

FUMED METAL OXIDES

# **CAB-O-SIL® PDMS-TREATED FUMED SILICAS** FOR ADHESIVES AND SEALANTS



**CABOT** 

## Introduction

Cabot Corporation has 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® polydimethylsiloxane (PDMS)-treated fumed silica products meet and exceed the challenging requirements of our global customers.

CAB-O-SIL PDMS-treated fumed silicas are our highest performing surface treated fumed silicas. These products improve adhesive systems by reducing the viscosity in the application without compromising sag resistance. The product line currently includes CAB-O-SIL TS-720, ULTRABOND™ and ULTRABOND 5780 fumed silicas.

CAB-O-SIL PDMS-treated fumed silicas improve adhesive performance in epoxy formulations for use in a wide range of industries including automotive, aerospace, construction, electronics and flooring.



## Rheology control

CAB-O-SIL® PDMS-treated fumed silicas provide rheology control to adhesive and sealant formulations that enable critical functionalities for end-products.

### Sag resistance and storage stability

In epoxy resins, CAB-O-SIL PDMS-treated fumed silicas provide 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 fumed silicas were shown to provide higher yield stress both initially and after aging than epoxies made with competitive PDMS-treated silicas.

### 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.

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.

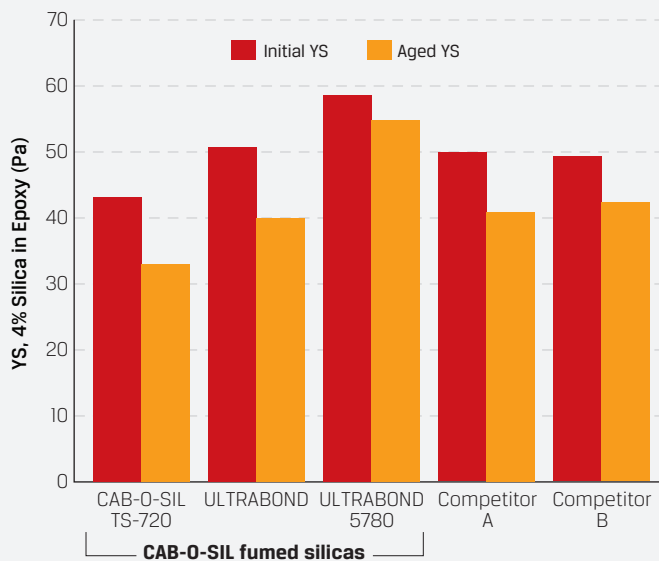
CAB-O-SIL ULTRABOND™ and ULTRABOND 5780 fumed silicas impart higher viscosity than CAB-O-SIL TS-720 fumed silica, yet are equally shear thinning and provide a faster rate of viscosity recovery.

### Adhesion on oily substrates

In comparison with other PDMS-treated silica grades, CAB-O-SIL ULTRABOND 5780 fumed silica enables superior adhesion performance of epoxy adhesives on oily substrates, allowing bonded joints to withstand stronger mechanical forces.

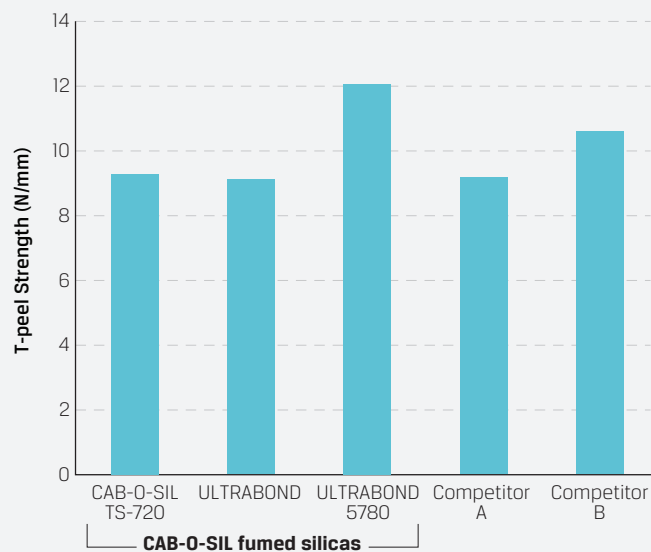
**Figure 2** shows the T-Peel strength of a model crash durable adhesive (CDA) formulation containing CAB-O-SIL PDMS-treated fumed silicas and two competitive grades after curing by heat. CAB-O-SIL ULTRABOND 5780 fumed silica performed consistently, resulting in higher bond strength of the cured adhesive on various grades of oily steel substrates, such as CRS and HDG (Hot-Dip Galvanized) cold rolled steel (CRS) and hot-dip galvanized (HDG) steel.

**Figure 1:** Yield stress and aging of treated silicas in epoxy



Yield stress is measured upon formulation, and after 28 days of accelerated aging at 60 °C. Silica loading is 4wt% in EPON™ 828 epoxy resin.

**Figure 2:** T-Peel tests on oily CRS steel substrate in a model 1K epoxy CDA formulation



T-Peel adhesion test (ASTM D1876) on cold rolled steel (CRS). All substrates are coated with Quaker FERROCOTE 61 A US oil at a loading of 5.5±0.5 g/m². Adhesive thickness: 0.2-0.3mm.

## Applications

### Transportation

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.

### Wind energy

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 viscosity.



### Automotive Applications

In Crash-Durable Adhesives (CDA) used in Original Equipment Manufacturers' (OEM) automotive production lines, CAB-O-SIL ULTRABOND 5780 fumed silica allows for stronger bonding of epoxy structural adhesives to lubricated or oily metal substrates (steel, aluminum, and other materials). CAB-O-SIL TS-720 fumed silica is Cabot's most widely adopted solution currently for rheology control in crash durable structural adhesives formulations.

These products promote high sag resistance and high wash-off resistance in uncured structural adhesives on automotive body-in-white (BIW), helping the adhesives to withstand aggressive substrate cleaning, pretreatment and e-coat conditions used at automotive OEM body shops.

### Construction

In construction applications, including chemical anchoring adhesives, PDMS-treated fumed silicas are used for anti-settling of fillers during storage of highly filled adhesive systems. The higher aged yield stress they impart also enables a lower fumed silica loading level in an adhesive or sealant formulation.

Our ULTRABOND products provide high sag resistance during application on vertical surfaces. This high sag resistance they enable can allow for a reduced fumed silica loading, meaning formulators can achieve desired sag resistance performance at a lower viscosity.

For more information on how Cabot's PDMS-treated fumed silicas can improve the performance of adhesive and sealant formulations **Cabot sales representative** or visit **[cabotcorp.com/adhesives](http://cabotcorp.com/adhesives)**.

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