“TOYOLAC”
High Heat Blow Molding ABS Resin

Technical Guide
for
Processing & Molding

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1. Typical Properties Data of “TOYOLAC” 450Y　BM1 and “TOYOLAC” 450Y　BM5

HIGH HEAT GRADE 耐热型					
Property 代表物性	Test Method 试验法	Test Condition 试验条件	Units 单位	High Heat Blow Molding 耐热 吹塑	
			Type 型号	450Y	450Y
			Suffix 区分字符	BM1	BM5
ISO STANDARD					
Melt Flow Rate 流动系数	ISO 1133	220°C / 10 kg	g/10min	2	2
Charpy Impact Strength (notched) 缺口冲击强度	ISO 179/1eA	23°C / 50 %RH	kJ/m^2	16	17
Deflection Temperature Under Load 热变形温度	ISO 75	1.8 MPa / 120°C/hr	°C	101	95
Tensile Strength 引张强度;降伏点	ISO 527	50 mm/min	MPa	45	48
Tensile Elongation at Break 拉伸伸长率			%	>20	>20
Tensile Modulus 拉伸模数		1 mm/min	MPa	2500	-
Flexural Strength 弯曲强度	ISO 178	2 mm/min	MPa	74	81
Flexural Modulus 弯曲模数				2200	2450
Density 比重	ISO 1183	23°C	kg/m^3	1060	1060
Flammability 燃烧性	UL94 File No. E41797			HB	HB

Note: The above values are typical data for the products under specific test conditions and not intended for use as limiting specifications.
「以上数据谨代表在特定条件下所得的测定值的代表例」

2. Molding Guide of High Heat Blow Molding TOYOLAC$_{TM}$ 450Y　BM1 & 450Y　BM5

1. Preliminary Drying

Commonly, ABS resin is absorbent (hydroscopic) and absorbs moisture in proportion to environmental humidity. The moisture absorbing process is reversible. Therefore, moisture of the wet pellet can be removed to environmental air with lower humidity. Dried pellet should absorb moisture until the amount touches equilibrium amount with the moisture in the air. The absorbing moisture content depends on the relative humidity in the air, how long the resin was exposed.

While Toyolac ABS resin is exposed to humidity, the moisture is absorbed onto surface and into inside of the pellets itself, recycled materials and molded parts. Typical equilibrium moisture of Toyolac ABS is around 0.2~0.3% at 23°C/50%RH and 0.5~0.6% at 40°C/95%RH. The rate of absorbed moisture is depending on pellet size, shape and environmental temperature.

Non-dried ABS resin can cause silver streaking problem on molded parts. The recommendable moisture content is less than 0.1%, more desirable is 0.05%. Generally, below pre-drying conditions are recommended.

Hot air ventilated dryer: 80°C; 3 ~ 5 hours
90°C; 2 ~ 4 hours

2. Blow Molding

Blow Molding is a process in which hollow plastic parts are manufactured. Basically, there are 3 types of blow molding: injection blow molding, extrusion blow molding and injection stretch blow molding. Please refer to Figure 1 for the Extrusion Blow Molding process.

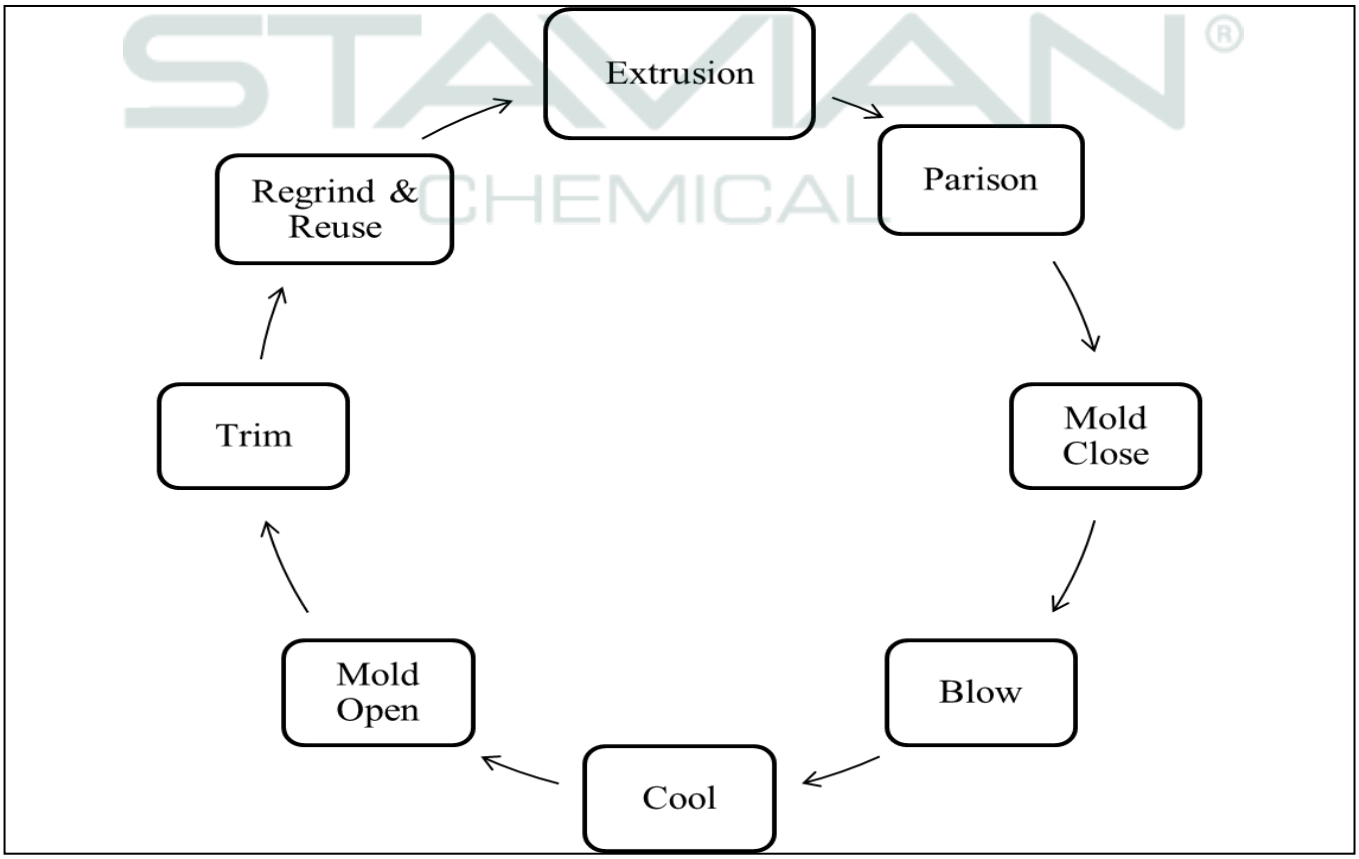
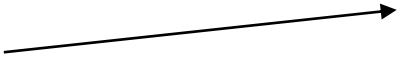


Figure 1: Extrusion Blow Molding Process Flow Chart

Generally, the barrel temperature of blow molding machine should increase from the hopper to the nozzle gradually.

Typical barrel temperature setting: 230 ~ 260°C (Example temperature profiles are shown in following table).

Table 1: Blow Molding Machine Temperature Profile

Profile	From hopper to nozzle	Remarks
Fixed		Constant profile is used to utilize plasticizing capacity.
Rising		Rising profile to allow moderate fusion of resin.
Mixed		Lower temperature at nozzle to prevent drooling or stringing.

It should be properly controlled according to the blow molding machines, that shapes and size of the products, and the mold structure. Temperature in excess of above recommended and long cycle time with long retention time inside barrel could result in discoloration or yellowish problem on the molded part. Those problems are the sign of damage to the material. Melt temperature of resin should be between 240°C ~ 260°C. It should be checked frequently and maintained within above recommended range to prevent defect of appearance and mechanical properties.

If shut down is required, remove the material from the machine and purge out completely to avoid burning problem.

Injection Speed & Pressure

Injection speed will be depending on products shape, gate structure and runner dimensions. Basically moderate injection speed is preferable in order to prevent orientation of rubber particles due to excessive shear stress. Injection pressure should be controlled to mold full parts consistently with acceptable appearance. Many parameters affect injection pressure, such as injection temperature, products shape, nozzle and gate size, runner dimensions and mold temperature. Typical injection pressure range is 70~140 MPa. It is important that injection pressure should drop off to holding pressure after fill-up immediately. The typical holding pressure is around 50~70 MPa.

Mold Temperature

The mold temperature affects the surface quality and the level of residual stress in the molded products. To provide a molded product having excellent surface finish and less residual stress, the mold temperature should be controlled as high as possible, ranging between 40°C and 80°C. However, higher mold temperature may cause longer cycle time and warpage problem. It should be taken attention excessive mold temperature.

Purging

General maintenance and equipment cleaning should include frequent purging with natural ABS resin. If prolonged shut-down is required, reduce barrel temperature less than 150°C, remove the material from the injection machine and purge with AS resin. Continue this operation until hopper is empty throughout and confirm barrel temperature has been dropped less than 150°C.

The standard molding condition of TOYOLAC$_{TM}$ 450Y BM1/ BM5 is shown in Table 2.

Table 2. Standard molding condition of TOYOLAC$_{TM}$ 450Y　BM1/ BM5

Item	Condition Setting
Molding Temperature	220 ～ 260℃
Mold Temperature	40 ～ 80℃
Screw rpm	40 ～ 80 rpm
Injection Pressure	70 ～ 140 MPa
Injection Speed	Medium to High
Back Pressure (resin pressure)	5～10 MPa

3. Troubleshooting Guide

Defects may occur which can be eliminated during the production of extrusion blow molded parts by following the suggested remedies below. There are usually two types of problems during blow molding process, which are either **Parison** or **Molding related.** Any one of the suggested remedies may solve a particular problem. However some problems may require a combination of suggested solutions. Each user of TOYOLAC$_{TM}$ High Heat Blow Molding Grade should make his own evaluation to determine the suitability of the material for his own particular use. If problems are still encountered after trying the remedies outlined below, contact Toray Plastics (M) Sdn. Bhd. for more information.

Table 3: Troubleshooting Guide

PARISON RELATED PROBLEMS

Problem	Cause	Solution
1. Parison curls outward	• Outer skin of parison may be too cold	• Heat the die ring
2. Parison curls inward	• Outer skin of parison may be too warm	• Align the die ring
3. Parison presents a banana shape	• Wall thickness variation through cross section	• Align the die ring
4. Parison length not controllable	• Melt viscosity too low • Processing temperature too high • Extrusion rate too low • Screw speed too low	• Select a more viscous material • Decrease melt temperature • Increase extrusion rate • Increase screw speed
5. Counter flow marks	• Degraded material contamination • Wrong flow path • Melt temperature too high	• Purge equipment • Modify head design • Decrease melt temperature
6. Flow marks in flow direction	• Mandrel support too close to die	• Modify head design
7. Heterogeneous flow marks in flow direction	• Contamination	• Clean die ring • Check die ring
8. Rough inner surface	• Melt temperature too low • Die temperature too low • Parison extruded too fast • Die chatter	• Increase melt temperature • Increase die temperature • Decrease parison speed • Check parison programming
9. Parison exhibits local discoloration	• Contamination • Recycling ratio	• Purge equipment • Decrease recycling ratio
10. Parison contains brown stripes	• Melt temperature too high • Too long residence time in screw • Too high shear rate • Overheating • Mandrel support not streamlined	• Decrease melt temperature • Increase output • Check all flow paths • Check heaters/temperatures • Reposition/change mandrel support

11. Small round or lens-shaped inclusions	• Porosity	• Dry material • Dry compressed air
12. Parison falls from head before mold closes	• Extrusion tooling closing • Parison too thin • Wet material	• Increase die gap at end of shot • Thicken parison at end of shot • Dry material
13. Prison folds or ripples	• Too thin parison • Excessive melt temperature	• Light preblow • Reduce melt temeprature
14. Bubbles	• Air entrapment	• Increase screw speed • Increase extrusion pressure • Vent the equipment

MOLDING RELATED PROBLEMS

Problem	**Cause**	**Solution**
1. Parison blows out	• Blow ratio too high • Parison walls too thin • Parison wall not uniform • Parison not correctly grapsed • Blowing air speed too high • Welding edges too sharp • Welding edges do not close tightly together • Melt temperature not uniform on length	• Change die or material • Increase wall thickness • Check parison control • Check mold halves position • Reduce air speed/pressure • Check welding conditions • Check parison thickness vs. die design • Increase output/screw speed
2. Parison not fully inflated	• Blow-up pressure is too low • Blow-up time is too short	• Increase blow-up pressure • Increase blowing time
3. Blown-up parison collapses in mold	• Blow-up air is activated too early • Blow-up air pressure is too low	• Check blow-up timing • Increase blow-up pressure
4. Material sticks to edges	• Mold temperature too high • Cycle time too short	• Decrease melt temperature • Increase cycle time
5. Weld seam too weak	• Melt temperature is too low or much too high • Closing mold timing is wrong • Pinch-off angle is wrong	• Adjust melt temperature • Adjust mold closing timer • Adjust pinch-off angle
6. Base seam displaced inwards	• Pinch-off angle too great • Mold closing time too short	• Decrease pinch-off angle • Delay mold closure
7. Base seam not centered	• Parison not fully vertically extruded • Mold halves not grasping parison evenly	• Center the position • Reposition mold halves

8. Sudden changes in wall thickness	• The parison controller is defective • Lost control of melt temperature	• Repair defective equipment • Regain control of melt temperature
9. Parting line protrudes	• Mold edges are damaged • Mold closing force is too low • Blow-up air is activated too early	• Check mold edges • Increase mold closing force • Check timing for air blowing
10. Contours of the mold sre not aligned	• Mold is loose	• Check mold locating elements
11. Demolded items change shape	• Cooling time too short • Blowing pressure too low	• Increase cooling time • Increase blowing time
12. Uneven appearance on mold surface	• Venting problem	• Improve venting
13. Scaly surface	• Contamination	• Clean equipment
14. Molding tears at demolding	• Degradation	• Decrease melt temperature • Check for overheating
15. Excess smoke and volatiles during extrusion	• Excessive melt temperature • Excessive shear rate in extruder	• Decrease melt temperatre • Check extrusion conditions
16. Poor part definition	• Trapped air • Consideration on mold • Cold mold • Low blow pressure	• Add/modify venting • Sand blast mold with coarse grit • Adjust temperature above dew point • Increase blow temperature

Important Notes:

1. In as much as Toray Plastics (Malaysia) Sdn. Bhd. has no control over the use to which other may put this material, it does not guarantee that the same result as those described herein will be obtained. Nor does Toray Plastics (Malaysia) Sdn. Bhd. guarantee the effectiveness or safety of any possible or suggested design for articles of manufacturer as illustrated herein by any photographs, technical drawing and the like. Each user of the material or design or both should make his own tests to determine the suitability of the material or any material for the design, as well as suitability or suggested uses of the material or design described herein are not to be construed as constituting a license under any Toray Plastics (Malaysia) Sdn. Bhd. patent covering such use or as recommendations for use of such material or design in infringement of any patent.

2. The material described here are not recommended for medical application involving any implantation inside the human body. Material Safety Data Sheet (MSDS) for the materials concerned should referred to before any use.