

ENGINEERED GLASS MATERIALS DIVISION Spheriglass® Solid Glass Microspheres

High Performance Solid Glass Polymer Additives

Technical and economic advantages can result from the inclusion of Spheriglass® solid glass spheres as a performance additive for thermoplastic and thermosetting resin systems. Their multiple benefits, including enhanced processing and reduced manufacturing costs are outlined below.

Glass spheres are smooth, hard and offer excellent chemical resistance and low oil absorption. These and other characteristics enable the spheres to be used in a wide range of applications in the transportation, automotive, chemical, electronic, industrial, and engineering industries, where they can substantially reduce reject rates in production.

Potters Industries is the world's leading supplier of glass spheres and has a Research and Development Laboratory to provide applications, engineering and technical assistance.

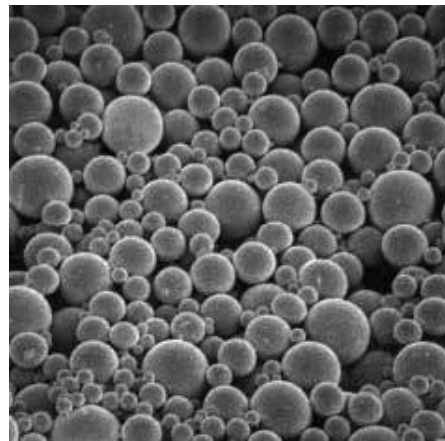
Multi Benefits of Spheres:

PROCESS

- Solid smooth shape
- Lowest surface to volume ratio
- High loading capacity
- Improved lubricity
- Low resin mix viscosity
- Excellent mold flow
- Uniform dispersion

PRODUCT

- Improve surface hardness, toughness and durability
- Improved abrasion/ scratch resistance
- Low uniform shrinkage
- Low warpage



- High flexural modulus
- Better stress distribution
- Enables high loading levels
- Excellent chemical resistance

Improved Flow Properties

Spheres lower the viscosity of most resin mix systems, acting as miniature internal ball bearings to improve flow. When used in combination with fibers or other particle shapes, mold flow is improved, thus reducing product defects, and potentially improving production rates.

Low Shrinkage and Warpage

High loadings of glass spheres add significantly to the dimensional stability of finished products by reducing shrinkage and improving part flatness.

Better Molded Parts

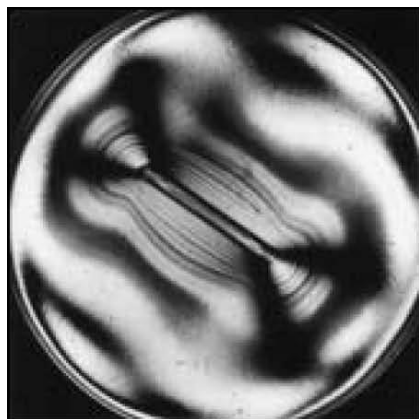
Glass spheres produce superior finished product characteristics in many resin systems. High loadings can increase flexural modulus, increase surface hardness and improve stress distribution.

High Resin Displacement

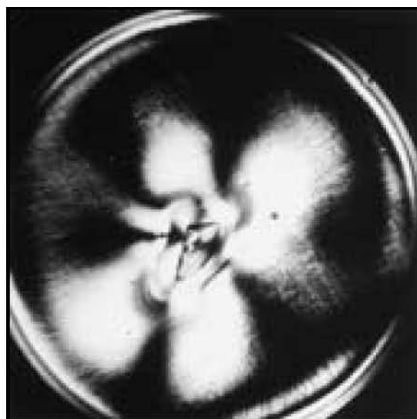
The precise geometry of Spheriglass spheres allows them to disperse evenly, pack closely, and wet out easily in the compound, permitting very high filler loadings.

General Product Information							
Product	Particle Size Distribution**†				Bulk Density* (Lbs. /cu. ft.) ASTM D-3101-78		Oil Absorption* (g oil/100g. spheres) ASTM D-1483
	Mean Value** (microns)	10% Finer Than: (microns)	50% Finer Than: (microns)	90% Finer Than: (microns)	Untapped	Tapped	
A-GLASS							
1820	271	235	271	317	92	99	18
1922	180	140	175	220	91	95	18
2024	156	105	151	192	88	92	18
2227	119	93	116	160	88	92	18
2429	85	72	83	99	88	92	18
2530	71	59	70	95	87	92	18
3000	35	10	35	80	82	100	18
4000	25	6	20	50	75	100	19
5000	11	3	9	15	60	85	20
E-GLASS							
3000E	35	10	35	70	85	100	19
EMB 20	10	4	9	13	65	75	21
EMB 10	5	3	6	7	55	75	21

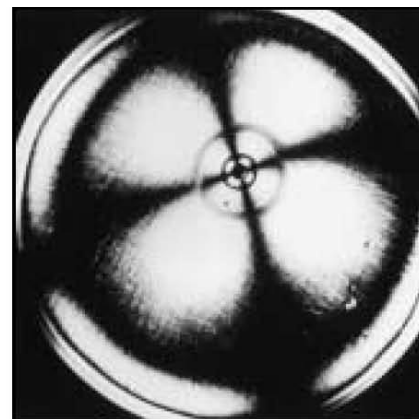
* Typical Values not intended for use as a specification
† Volume distribution values



FIBER



REGULAR PARTICLE



GLASS SPHERE

Dimensional Stability

Better stress distribution is achieved from the use of a spherically shaped particle. This behavior is illustrated above showing the stress patterns in cured epoxy resins compounded with the three different classes of substances commonly mixed into plastics: fibers, irregular particles and spheres. With glass spheres, the stress pattern is regular and predictable, showing less localized stress concentrations.

A molded part can shrink in any of its three dimensions. Glass fiber-filled parts, owing to the directional orientation of the fibers, normally have different shrinkage rates for different directions. Shrinkage measured along the length of the fiber is very low; across the fiber it is usually quite high. Therefore, the dimensional stability of glass fiber-filled parts is partially dependent on the flow of material into the mold. The non-directional orientation of spheres produces a more uniform shrinkage rate throughout the part and the isotropic nature of spheres results in more predictable manufacturing quality.

Coupling Agent Coatings

Spherglass solid glass spheres are incorporated into most thermoplastic and thermosetting resin systems as an inorganic reinforcement. When coated Spherglass additives are used, processing and resin composite performance are enhanced, while overall manufacturing costs are reduced. Spherglass solid glass spheres are available with coupling agents CP-01, CP-02, and CP-03; each designed for optimum performance in specific resin systems. The coupling agents are applied in molecular layers to obtain maximum interfacial bonding between spheres and resin.

Recommended Coupling Agents

Thermoplastic Resin Systems	
Acrylics	CP-01
Acetal	CP-02, CP-03
Acrylonitrile Butadiene Styrene	CP-01
Cellulosics	CP-02, CP-03
Fluoroplastics	CP-26
Ionomer	CP-02, CP-03
Nylon	CP-03
PBT/PET	CP-02, CP-03
Polycarbonate	CP-02, CP-03
Polyethylene	CP-01
Polyimide	CP-03
Polymethyl Methacrylate	CP-01
Polyphenylene Oxide	CP-03
Polypropylene	CP-03
Polystyrene	CP-01
Polysulfone	CP-03
Polyvinyl Chloride	CP-03
Styrene Acrylonitrile	CP-01
Thermosetting Resin Systems	
Epoxy	CP-02, CP-03
Melamine	CP-02, CP-03
Phenolic	CP-03
Polyester, unsaturated	CP-01
Silicone	CP-01
Urea	CP-03
Urethane	CP-03
Vinyl Ester	CP-01

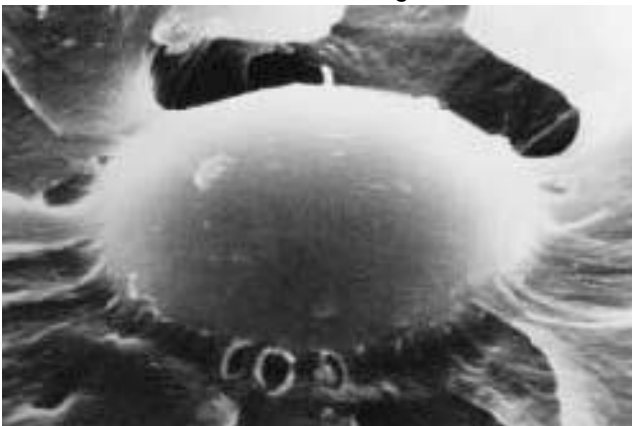
The following chart illustrates the improved properties of coated glass sphere filled Nylon 6/6 compounds.

Coupling Agents Improve Properties		Unfilled	Solid Glass Spheres (40% by wt.)	
			3000 Uncoated	3000 CP-03 Coated
Flexural Strength (psi)	Dry	14300	14200	19000
	Wet ²	8900	8700	12100
Flexural Modulus (psi x 10 ⁵)	Dry	3.2	4.9	5.4
	Wet ²	1.7	2.7	3.1
Tensile Strength (psi)	Dry	9400	7100	11100
	Wet ²	8000	5500	9400
Heat Deflection Temp.		75	127	126

¹ The Nylon 6/6 used was "Zytel" 101 (Dupont)

² Sample conditioned for 16 hours in water at 50°C prior to testing wet physicals.

SPHERES with coating



SPHERES Uncoated



PHYSICAL PROPERTIES OF A AND E GLASS*

TYPICAL VALUES **	A -GLASS Soda Lime	E-GLASS Borosilicate
Specific Gravity	2.5	2.57
Refractive Index	1.51	1.54
Young's Modulus, 10 ⁶ psi	10.0	12.6
Hardness (Moh)	6.0	6.5
Dielectric Constant, 22°C, 10 ⁶ Hz	6.9	5.8
Softening Point, °C	735	830
Expansion Coefficient, in/in/°C X 10 ⁻⁷	87	32
pH†	9.4	8.5
Composition %:	A-Glass	E-Glass
SiO ₂ ††	71-73	54.5
Na ₂ O	12-14	0.5
CaO+MgO	11-16	22
Al ₂ O ₃	0.5-1.5	14.5
B ₂ O ₃	—	8.5

* Not meant for specification purposes

** Typical Values taken from- Schneider, Samuel J., Engineered Materials Handbook, Vol. 4. 1991, ASM International.

†10% solution in deionized water

†† No measurable free crystalline silica content as tested by ASTM C-169

Packaging

Spheriglass® Solid Glass Microspheres are available in paper bags with plastic liners, bulk bags and various bulk shipping modes. Details of packaging options are available as a separate document. Samples in sufficient quantity for testing are available on request.

Other Products Offered:

Spherichel® Light Weight Hollow Glass Microspheres
 Q-CEL® Ultra-Light Weight Hollow Microspheres
 Conduct-O-Fil® Conductive Particles
 Z-Cel® Sodium Aluminosilicate Microspheres

Safety Information

Material Safety Data Sheets (MSDS) can be supplied on request.

For further information about our range of Solid and Hollow Microspheres, please contact us:

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