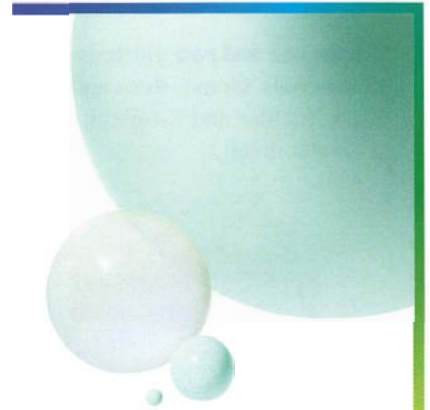




Microspheres

Thermal Conductivity Report



June, 1998

Increasing or decreasing thermal conductivity

The addition of 3M™ Microspheres to a resin system can increase or decrease thermal conductivity in parts and films. The change depends on the type and amount of microspheres used. This thermal control is in combination with other possible enhancements such as lighter weight.

Potential microsphere applications for thermal conductivity include the following:

- Potting compounds – protecting components from environmental heat.
- Floor tiles with feeling of warmth.
- Insulative pipe wrap to decrease heat loss.
- Refractory brick in furnaces for heat retention.
- Syntactic foam insulation.
- Cast polyester products with the warm feel of wood.

Test Parameters

The following report compares 3M™ Scotchlite™ Glass Bubbles K1 and K46, Z-light Spheres™ Ceramic Microspheres W1300, Zeeospheres™ Ceramic Microspheres G400 and W410 and calcium carbonate.

K1 – 0.125 g/cc true density with 30-120 micron size range.

K46 – 0.46 g/cc true density with 15-80 micron size range.

W1300 – 0.7 g/cc true density with 70-350 micron size range.

G400 – 2.4 g/cc true density with 1-24 micron size range.

W410 – 2.4 g/cc true density with 1-24 micron size range.

CaCO₃ – 2.7 g/cc true density with 2-48 micron size range.

RTV silicone and epoxy resins were used for commonality and workability.

General Electric's RTV silicone resin 615A cured with RTV 615B was mixed as follows:

1. Prescribed amount of resin and curing agent weighed and mixed in a 50 ml plastic beaker.
2. Proper amount of filler added and slowly mixed to reduce the air entrained.
3. Mixed material poured to the top of a round dish, 2" dia. x 1/4" deep. Cured overnight before removal.

Shell EPON™ 813 epoxy resin cured with 3072 was prepared in a similar manner to the silicone, but the epoxy/curing agent mix was allowed to thicken before pouring into the dish.

All samples were analyzed with an Anter Corporation Model 2021 Thermal Conductivity apparatus following ASTM-518 protocol.

Results

Test results in the charts on the back page show a linear trend when fillers are added to the resins.

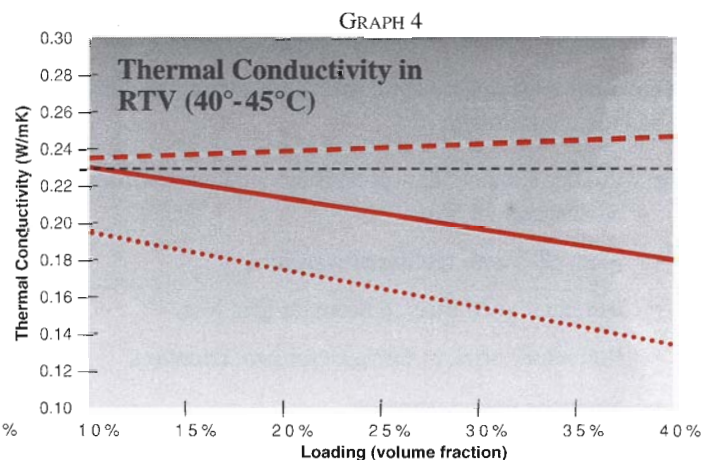
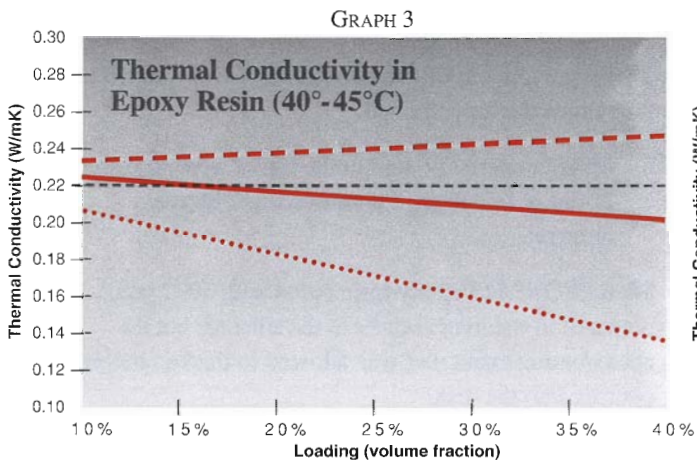
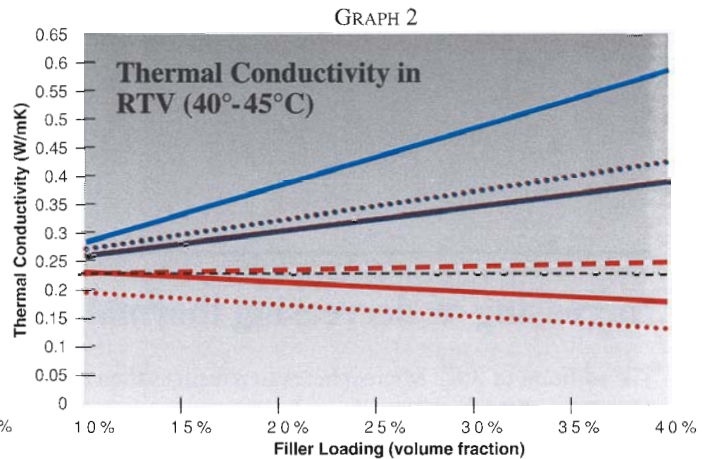
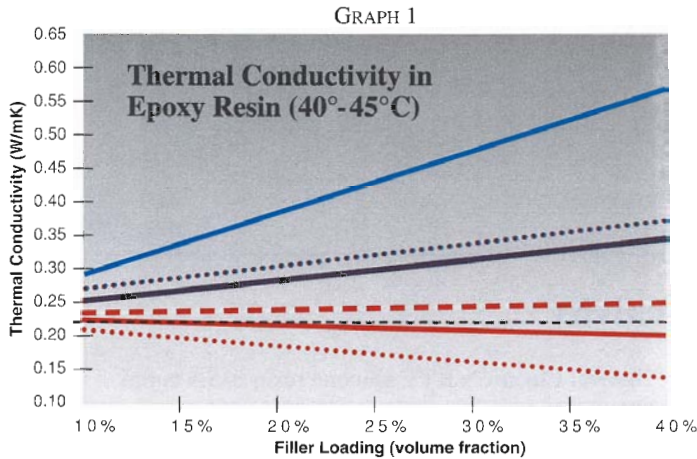
Scotchlite Glass Bubbles reduced the thermal conductivity of both resins. This would be important, for example, in syntactic foam insulation. With Z-Light Spheres Microspheres thermal conductivity increased slightly, but is less than mineral fillers, a characteristic to consider for refractory brick. Zeeospheres Microspheres provide higher thermal conductivity when enhanced heat transfer is preferred.

Results

Graphs one and two illustrate thermal conductivity trends for all materials. Graphs three and four present 3M™ Scotchlite™ Glass Bubbles and Z-light Spheres™ Ceramic Microspheres in greater detail.

Legend

- K1
- K46
- W1300
- G400
- W410
- CaCO₃
- Control (unfilled resin)



For further information or sales assistance, contact 3M Specialty Additives

1-800-367-8905 • Fax 651-736-4133

In Canada, 1-800-410-6880, ext. 6019.

In Puerto Rico, 787-750-3000.

IMPORTANT NOTICE TO PURCHASER: The information in this publication is based on tests 3M believes are reliable. Your results may vary due to differences in test types and conditions. You must evaluate and determine whether the product is suitable for your intended application. In addition, because this material may be used in many applications and under many conditions, all of which are outside of 3M's control. Accordingly, 3M MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF REMEDIES AND LIABILITIES: IF THIS PRODUCT IS PROVEN TO BE DEFECTIVE, THE EXCLUSIVE REMEDY, AT 3M'S OPTION, SHALL BE TO REFUND THE PURCHASE PRICE OF OR REPLACE THE DEFECTIVE PRODUCT. 3M SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE WHETHER THAT DAMAGE IS DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL, REGARDLESS OF THE LEGAL THEORY ASSERTED, INCLUDING NEGLIGENCE, WARRANTY OR STRICT LIABILITY.

3M

Specialty Additives

3M Center Bldg. 220-8E-04
St. Paul, MN 55144-1000



Recycled paper
40% pre-consumer
10% post-consumer

GX223
Printed in USA. Issued 6/98
© 3M 1998 98-0212-0396-7