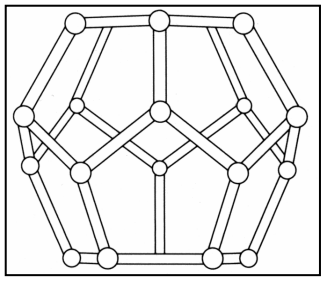
Zotefoams plc



Technical Information Sheet – TIS 23
(previously BTI10)
Advice for Thermoforming of Azote Foams

INTRODUCTION

Thermoforming is the process by which the application of heat to a thermoplastic material and the subsequent application of pressure enables three dimensional shapes to be produced from a flat sheet.

Plastazote Foam, Evazote Foam and Supazote Foam are expanded cross-linked polyolefins. Even at temperatures above the polyolefin softening point, cross-linking maintains the foam structure and enables thermoforming techniques to be used. The unique characteristic of thermoforming applies only to cross-linked foams. This Technical Information Bulletin outlines the techniques and provides process guidelines.

Heating
Correct application of heat is the key; therefore, correct temperature conditions are most important for successful thermoforming. The selected grade of foam is first softened to a pliable state using an appropriate time and temperature cycle. The heated foam sheet can then be manipulated using the various techniques mentioned in the text. Heating conditions are shown in Table 1.

Techniques
These consist of:
- Heat Moulding
- Heat Impression Moulding
- Vacuum Forming

HEAT MOULDING

The original method of heat moulding was direct to the body and information on techniques together with cycle times is contained in the Health Care Applications Brochure.

The commercial technique of heat moulding utilises an unheated foam shape, often prefabricated and with a 10% overload to ensure good definition, which is placed into an unheated two part mould. After closing the mould, the heating procedure using the correct temperature and time cycle is begun. At the end of the cycle the mould is allowed to cool.

Grade	Nominal Density [kg/m³]	Temperature (Hot Air Oven) [ºC (ºF)]	Approximate Heating time per 1mm Thickness [sec]	Comments
Plastazote® LD15 LD18 LD24 LD29 LD33 LD45 LD60 LD70	 15 18 24 29 33 45 60 70	140 (285)	 6 6 6 7 7 10 13 14	Can be handled
Plastazote® MP15 MP24 MP33 MP45	 15 24 33 45	140 (285)	 8 10 12 15	Can be handled
Plastazote® HL34 HL47 HL79	 34 47 79	150 (300)	 20 25 30	Use gloves
Plastazote® HD30 HD60 HD80 HD115	 30 60 80 115	160 (320)	 10 20 25 30	Use gloves
Evazote® EV30 EV50	 30 50	140 (285)	 7 10	Can be handled
Evazote® VA35 VA25	 35 25	140 (285)	 7 6	Can be handled
Supazote® EM26	 26	115 (240)	 6	Can be handled

Table 1 Heating Guidelines

HEAT IMPRESSION MOULDING

Using this technique pre-heated sheets are placed into unheated tooling. The chosen material is heated and then loaded into a single sided mould and the press platten closed. A matched mould can be used in the same manner; dependent on the design some pre-shaping may be required. The cooling time (which is normally the same as the heating time) can be shortened using (cold) fans.

VACUUM FORMING

The selected foam sheet is clamped in a frame and a heater panel is brought forward over the material for the established cycle and then retracted. The mould is raised up into the heated material and vacuum applied. After cooling, the formed shape is removed from the machine.
The correct calibration of heater panels is important, whether single sided using a top heater only, or double sided for 9mm and above using both top and bottom heaters. Recommendations are shown in Table 2 (below).

Single Sided Heating		Double Sided Heating
Top heater only overall output 8.1 Kw Zones adjusted as below.	ZONE	Top Heater overall output 5.4 Kw Zones adjusted as below.
11.87 Kw/m²	1	7.92 Kw/m²
8.13 Kw/m²	2	5.43 Kw/m²
8.13 Kw/m²	3	5.42 Kw/m²
7.03 Kw/m²	4	5.42 Kw/m²
7.03 Kw/m²	5	4.69 Kw/m²
13 Kw/m²	6	5.43 Kw/m²
		Bottom Heater not zoned. Uniform output 2.7 Kw/m²

Table 2 Recommended heater zoning

Zone Distribution is shown in Table 3

<table>
<tr><td colspan="5">4 x 300 W
3 3 (1.2kW) 3 3</td></tr>
<tr><td>8 x 300 W
(2.4 kW)
2
2
2
2</td><td colspan="2">8 x 300 W
(2.4 kW)
4
4
4
4</td><td>4
4
4
4</td><td>9 x 300 W
(2.4 kW)
6
6
6
6</td></tr>
<tr><td></td><td colspan="2">8 x 300 W
(2.4 kW)</td><td></td><td></td></tr>
<tr><td>2
2
2
2</td><td>5
5
5
5</td><td></td><td>5
5
5
5</td><td>6
6
6
6</td></tr>
<tr><td colspan="5">4 x 400 W
1 1 (1.2 kW) 1 1</td></tr>
</table>

Table 3 Typical thermoforming machine heater element arrangement:

Front of heater
Total area of the heater = 1.0 m x 0.65 m = 0.65 m^2
Each element is 245 x 60 mm
Total possible heater rating = 19.1 kW/m^2

HEATING METHOD

The preferred method of heating (except for vacuum forming) is a hot air oven with fan assistance capable of operating between 100°C and 200°C with a tolerance of ±5°C. As an alternative, infra red heaters utilising ceramic encapsulated elements may be used. These require zoning (see Table 2 and 3).

Cooling times are approximately the same as heating times. Additional cooling techniques, i.e. fan blowers, water cooling etc., can be used. Tools or moulds can be made from plaster, timber, GRP, epoxy, or aluminium.

SUMMARY OF MOULDING CONDITIONS

	LDPE/EVA	HDPE	EM
Temperature	140 °C (285 °F)	160 °C (320 °F)	115 °C (240 °F)
Shrinkage	2%	2%	2%
Closing Speeds	130-1000 mm/min		
Mould Pressures	For heat impression moulding, the press should achieve at least 0.5 kgf/cm^2 (7 lbs/in^2) over the area of the tool, and typically 7 kgf/cm^2 (93 lbs/in^2) is needed. For heat moulding at least 3 kgf/cm^2 (40 lbs/in^2) is required.		

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