

# PQ Hollow Spheres

## Q-Cel® Ultra-Light Hollow Glass Microspheres Q-Cel® in Epoxies

In epoxy formulations, Q-Cel® Hollow Microspheres offer several significant benefits:

- Polymer Extension
- Cost Reduction
- Density Reduction
- Increased Hiding Power
- Improved Whiteness
- Reduced Thermal Conductivity

### Density Reduction

PQ Hollow Spheres are easily incorporated into resin systems at levels of up to 50% by column; Table 1 compares two epoxy formulations.

| Table 1: Density Comparison of filled versus unfilled resins |                            |                           |                       |                           |
|--------------------------------------------------------------|----------------------------|---------------------------|-----------------------|---------------------------|
|                                                              | Q-Cel® Filled Formulations |                           | Unfilled Formulation  |                           |
|                                                              | Parts by Weight<br>kg      | Parts by Volume<br>litres | Parts by Weight<br>kg | Parts by Volume<br>litres |
| Epon 828 Resin                                               | 92.5                       | 69.1                      | 100.0                 | 87.7                      |
| Q-Cel® 6019                                                  | 3.0                        | 10.2                      |                       |                           |
| Heloxly 8 Diluent                                            | 4.5                        | 3.4                       |                       |                           |
| Epon H2 Curing Agent                                         | 20.0                       | 17.5                      | 20.0                  | 17.5                      |
| Density (g/cm <sup>3</sup> )                                 | 1.01                       |                           | 1.14                  |                           |
| Viscosity (cps)                                              | 12,000                     |                           | 12,000                |                           |

### Viscosity

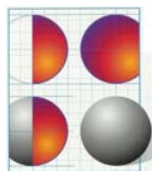
The addition of Q-Cel® Hollow Microspheres will increase the viscosity of the total systems. However, various reactive and non-reactive diluents can be added to achieve the working viscosity desired. The amount of diluents required will be determined by the volume percent of Q-Cel®, the initial viscosity of the epoxy, the ambient temperature and the desired final viscosity of the system.

### Cost Comparison of filled versus unfilled resins: cure systems

Q-Cel® Hollow Microsphere have been evaluated in epoxy systems with various curing agents. Amines, anhydrides, polyamides and catalytic curing agents can be used with PQ Hollow Spheres. However, the overall performance level will depend upon the specific formulation and end use.

### Applications

Recent studies have demonstrated the utility of adding Q-Cel® Hollow microspheres to an epoxy adhesive system. Q-Cel® can reduce formulation costs by as much as 25% without affecting the performance of the adhesive.



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Q-Cel® 6019 Hollow Microspheres are a free-flowing, oleophilic product that is low in density ( $0.19\text{g/cm}^3$ ) and small in particle size ( $75\mu\text{m}$ , avg). This product is especially suited for use in adhesive applications.

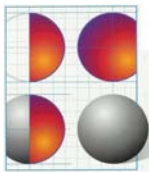
When Q-Cel® is added to a “workhorse” epoxy resin system (bisphenol-A, cured with a modified aliphatic amine) at volume levels of 9 and 18%, resin density is reduced substantially, while lap-shear adhesive strength is retained, and in some cases, improved. Additionally when used to augment the same resin system containing conventional solid fillers (calcium carbonate with fumed silica), Q-Cel® microspheres impart similar benefits.

The data collected in the study illustrate the benefits gained from the use of Q-Cel® Hollow Microspheres in the epoxy system as shown in Table 2. Benefits include:

- Formulation density reduction, leading to cost savings
- Maintenance of adhesive performance, potential improvement in bond strength at ambient temperatures and after exposure to elevated temperature stress
- Viscosity optimization of the formulation, aiding in sag prevention and development of adequate “glue-line”.

Additional information and assistance is available to aid formulators in the evaluation of Q-Cel® Hollow Microsphere in epoxy applications.

| <b>Table 2: Epoxy Adhesive Formulations</b>                                                                  |                   |                   |                   |                                                     |                   |
|--------------------------------------------------------------------------------------------------------------|-------------------|-------------------|-------------------|-----------------------------------------------------|-------------------|
|                                                                                                              | Control           | Q-Cel® 6019       |                   | Q-Cel® 6019, SiO <sub>2</sub> , & CaCO <sub>3</sub> |                   |
|                                                                                                              | Volume %          | Volume %          | Volume %          | Volume %                                            | Volume %          |
| Resin                                                                                                        | 100.0%            | 91.0%             | 82.0%             | 77.2%                                               | 69.5%             |
| SiO <sub>2</sub>                                                                                             | -                 | -                 | -                 | 1.0                                                 | 0.9               |
| CaCO <sub>3</sub>                                                                                            | -                 | -                 | -                 | 12.9                                                | 11.7              |
| Q-Cel® 6019                                                                                                  | -                 | 9.0               | 18.0              | 8.9                                                 | 17.9              |
| TOTAL                                                                                                        | 100.0%            | 100.0%            | 100.0%            | 100.0%                                              | 100.0%            |
| Viscosity, cps                                                                                               | 11,200            | 19,200            | 25,600            | 57,600                                              | 83,200            |
| Density, lb/gal                                                                                              | 9.7               | 8.8               | 8.0               | 10.7                                                | 9.9               |
| <b>Formulation Performance</b>                                                                               |                   |                   |                   |                                                     |                   |
| <b>(Tensile Lap-Shear Strength, Ground Steel to Ground Steel, Average psi for 7 specimens)</b>               |                   |                   |                   |                                                     |                   |
| Standard Cure*                                                                                               | 871<br>(SD±220)   | 1,206<br>(SD±97)  | 1,011<br>(SD±70)  | 1,252<br>(SD±100)                                   | 1250<br>(SD±103)  |
| Thermally Stressed**                                                                                         | 2,306<br>(SD±190) | 2,706<br>(SD±210) | 2,326<br>(SD±140) | 3,591<br>(SD±224)                                   | 3,380<br>(SD±238) |
| Elevated Temp Performance***                                                                                 | 3,490<br>(SD±187) | 3,694<br>(SD±87)  | 3,330<br>(SD±125) | 3,716<br>(SD±106)                                   | 3,352<br>(SD±114) |
| *Test Specimens cured at 20°C for 7 days, Testing conducted at 20°C                                          |                   |                   |                   |                                                     |                   |
| ** Test Specimens cured at 20°C for 3 days, then heated to 150°C for 8 hours. Testing conducted at 20°C      |                   |                   |                   |                                                     |                   |
| *** Specimens cured as above. Testing conducted at 80°C, the upper heat tolerance of the amine curing agent. |                   |                   |                   |                                                     |                   |



## PQ Hollow Spheres



**Potters Europe**

Engineered Glass Materials Division



### Other Product Range:

Sphericel® Ultra-Fine Weight Reducing Hollow Glass Microspheres

Spheriglass® Performance-Enhancing Solid Glass Microspheres

Spheriwhite™ Colour-Enhancing Solid Glass Microspheres

Luxsil® Cosmetic Microspheres

GlassFill® Ultra-Fine Powdered Glass

### Safety Information:

When using this product for prolonged periods in dusty environments, inhalation may irritate the respiratory tract. NIOSH approved mask or respirators are recommended when handling the product. Material Safety Data Sheets will be supplied on request.

For further information about our range of Hollow Glass Microspheres, please do not hesitate to contact us:

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