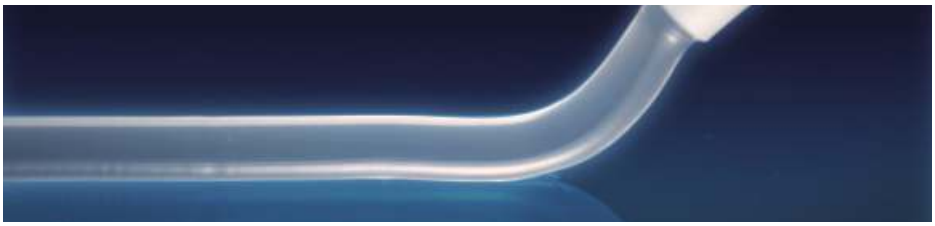
FUMED METAL OXIDES

CABOT
creating what matters

CAB-O-SIL® TS-622 Treated Fumed Silica for Silicone Sealants

Introduction



CAB-O-SIL® TS-622 treated fumed silica

CAB-O-SIL® TS-622 is a high-purity, fumed (pyrogenic) synthetic amorphous silicon dioxide which has been surface-modified with dimethyldichlorosilane. The BET surface area of the base silica is 220 m^2/g before treatment. The treatment renders it hydrophobic, with very different properties than untreated (hydrophilic) fumed silica. This product was designed to be used as a reinforcing filler for RTV-1 silicone sealants. CAB-O-SIL TS-622 provides:

Compatibility with silicone polymer for
- **Faster wet-in or incorporation**
- **Better dispersion**
- **Good sealant surface smoothness and appearance**

Low adsorbed moisture for
- **Longer sealant shelf-life**
- **Reduced cross-linker requirement**

Higher silica surface area for
- **Good reinforcement at lower silica loading**
- **Increased transparency of clear sealants**

Benefits In RTV-1 Silicone Sealants

The surface treatment enables the formulator to use fumed silica with higher BET surface area than would otherwise be possible.

The relatively high BET surface area of TS-622:
- Enables the formulator to achieve higher reinforcement at constant loading, or
- Enables the formulator to achieve equivalent reinforcement with less silica.
- Allows production of sealants which exhibit better color and haze.

The compatibility of the surface treatment with silicone polymers:
- Enables TS-622 to wet-in and incorporate faster than untreated silica with the same surface area.
- Enables TS-622 to disperse better than untreated silica with the same surface area.
- Enables sealant made with TS-622 to exhibit good surface appearance.

The surface treatment makes the fumed silica hydrophobic which means:
- TS-622 adsorbs less moisture.
- Sealant made with TS-622 requires less cross-linker.
- Sealant made with TS-622 exhibits longer shelf-life.

The properties of sealants made with TS-622:
- Exhibit a maximum in reinforcement.
- Are more robust to the natural variation in BET Surface Area

CAB-O-SIL® TS-622 treated fumed silica

Application Guide

Focus on RTV-1 Silicone Sealants

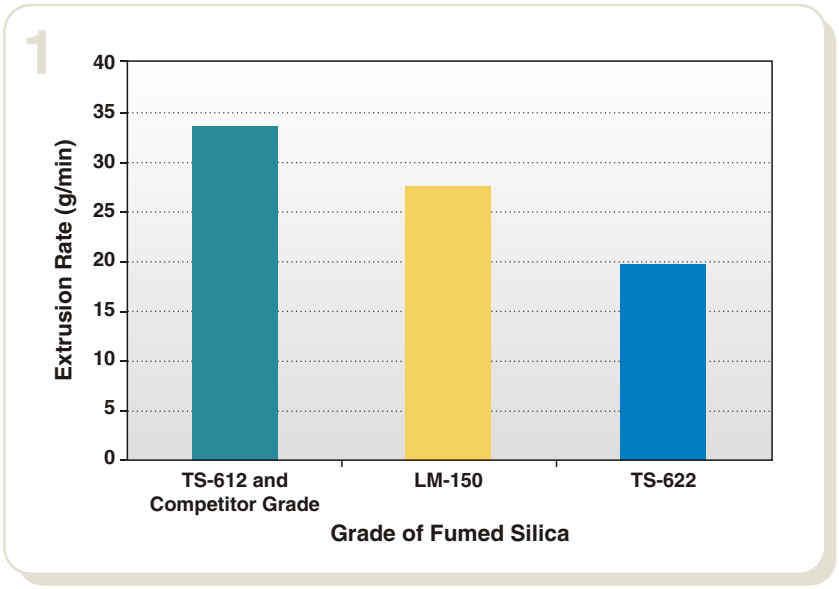


Figure 1.

Extrusion Rate vs. Grade of Fumed Silica for 9.3% w/w fumed silica in an acetoxy silicone sealant. CAB-O-SIL® TS-612 (130 m^2/g), Competitor Grade (130 m^2/g) and TS-622 (220 m^2/g) are treated with dimethyldichlorosilane. LM-150 (150 m^2/g) is untreated (hydrophilic). The BET surface areas of the silicas before treatment are given in parentheses after each grade.

Analysis

In RTV-1 silicone sealants, extrusion rate is a critical measure of reinforcement. The lower the extrusion rate, the greater the reinforcement. In Figure 1, the BET surface area of the grades increases from left to right. The data show that as the BET surface area increases, the extrusion rate decreases and the reinforcement increases. TS-622 exhibits approximately 20% greater reinforcement than LM-150.

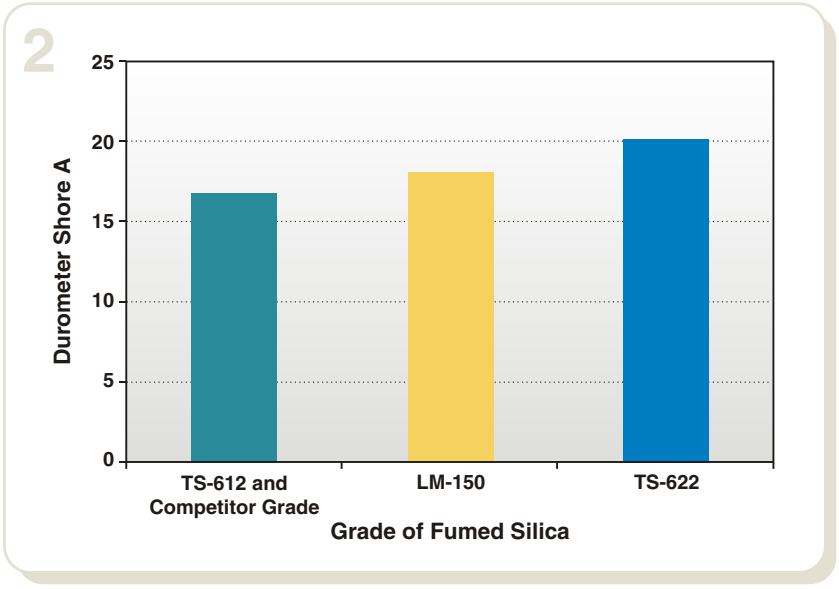


Figure 2.

Hardness (Shore A Durometer) vs. Grade of Fumed Silica for 9.3% w/w fumed silica in an acetoxy silicone sealant. CAB-O-SIL® TS-612 (130 m^2/g), Competitor Grade (130 m^2/g) and TS-622 (220 m^2/g) are treated with dimethyldichlorosilane. LM-150 (150 m^2/g) is untreated (hydrophilic). The BET surface areas of the silicas before treatment are given in parentheses after each grade.

Analysis

In RTV-1 silicone sealants, Hardness as measured by Shore A Durometer is a critical measure of reinforcement of the cured sealant. The greater the value, the greater the reinforcement. In Figure 2 the BET surface area of the grades increases from left to right. The data show that as the BET surface area increases, the Hardness or reinforcement increases. TS-622 exhibits approximately 15% greater hardness than LM-150. At the silica loading used in this example, approximately 20% less TS-622 was required to match the hardness achieved with LM-150.

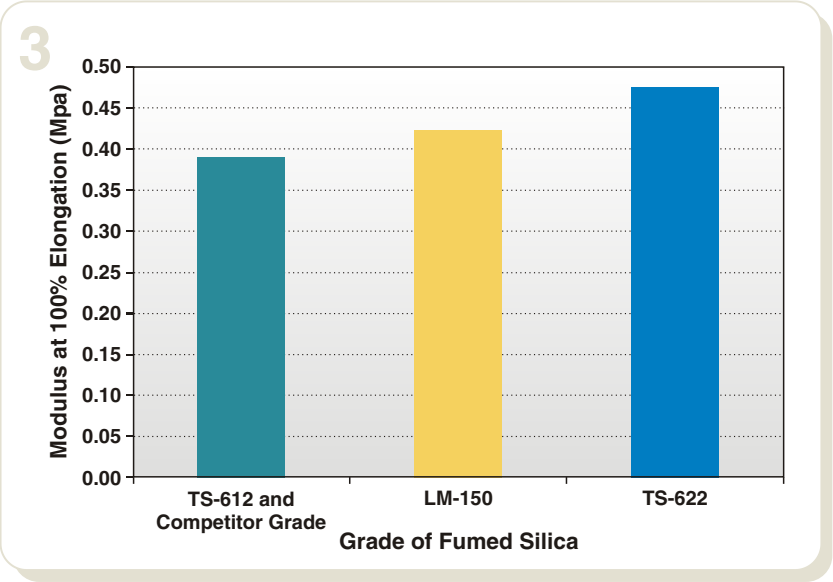


Figure 3.

Modulus at 100% Elongation vs. Grade of Fumed Silica for 9.3% w/w fumed silica in an acetoxy silicone sealant. CAB-O-SIL® TS-612 (130 m^2/g), Competitor Grade (130 m^2/g) and TS-622 (220 m^2/g) are treated with dimethyldichlorosilane. LM-150 (150 m^2/g) is untreated (hydrophilic). The BET surface areas of the silicas before treatment are given in parentheses after each grade.

Analysis

In RTV-1 silicone sealants, Modulus is an additional measure of reinforcement. The greater the value, the greater the reinforcement. In Figures 3 the BET surface area of the grades increases from left to right. Again, the data show that as the BET surface area increases, Modulus increases and, thus, reinforcement increases.

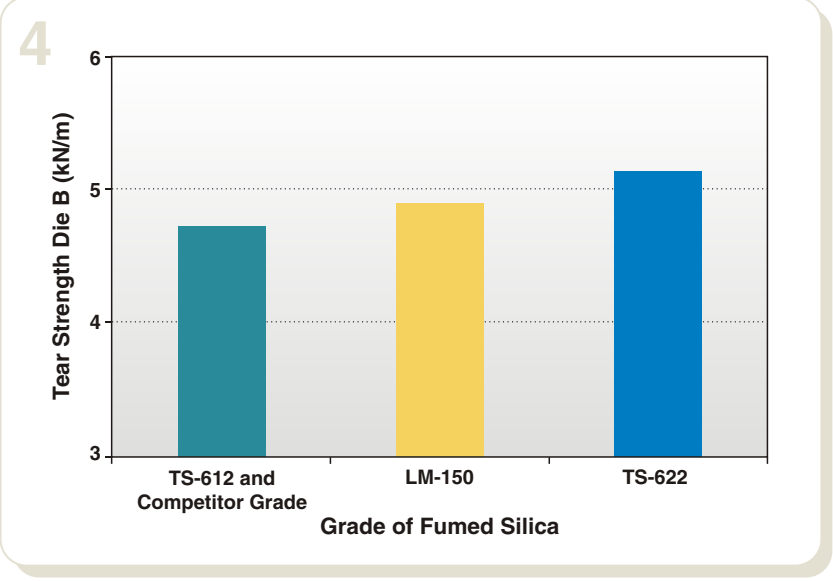


Figure 4.

Tear Strength Die B vs. Grade of Fumed Silica for 9.3% w/w fumed silica in an acetoxy silicone sealant. CAB-O-SIL® TS-612 (130 m^2/g), Competitor Grade (130 m^2/g) and TS-622 (220 m^2/g) are treated with dimethyldichlorosilane. LM-150 (150 m^2/g) is untreated (hydrophilic). The BET surface areas of the silicas before treatment are given in parentheses after each grade.

Analysis

In RTV-1 silicone sealants, Tear Strength is an additional measure of reinforcement. The greater the value, the greater the reinforcement. In Figure 4 the BET surface area of the grades increases from left to right. Again, the data show that as the BET surface area increases, Tear Strength increases and, thus, reinforcement increases.

Analysis of Figures 1 - 4

The data show that as the BET surface area increases, the mechanical properties and, thus, reinforcement increase. Again, these figures illustrate the universal observation that the properties of the sealant are predominantly a function of the BET surface area. The primary function of the treatment is to improve wet-in and dispersion. In other words, treatment enables a compounder to capture the benefits of fumed silica with higher BET.

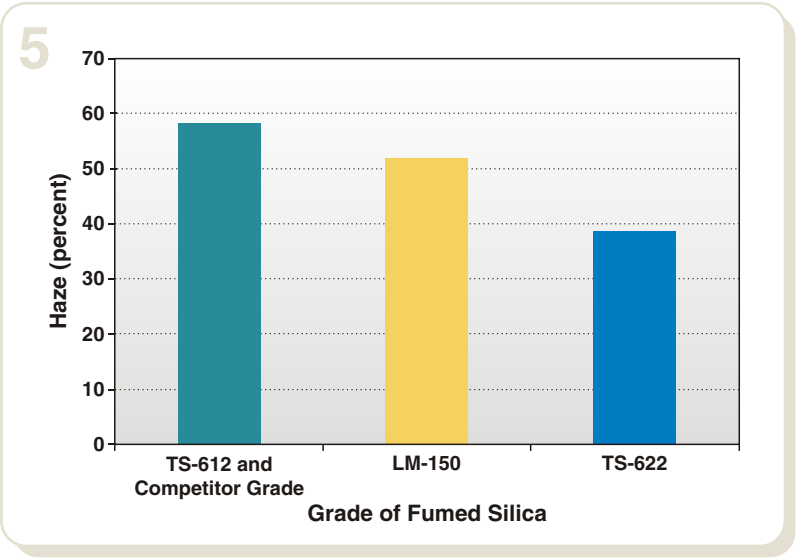


Figure 5.

Haze vs. Grade of Fumed Silica for 9.3% w/w fumed silica in an acetoxy silicone sealant. CAB-O-SIL® TS-612 (130 m^2/g), Competitor Grade (130 m^2/g) and TS-622 (220 m^2/g) are treated with dimethyldichlorosilane. LM-150 (150 m^2/g) is untreated (hydrophilic). The BET surface areas of the silicas before treatment are given in parentheses after each grade.
Haze equals the amount of diffuse light transmitted through the sample divided by the total light transmitted through the sample expressed as a percentage. As the Haze decreases, the transparency increases. The test as run is similar to ASTM D1003 but the results do not conform exactly because of differences in the geometry of the colorimeter used in this study.

Analysis

In clear RTV-1 silicone sealants, transparency is extremely important. In Figure 5, the BET surface area of the grades increases from left to right. As the BET surface area increases, the diameter of the primary particles decreases. One would expect that transparency would increase and, conversely, that Haze would decrease as the primary particle size decreases. This expectation is based on the assumption that the fumed silica can be adequately dispersed during mixing. Indeed, Figure 5 shows that the Haze decreases significantly as the BET surface area increases. This is further evidence that the treatment improves wet-in and dispersion of the fumed silica.

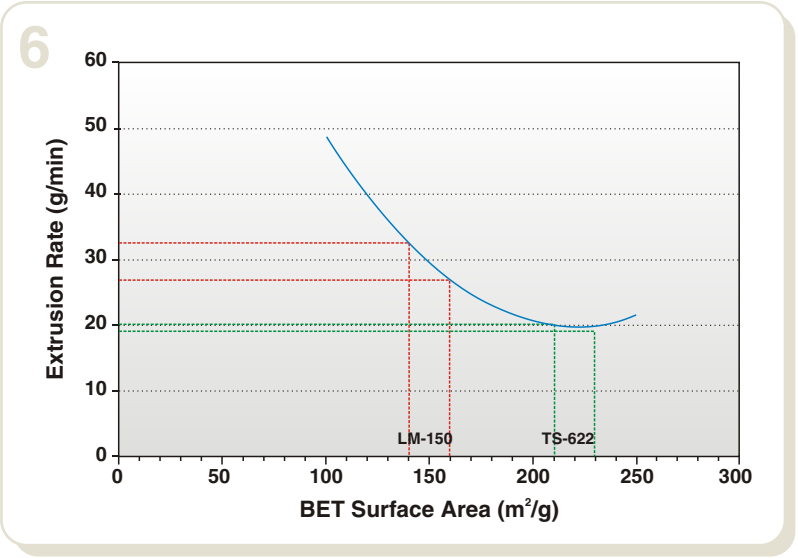


Figure 6.

Extrusion Rate vs. BET Surface Area for 9.3% w/w fumed silica in an acetoxy silicone sealant. Analysis of all the fumed silicas examined in this study shows that there is a maximum of reinforcement (a minimum in Extrusion Rate) at approximately 220 m^2/g. Figure 6 illustrates how variation in BET surface area would transmit into variation in Extrusion Rate for two fumed silicas with different target BET surface areas: 150 m^2/g and 220 m^2/g.

Analysis

As in all manufacturing operations, there is some variation around the target surface area during the production of fumed silica. Figure 6 illustrates that the effects of this natural variation in BET surface area will be minimized when reinforcement is maximized. A variation of ±10 m^2/g around 150 m^2/g results in a variation of 6 g/min in the Extrusion Rate as shown in red. However, the same variation of ±10 m^2/g around 220 m^2/g (TS-622), which corresponds to the maximum in reinforcement, results in a variation of only 1 g/min in the Extrusion Rate as shown in green in this illustration. Of course, this analysis accounts for the variation due to BET surface area only and does not take into account the variation due to the test itself. Figure 6 is simply intended to illustrate the improvement in Robustness that is possible by using TS-622. Similar response curves were observed for mechanical properties which implies that overall improvements in Robustness are possible by using TS-622.

Summary

By virtue of its treatment, TS-622 enables the formulator to use fumed silica with higher BET surface area than otherwise possible. The formulator can achieve greater reinforcement at constant loading or equivalent reinforcement at reduced loading. TS-622 exhibits faster wet-in and dispersion. Sealant made with TS-622 exhibits improved color and haze and the mechanical properties are more robust to natural variation in BET surface Area.

Cabot in the World

With business extending over 20 countries, Cabot has 6 fumed metal oxides manufacturing facilities in the world, besides research and development facilities focused in developing new products and technology and bringing new solutions to our customers.

Technical Centers:

- Billerica, MA - USA
- Rheinfelden - Germany
- Shanghai - China

Addresses

EUROPE
Cabot
Interleuvenlaan, 15 i
B - 3001 Leuven - Belgium
Tel.: +32 16 39 24 00
Fax: +32 16 39 24 44

NORTH AMERICA
Cabot Corporation
Business and Technical Center
157 Concord Road
Billerica, MA 01821-7001 - USA
Tel.: +1 978 663 3455
Technical Service:
Tel.: 800 462 2313
Fax: +1 978 670 7035
Customer Service:
Tel.: 800 526 7591

SOUTH AMERICA
Cabot Latin America Division
Rua do Paraíso, 148 - 5th floor
Paraíso CEP 04103-000
São Paulo - SP - Brazil
Tel.: +55 11 2144 6400
Fax: +55 11 3253 0051
Customer Service:
Tel.: 0800 195959

MIDDLE EAST/AFRICA
Cabot Specialty Chem. Inc.
Jebel Ali Free Zone
LOB 15, Office 424
Dubai - United Arab Emirates
Tel.: +971 4 8871 800
Fax: +971 4 8871 801

PACIFIC/ASIA
Cabot Specialty Chemicals, Inc.
Level 21, Etiqa Twins Tower 2
11, Jalan Pinang
50450 Kuala Lumpur - Malaysia
Tel.: +60 3 2096 3888
Fax: +60 3 2162 0253

CHINA
Cabot (China) Limited
558 Shuangbai Lu
Wujing Shanghai,
201108 - China
Tel.: +86 21 5175 8800
Fax: +86 21 6434 5532

JAPAN
Sumitomo Shiba-Daimon Bldg. 11F
2-5-5 Shiba Daimon, Minato-ku
Tokyo, 105-0012 - Japan
Tel.: +81 3 6820 0255
Fax: +81 3 5425 4500

FMO/LIT:SSEAL/06.08/ING

www.cabot-corp.com/fmo
CAB-O-SIL® is a registered trademark of Cabot Corporation.

CABOT
creating what matters