Specialty Compounds Containing

3M™ Scotchlite™ Glass Bubbles

Technical Brief

Customized Thermoplastic Solutions

▶ **Benefits of RTP Company Compounds Containg 3M™ Scotchlite™ Glass Bubbles:**

Processing Improvement and Productivity Gains

- Reduced shrinkage
- Reduced warpage
- Improved flow
- More "control" than foam

Physical Property Enhancements

- Lower specific gravity
- Better surface finish
- Colorable
- Improved chemical resistance

Markets

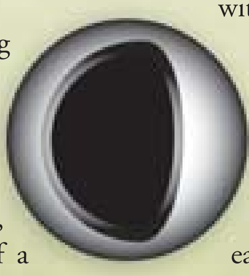
- Automotive
- Aerospace
- Marine
- Electronic
- Medical

Cost Savings

- Increased design flexibility
- Overall weight savings
- Improved manufacturing efficiencies

Scotchlite™ Glass Bubbles from 3M are particles engineered to offer a unique alternative to conventional thermoplastics fillers. These hollow glass microspheres are designed to reduce part weight, enhance properties and lower part costs in demanding applications. RTP Company specialty compounds enhanced with glass bubbles offer the unique potential to lower part weight while still meeting the specific processing and end use requirements for many applications.

Specialty compounds containing Scotchlite glass bubbles can reduce the density of many thermoplastic compounds by as much as 30 percent, while offering more control than other density control methods, such as foaming. Manufactured of a chemically-stable soda-lime borosilicate glass composition they are non-combustible and non-porous, so they do not absorb moisture. Offering great survivability under demanding processing conditions, they are able to produce stable voids, resulting in low thermal conductivity and low dielectric constants.



Designed for a variety of industries from aerospace and automotive to cosmetics and explosives, specialty compounds containing Scotchlite glass bubbles are designed to provide high strength to weight ratios for materials with lower specific gravity. In addition to reducing part weight these microspheres provide lower viscosity, improved flow, and reduced shrinkage and warpage. Compounds containing Scotchlite glass bubbles are available in most resins and adapt easily to most production processes including injection molding and extrusion.

Scotchlite™ Glass Bubbles

Courtesy of 3M

Scotchlite™ Glass Bubbles are products of 3M

Specialty Compounds Containing 3M™ Scotchlight™ Glass Bubbles

Processing Considerations

When processed properly, RTP Company's glass bubble formulations retain their glass integrity during molding to produce high-quality, lightweight parts. The main focus of part/mold design and processing should be on reducing shear of the material; crushing the bubbles during processing can result in sharply reduced material properties and increased part weight.

Molding guidelines are offered as suggestions and may be subject to modification, depending on your specific material, part design, and machine. Please contact RTP Company's technical service representatives for further assistance.

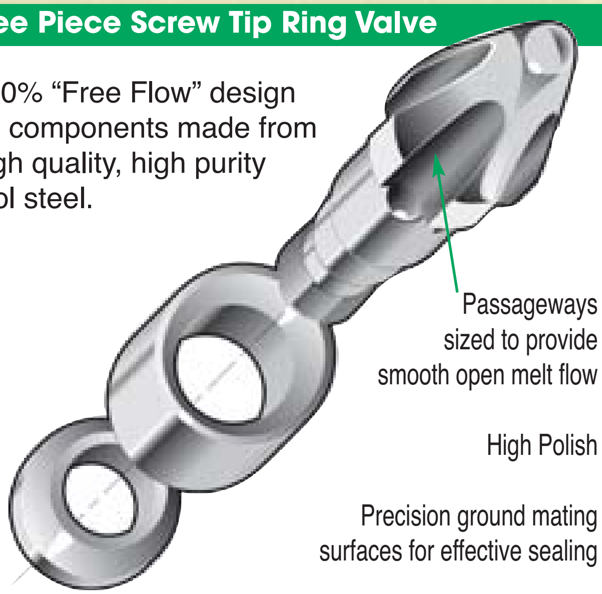
Equipment Considerations

A general purpose screw that utilizes a typical three-zone style is best for processing compounds containing glass bubbles. The screw has three sections: feed, compression, and metering. Metering should be done with an L/D ratio of 16:1 to 22:1, with a low compression ratio of 2.0:1 to 2.5:1. Mixing screws, such as barrier, vented, and double wave are NOT recommended.

A 100% "Free Flow" fluted screw tip valve assembly is required to allow smooth melt flow. The nozzle/sprue orifice should have generous dimensions (0.25 in/5.5 mm) and be without sharp edges or severe convolutions. Do not use internally tapered tips or tips without a constant diameter pathway.

Material construction for screws and barrels can be the same as for standard reinforced materials; however, wear resistant alloys provide longer life.

Three Piece Screw Tip Ring Valve



Tooling Considerations

- Full round runners with a diameter of 0.25" (5.5 mm) are preferred.
- Runners should have no sharp corners
- Minimum gate thickness of 0.080" (2 mm).
- Sprues as short as possible, with initial diameter of 0.25" (5.5 mm), tapered to 11/32" (8.7 mm).
- Open channel type hot runner systems are acceptable.
- Use same materials for molds as for other reinforced materials.

Processing Considerations

- Barrel temperatures are critical for successful processing of compounds containing glass bubbles. Use a reversebarrel profile to "pre-soak" material prior to compression zone.
- Minimum back pressure should be used, typically 10-50 psi (0.17-0.34 MPa).
- Excessive injection speeds and pressures contribute to glass bubble breakage. Keep injection speeds slow to medium and cavity pressures below 10,000 psi (69 MPa).

Molding Temperature

Please refer to the specific glass bubble formulation processing conditions supplied by RTP Company's Technical Service Department for recommended starting temperatures. Normally, reinforced materials require higher mold temperatures than non-reinforced materials. This helps achieve a smoother, more blemish free surface by providing a resin rich skin on the molded part.

Minimizing Wear in Processing Equipment

Highly-filled engineering plastics can cause wear on conventional steel molds constructed with insufficient hardness. Of the factors causing wear, glass content has the most influence with a Mohs hardness of 5 to 7. Comparatively, carbon fiber has a Mohs hardness of 2, and common tool steels have a hardness of 4.

Wear can be minimized by proper processing and properly hardened tool steel cavities, cores, runner systems and sprue bushings. Cavities must be vented at the end of fill to minimize trapped gasses, which could cause pitting from high temperatures. Excessive gate wear can be seen if the gates are sized too small and fast injection speeds are used. Fast injection speeds can also cause increased wear, in addition to excessive shear to the glass bubbles.

The mold cavity and core finish play an important role in tool longevity, and machining marks have been shown to accelerate wear. A 4 microinch (0.0001 mm) or better finish is recommended for high production cores and cavities. Gates should be hardened and replaceable to obtain mold longevity.

Mold Steel Selection

Many tool steels are able to resist the erosion caused by glass bubble formulations. The choice of tool steel is dictated by economics, location within the mold and life expectancy required. The following are tool steels with good abrasion resistance:

- A-2 Steel resists serious abrasion when hardened to 58-60 Rockwell C(Rc)

- D-2 Steel contains more chromium, is more resistant to abrasion, and is somewhat harder to machine than A-2. D-2 is limited to smaller components due to its brittleness.

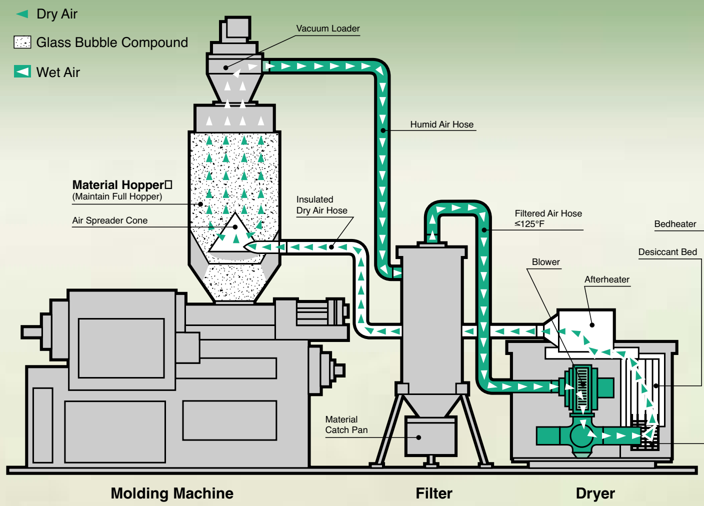
Mold plating is an excellent way to improve the service life of a mold. Effective abrasion-resistant coatings include electroless nickel plating, slow deposition dense chrome, and nye-carb plating.

For long production molds, A-2 or D-2 tool steel hardened to Rockwell C~60+ is recommended. Of these, A-2 steel is a little more flexible and forgiving. For low volume runs, S-7 and H-13 are acceptable softer steels.

Drying Compounds Containing Glass Bubbles

Moisture may be present in some materials, either on the surface or absorbed by the resin system. Without proper drying, this moisture may be converted to steam in the injection cylinder and cause blisters, splay, internal voids, and lamination of the molded part's surface. Undried hygroscopic materials can suffer degradation of properties. Please refer to the recommended processing conditions for each material being molded.

Typical Dehumidifying Closed Systems for Drying Glass Bubble Formulations



In the hopper, the drying units force hot dehumidified air through the plastic granule by way of a closed air circulating system. The moisture is removed by the sieve desiccant, which traps the moisture molecules. The dry air is then heated to a preset temperature and delivered to the material in the insulated hopper.

The majority of water is absorbed in the initial contact with the desiccant bed. When the bed becomes saturated, it is regenerated by heating to more than 500°F (290°C), purging itself of moisture. Properly maintained dryer systems give consistently dry resin, higher yields, and improved cycle times. Desiccants should be replaced every two years, and dryer filters should be checked and cleaned once each shift to insure adequate air flow to the bed.

Regrind

Since the potential exists for glass bubble breakage during molding and then regrinding, part density may increase and physical properties may decrease with excessive amounts of regrind. Grinder screen holes of 5/16" (8 mm), or larger are preferred to reduce bubble breakage during the grinding process. It is recommended that a regrind study, including part testing be performed using varying amounts of regrind to determine an acceptable amount in the finished part. Accurately mix ground runners, sprues, and rejects with the virgin pellets, being careful to keep the mixture free of contamination.

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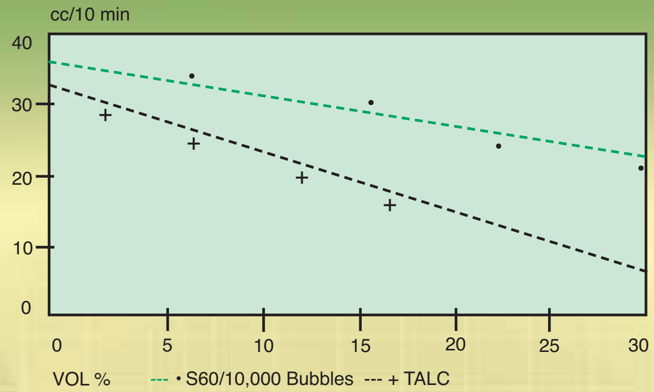
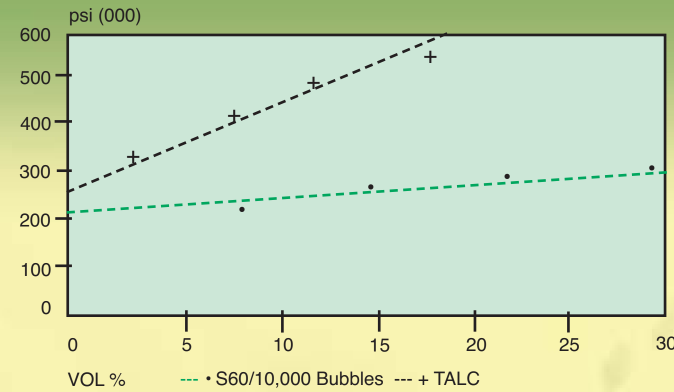
3M Test Results for Polypropylene

Melt Flow Index (ASTM D1238 using volume/time)



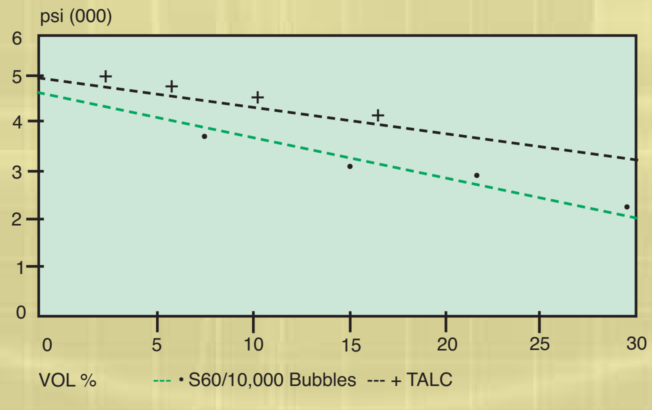
All fillers impede resin flow. 3M Scotchlite™ Glass Bubbles, due to their spherical shape and low surface area, impede flow less than talc. When comparing different density formulations, using volume/time is more meaningful than weight/time.

Flexural Modulus (ASTM D790)



With glass bubbles, there is only a slight increase in flexural modulus.

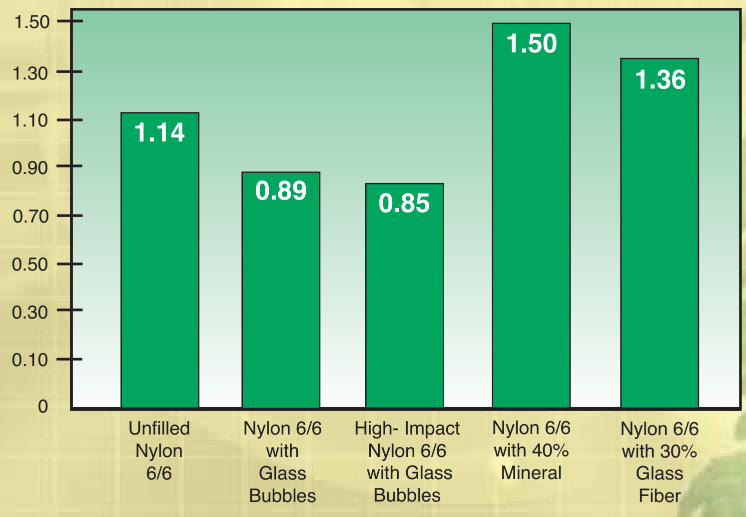
Tensile Strength at Yield (ASTM D638)



Tensile strength at yield – the force required to dimensionally change the part – declines as glass loading increases.

RTP Company Data

Specific Gravity (ASTM D792)



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