LyondellBasell Technical Tip

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Reduced Shrinkage in Sheet Molding/ Bulk Molding Compound Applications

In Thermoplastic and Thermosetting Resins

Microthene® F powders are added to certain thermoplastic and thermosetting resins to improve surface appearance mold flow, color uniformity, dimensional stability, mold release, extrudability, or shrinkage characteristics.

GLASS REINFORCED POLYESTER

The addition of Microthene **FN510** to glass-fiber-reinforced polyester sheet molding compound (SMC) effectively improves surface appearance and smoothness, pigment uniformity and reduces shrinkage in the final product. Similar performance improvements can be obtained in bulk molding compounds (BMC) by the use of Microthene F powders with the added benefit of improved mold flow.

In general FN510 is the Microthene powder of choice for these applications, as it offers a good balance in properties. However, specialized needs may require the use of one of the other Microthene powders. For example, if abrasion resistance or surface hardness are of prime importance in the application, then **FA700** (HDPE) powder may be an alternative. In some applications a higher MI LDPE (**FN501**) may be a good alternative if die lubrication is important.

By adding one percent to six percent by weight Microthene FN510, resin filler distribution, mold release, mold flow and moisture resistance are improved, while strength properties are successfully retained. The effect of varying the level of Microthene FN510 on the physical properties of BMC moldings is shown in Table 1. In pigmented systems, colors can be molded without surface mottling.

Formulation			0 wt%	2 wt%	4 wt%	6 wt%
Microthene F FN 51000			0	2	4	6
Polyester Resin			20.25	20.25	20.25	20.25
Styrene Monomer			4.40	4.40	4.40	4.40
Tertiary Butyl Perbenzoate			0.21	0.21	0.21	0.21
Zinc Stearate			1.10	1.10	1.10	1.10
Calcium Carbonate			53.89	51.89	49.89	47.89
Modifier "M"			0.15	0.15	0.15	0.15
¼" Fiberglass			20	20	20	20
Physical Properties	**ASTM**	**Units**	**0 wt%**	**2 wt%**	**4 wt%**	**6 wt%**
Shrinkage (based on cold Mold)			3.60	1.90	1.40	1.00
Gloss 60° max/min	D 523	%	32/14	84/65	84/64	74/49
Barcol Hardness			69.00	50.00	37.00	30.00
Specific Gravity	D 792	—	1.95	1.86	1.81	1.75
Deflection Temp.	D 648 (1961)	°C	>205	>205	>205	>205
Flexural Strength	D 790-66	psi	11,600	18,200	18,800	16,000
Flexural Modulus	D 790-66	psi	$1.2x10^6$	$1.75x10^6$	$1.64x10^6$	$1.37x10^6$
Tensile Strength	D 638	psi	4,350	6,510	5,510	5,620
Izod Impact (notched)	D 256	ft. lb./in.	4.79	5.32	4.17	5.38
Water Absorption 24 hrs at 75°F	D 570	%	1.54	0.33	0.32	0.35

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Microthene F powder imparts good surface appearance because it reduces volumetric shrinkage of the polyester/styrene resin. At low concentrations, the Microthene F powder does not phase out of the system when heat is applied during the compression molding operation. At higher concentrations, Microthene F powder "blooms" to the surface and can improve gloss and help with the mold release. Typically, Microthene F powder is added in the two wt% to five wt% range. The amount required for optimum performance depends on the total formulation of the molding compound. Problems can occur if too much Microthene F powder is added to the formulation. The excess polyolefin that migrates to the surface of the part can lead to a "fouling" of the mold.
FA 700 and FP 800 are less prone to "fouling" and in some specific and limited instances could be and alternative to FN 510.

Microthene F powder can be added directly to the unsaturated premix without first being dissolved in the styrene monomer. The small particle size of Microthene F powder enables it to be dispersed easily. For the best surface properties optimum dispersion of Microthene F powder is required.

TYPICAL MIXING PROCEDURE

Following is a typical mixing procedure as used in laboratory evaluations:

1. Combine the resin paste ingredients and mix thoroughly using a high shear mixer such as a Cowles, Eppenbach or Kady Zolver. The catalyst should be added as a paste in the styrene monomer.
2. Transfer the proper amount of resin paste to a double-arm mixer.
3. Add the calcium carbonate and mix thoroughly
4. Add the modifier and mix.
5. Add the Fiberglass and mix until dispersed uniformly. This should normally take two-and-one-half minutes to four minutes depending on batch size.
6. Remove from mixer and compress into slabs approximately 3/4 inch thick for cutting into mold charge weights. If the parts to be molded are heavy, it may be advisable to pre-weigh individual charges before the compound thickening action has progressed. The compound must be wrapped in a suitable vapor barrier material to prevent monomer loss in storage. A combination of polyethylene film and a cellophane overwrap is satisfactory.

Microthene F powder also improves the surface finish of glass-reinforced-polyester structural shapes made by the pultrusion process. As little as one percent by weight of Microthene FN501 added to the polyester compound greatly improves surface smoothness by lubricating the profile die and reducing friction.

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