching that shown only by polyethers.

The unusually high strength to weight ratio conferred by Polycaprolactone in these foams means that in some applications lower densities can be used to achieve given physical properties.

POLYCAPROLACTONE - Capa® 3022

Typical analysis:

Hydroxyl value	-	540 mg KOH/gm
Acid value	-	normally less than 0.5 mg KOH/gm
Water content	-	normally less than 0.5%
Viscosity (23^0C)	-	210 cps
Colour	-	pale straw
Odour	-	slight, pleasant sweetish

Typical formulations:

	1	2	3
	Addition Levels		
Polycaprolactone 3022	100	100	100
Silicone surfactant[(a)]	0.5	0.5	0.5
Dimethylcyclohexylamine[(b)]	0.9	0.4	
Dibutyltindilaurate[(c)]		0.02	
Dabco WT		0.9	0.9
Solkane 141b[(d)]	To suit density required		
Crude MDI	142	142	142

(a) Dow Corning DC 193.
(b) ICI Catalyst SFC.
(c) Stanclere DETL.
(d) Solvay Fluor und Derivat

Formulation:

1. Produces moderate thickness skins of high density.
2. Produces low thickness skins of high density.
3. Produces high thickness skins of low density.

Formulations 2 and 3 are recommended for machine mixing.

Physical properties - samples ½" thick - density 0.47 gm/cc:

Heat distortion temperature BS2782 (102G)	61°C
Impact strength (falling weight)	160 inch lbs
Flexural strength	280 kg/cm^{-2}
Flexural modules	4000 kg/cm^{-2}

PROPERTIES OF INTEGRAL SKIN RIGID POLYURETHANE FOAMS

Typical results from slabs of integral skin moulded to ½" thickness. Fluorocarbon blown.

POLYOL	3022	
Density gm cc^{-1}	0.3	0.5
Heat distortion temp. °C	58	61
Impact strength ins.lbs.	80	160
Typical flexural strength		280 kg cm^{-2}
Typical flexural modulus		4000 kg cm^{-2}

Rigid foams may be immersed in fresh and salt water, warm water, dilute mineral acids and alkalis, petrol and mineral oils for several months without distortion or loss of surface finish.

Formulation

Amine catalysts are used and some suggested levels of readily available materials are listed below.

NN-Dimethyl cyclohexylamine[1]	-	0.75 parts/100 polyol
or Triethylamine	-	0.85 parts/100 polyol
or Triethylenediamine	-	0.2 parts/100 polyol

A range of silicone surfactants[2] may be used at levels between 0.2 and 0.8 parts/100 polyol.
Isocyanates - crude MDI is generally used and 148 parts weight are required per 100 parts polyol.

Blowing agent - Trichlorofluoromethane at levels of 10 and 20 parts per hundred polyol give free rise densities of 0.1 and 0.05 gm/cc respectively. For applications requiring a higher heat distortion temperature, water is the recommended blowing agent. Separate formulations are available.

1. ICI catalyst SFC has been found satisfactory.
2. Dow Corning DC 193 typically gives satisfactory results.

Processing

Systems based on Polycaprolactones can be easily handled by suitable urethane dispensing machines. The catalyst levels given above give the following process times:-

Cream time	45 seconds	(mixing temperature 20 -25°C)
Gel time	63 seconds	mould temperature normally 30 -50°C
Tack free time	67 seconds	

These times are for hand mixed samples.

Machine mixing of a similar formulation will give a cream time of approximately 25 seconds.

Demould times depend on the size of the moulding
- for small components this is less than five minutes.

Handling

The systems should be stored in air tight containers to prevent absorption of water from the atmosphere. Water absorbtion can cause variation in foaming rate, foam density and in extreme cases, it could affect the foam properties considerably.

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