CABOT

FUMED METAL OXIDES

CAB-O-SIL® ULTRABOND™
FUMED SILICA FOR EPOXY ADHESIVES

Introduction

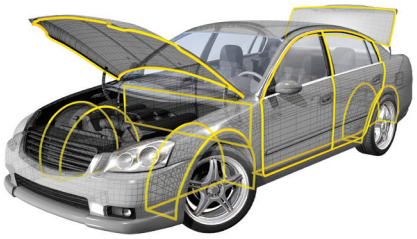
We have a long history of supporting adhesive and sealant manufacturers to meet new performance requirements. Fumed silica provides rheology and reinforcement to adhesive and sealant formulations. Our CAB-O-SIL® fumed silica products meet and exceed the challenging requirements of our global customers. CAB-O-SIL ULTRABOND™ fumed silica sets a new standard of performance for epoxy adhesives when it entered the market.

CAB-O-SIL ULTRABOND fumed silica is our highest performing surface treated fumed silica. Compared to other polydimethylsiloxane (PDMS) treated silicas, CAB-O-SIL ULTRABOND fumed silica improves adhesives systems by reducing the viscosity in the application without compromising sag resistance.

CAB-O-SIL ULTRABOND fumed silica is best suited for epoxy adhesives with loading levels greater than 5% and those that require high sag resistance and excellent storage stability.

Structural adhesives

CAB-O-SIL ULTRABOND fumed silica improves adhesive performance in epoxy formulations for use in a wide range of industries including automotive, aerospace, construction, electronics and flooring.



The transportation industry now requires structural adhesives that can replace traditional welding or riveting to bond two vehicle parts together. The use of structural adhesives in transportation manufacturing has steadily increased over the years, as it offers advantages over classic bonding techniques, including the ability to use lightweight design components with improved mechanical strength. These lightweight components help the transportation industry achieve more aggressive weight-reduction goals and improve vehicle fuel efficiency.

Sag resistance and storage stability

In epoxy resins, CAB-O-SIL ULTRABOND fumed silica provides excellent sag resistance and storage stability compared to other PDMS treated silicas. Figure 1 shows the sag resistance in epoxy resin, as assessed by a yield stress measurement, upon manufacture and after 28 days of accelerated aging at 60 °C. The epoxy resins containing CAB-O-SIL ULTRABOND fumed silica were shown to provide higher yield stress both initially and after aging than epoxies made with competitive PDMS-treated silicas.

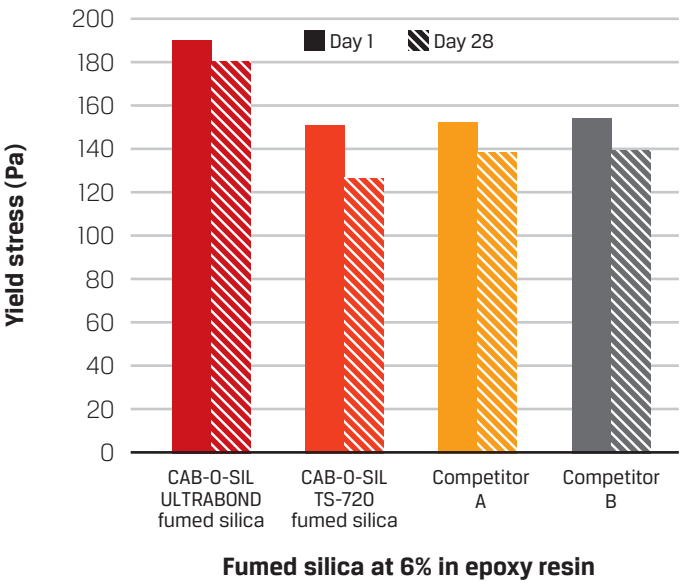


Figure 1: Sag resistance of Hexion EPON 828 epoxy resin containing PDMS-treated fumed silicas after 28 days of accelerated aging at 60 °C

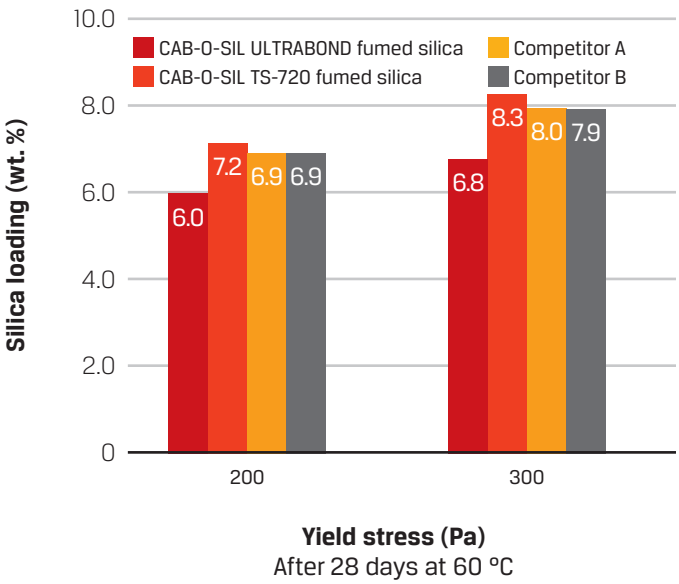


Figure 2: Fumed silica required to achieve a yield stress in epoxy resin

Wind bonding paste, used to manufacture wind blades, is a critical component with strict performance requirements. As a result of collaboration between our adhesives applications development team and wind blade producers, CAB-O-SIL ULTRABOND fumed silica enables significant improvements in sag resistance and storage stability of bonding paste. This enables bonding paste to have an extended shelf life, allowing producers to ship paste to blade manufacturers around the world. CAB-O-SIL ULTRABOND fumed silica can be added to bonding paste at lower loadings, while still maintaining sag resistance and reduced viscosity.

Delivers better performance at lower loading

As shown in Figure 2, instead of the typical fumed silica loading of 8% in epoxy based bonding paste, CAB-O-SIL ULTRABOND fumed silica loading could be reduced by 10 – 15% versus competitive products, while still maintaining the same sag resistance performance. This can effectively reduce the processing time, allowing bonding paste producers to decrease their respective manufacturing costs while increasing their manufacturing capacity.

To generate the data shown in Figure 3, equal amounts of silica were incorporated into an epoxy resin. The relative amount of time to incorporate the competitive silicas was 1.5 times that of ULTRABOND fumed silica. In formulations with high silica loadings, the faster incorporation of ULTRABOND fumed silica can translate into shorter batch times and higher throughput.

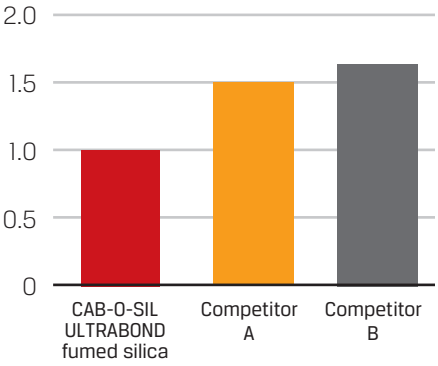


Figure 3: Total relative processing time using fumed silica in epoxy resin

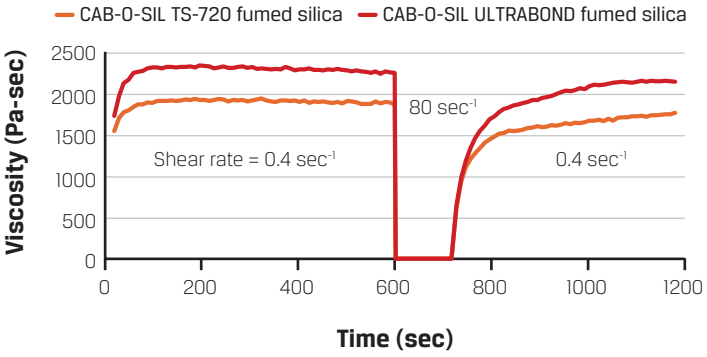
Shear thinning and recovery rate

The thixotropic (shear thinning) behavior imparted by PDMS-treated silica in an epoxy system is important to the adhesive formulator and user. At high shear rates equivalent to those imparted during mixing or bead application, the viscosity decreases, facilitating processing, pumping and dispensing of the adhesive. This is illustrated in Figures 4 and 5.

Following high shear mixing, viscosity recovers quickly to comparable levels exhibited by the formulation prior to high shear. During use, this can prevent an adhesive bead from slumping or sagging and fillers from settling.

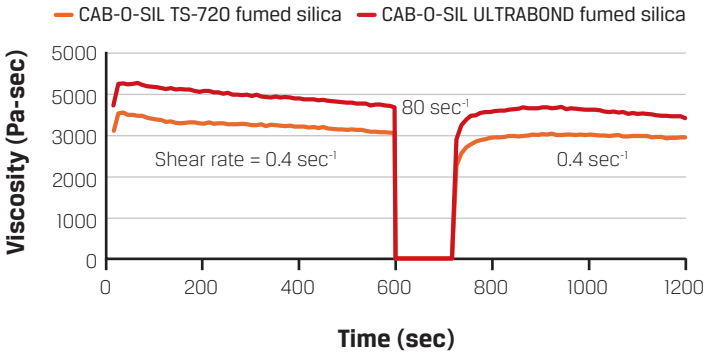
CAB-O-SIL ULTRABOND fumed silica imparts higher viscosity than CAB-O-SIL TS-720 fumed silica, our other leading PDMS-treated silica, yet is equally shear thinning and provides a faster rate of viscosity recovery.

Viscosity of epoxy adhesives



8% silica by weight in Hexion EPON® 828 epoxy resin mixed with Air Products and Chemicals, Inc. Ancamide® 351A curing agent (52 parts curative to 100 parts resin)

Figure 4: Shear thinning behavior of epoxy resin and polyamide curing agent at 5.4% silica loading



8% silica by weight in Hexion EPON 828 epoxy resin mixed with Huntsman Performance Products Jeffamine® D-230 curing agent (32 parts curative to 100 parts resin)

Figure 5: Shear thinning behavior of epoxy resin and polyetheramine curing agent at 6.2% silica loading

NORTH AMERICA
Cabot Corporation Business and Technical Center
157 Concord Road
Billerica, MA 01821
USA
T: +978 663 3455
F: +978 663 5471
T: +678 297 1300 (Customer service)

SOUTH AMERICA
Cabot Brasil Industria e Comericio Ltda.
Rua do Paraiso 148 - 5 andar
04103-000 Sao Paolo,
SP Brazil
T: +55 11 2144 6400
F: +55 11 3253 0051

EUROPE
SIA Cabot Latvia
101 Mukusalas Street
Riga, LV-1004,
LATVIA
T: +371 6705 0984
T: +371 6705 0900
F: +371 6705 0985

MIDDLE EAST & AFRICA
Cabot Dubai
P.O. Box 17894
Jebel Ali Free Zone
LOB 15, Office 424
Dubai
United Arab Emirates
T: +971 4 8871800
F: +971 4 8871801

ASIA PACIFIC
Cabot China Ltd.
558 Shuangbai Road
Shanghai 201108
China
T: +86 21 5175 8800
F: +86 21 6434 5532

JAPAN
Cabot Specialty Chemicals Inc.
Sumitomo Shiba-Daimon Bldg. 3F
2-5-5 Shiba Daimon,
Minato-ku
Tokyo 105-0012
Japan
T: +81 3 6820 0255
F: +81 3 5425 4500

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