Coating Surface & Interface Modifying Additives
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Surface Modifying Additives

Coating layer
Substrate

- Leveling ability
- Defoaming property
- Antiblocking property
- Hydrophilicity
- Water-slippability
- Release property
- Anti-flooding
- Scratch resistance
- Sliding property
- Hammertone
- Anti-corrosion property
- Adhesion
- Abrasion resistance
- Water repellency
- Oil repellency
- Antistatic property
- Light resistance
- Wettabiliy

Interface Modifying Additives (Coating layers × substrates)

- Adhesion
- Adjusting adhesion

Interface Modifying Additives (Coating agents × fillers)

Coating agent
Filler

- Adhesion
- Dispersibility
What is the KP Series?

**Features**

1. **Surface free energy: Low**
   - Silicone moves easily to the surface to effectively improve the surface of resins and coatings.
2. **The unique performance of dimethyl polysiloxane structure**
   - With their ② low surface tension, ③ anti-fouling properties, and ④ slickness, these products can be used to impart a variety of characteristics.

**Low surface tension**

Silicone fluids have very low surface tension.

<table>
<thead>
<tr>
<th>Types of liquid</th>
<th>Surface tension 25°C mN/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimethyl silicone KF-96</td>
<td>21</td>
</tr>
<tr>
<td>Toluene</td>
<td>28</td>
</tr>
<tr>
<td>Mineral oil</td>
<td>30</td>
</tr>
<tr>
<td>Glycerin</td>
<td>63</td>
</tr>
<tr>
<td>Water</td>
<td>72</td>
</tr>
</tbody>
</table>

**Anti-fouling property**

- Anti-fouling
- Hammertone
- Wettability
- Leveling ability
- Defoaming property
- Water repellency
- Oil repellency
- Water-slippability
- Antifouling property
- Scratch resistance
- Sliding property
- Abrasion resistance

**Slip property**

Customization

1. The strength of the product’s properties and its compatibility with particular resins can be altered by changing the length of the siloxane main chains.
2. Compatibility and reactivity can be controlled by introducing various functional groups.
   - Product can be customized to make it an ideal additive for the user’s resin composition.

**Relationship between siloxane chain length and expressed properties & compatibility**

- **Main Chain Length of Siloxane**
  - Low
  - Medium
  - High

- **Defoaming property**
  - Defoaming property
  - Slip property
  - Anti-fouling property

- **Compatibility (Cissing)**
  - Good
  - Bad

- **Imparting functional groups and its effect**
  - Polyether (compatibility, water solubility, recoatability), Polyol (hydrophilicity, high polarity) Acrylic (compatibility with acrylic resins), Fatty acid ester (compatibility with alkyl resins) Phenyl (compatibility, heat resistance), Fluorine (activity in presence of aromatic solvents) Alkyl (lipophilicity), Aralkyl (heat resistance, lipophilicity), Polyester (compatibility with polyester resins)
KP Series Selection Guide, Arranged by Purpose

For Solvent-based Paints

Polyester Paints
- KP-626
- KP-624

Epoxy Paints
- KP-323
- KP-322

Alkyd Paints
- KP-625
- KP-623
- KP-624

Cellulose Paints
- KP-104
- KP-105
- KP-625

For Water-based Paints

For Alcohol-based Paints

Improved Leveling Ability
- KP-124
- KP-106

All-round Product
- KP-341

Imparting Anti-cissing Property
- KP-120

Standard Products
- KP-110
- KP-106
- KP-104 *

Imparting Antiforming Property
- Additional amount
- KP-650

Imparting Anti-cissing Property
- KP-120

Imparting Anti-cissing Property
- Additional amount
- KP-650

Increase Slip Property
- KP-109

Reduce Slip Property
- KP-624
- KP-106

Improve Releasability
- KP-369, KP-368
  (For Urethanes)
- KP-611 (For Acrylics)

Improved Releasability
- KP-125
- KP-101
- KP-104

Improved Leveling Ability
- KP-301
- KP-369
- KP-623
- KP-322
- KP-327
- KP-625

Improved Anti-cissing Property*
(Completely Eliminates Fine Cissing)
- KP-611
- KP-120
- KP-620

*To eliminate cissing, first try adding a smaller amount of product.

* KP-104: Works especially well with water-soluble resins such as Polyvinyl Alcohol.

*This map is offered as a guide for product selection.
Features
- Functional groups are meth(acrylate) groups.
- Can be added to films and radical-cure coating agents.
- Reactive and imparts long-lasting properties.

3 product types and conceptual modification diagrams
Three types are available, depending on the position of the functional groups: end-functionalized, double end-functionalized, and side-chain-functionalized. Each type will impart different properties, so the user can select the right product for the intended purpose.

Ranking of features and compatibility
Long silicones (high molecular weight): Silicone characteristics imparted more effectively to the surface. Short silicones (low molecular weight): Better miscibility with resins.

Features of KP-423
Good compatibility despite the fact that the silicone chains are relatively long.
Benefits:
1. Good reactivity, characteristics can be imparted effectively.
2. Improved transparency.

Conceptual modification diagrams
Groups introduced that improve compatibility

X : (meth)acrylic groups
KY-1203: Fluorinated anti-fouling agent with radical curable groups

■General Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Product name</th>
<th>KY-1203</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td>Transparent to pale yellow</td>
</tr>
<tr>
<td>Viscosity at 25°C mm/s</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td>Specific gravity at 25°C</td>
<td></td>
<td>0.88</td>
</tr>
<tr>
<td>Active ingredient wt%</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Solvent</td>
<td></td>
<td>MEK, MIBK</td>
</tr>
</tbody>
</table>

■Properties (Hard coated surface)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No addition</th>
<th>KY-1203 added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water contact angle</td>
<td>59°</td>
<td>114°</td>
</tr>
<tr>
<td>Oleic acid contact angle</td>
<td>22°</td>
<td>73°</td>
</tr>
<tr>
<td>Oleic acid sliding angle</td>
<td>Not measurable</td>
<td>3°</td>
</tr>
<tr>
<td>Dynamic friction coefficient</td>
<td>0.6</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Application example (14% addition based on solid)
Hard coating: EBCRYL 40 (made by DIAGEC ALLNEX Ltd) …… 100 parts
Thinner: 2-propanol ………………………………………………………………………………………………………………………………... 142 parts
Initiator: RIGACURE 184 (BASF Japan Ltd) …………….. 3 parts
Additive: KY-1203 ……………………………………………………………………………………………………………………………………………………... 5 parts
Substrate: Polycarbonate panel
Coating condition: Spin coating: 500 rpm × 10 sec + 3,000 rpm × 20 sec
Preliminary drying: 80 °C × 1 min
Curing apparatus: UV light (metal halide lamp) conveyor system
Irradiation condition: N2 atmosphere, lamp capacity 80 W/cm, accumulated power 1,600 mJ/cm²

■Function mechanism of anti-fouling additives

Mixing small amounts of anti-fouling additive into hard coating.

Additive dissolves in coating solution.

Distribution on the outer surface by coating and drying.

Fluorinated chain is fixed on the outer surface

■Application process

Acrylic hard coating surface including anti-smudge additive

KP-983: Water repellency & slippability improver

■Features

- KP-983 is a water repellency & water-slippability improver.
- Add 1–2% KP-983 to a coating agent to produce a coating with water-slippability.
- Active ingredient: 100% silicone

■Water repellency test

Adding to silicone oligomer type coating (Adding amount) silicone oligomer type coating (KR-400) : KP-983 = 100 wt. part : 1 wt. part

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before adding</th>
<th>After adding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water contact angle*</td>
<td>82</td>
<td>103</td>
</tr>
<tr>
<td>Water drop angle**</td>
<td>51</td>
<td>9</td>
</tr>
</tbody>
</table>

* Water droplet volume 2μl  ** Water droplet volume 20μl

Add 1–2% to coating agents.

Excellent water repellency

Excellent water-slippability
X-40-2450: Anti-static property improver

X-40-2450 is a silicone oligomer created through the silicone modification of an ionic liquid. When added in small amounts to resins, X-40-2450 migrates easily to the coating surface, improving its heat resistance, and provides long-lasting antistatic properties.

### General Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>X-40-2450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form of silicone</td>
<td>Siloxane</td>
</tr>
<tr>
<td>Appearance</td>
<td>Colorless transparent liquid</td>
</tr>
<tr>
<td>Non-volatile content</td>
<td>%</td>
</tr>
<tr>
<td>Viscosity 25℃</td>
<td>mm²/s</td>
</tr>
<tr>
<td>Specific gravity 25℃</td>
<td></td>
</tr>
<tr>
<td>Solvent</td>
<td>Methyl ethyl ketone</td>
</tr>
<tr>
<td>TSCA</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

### Structural Model

![Structural Model of X-40-2450]

### Comparison of Antistatic Properties

- **Treated**
- **Untreated**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Treated</th>
<th>Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>4 x 10¹⁰</td>
<td>&gt; 10¹⁵</td>
</tr>
<tr>
<td>After wipping test¹</td>
<td>1 x 10¹¹</td>
<td>&gt; 10¹⁵</td>
</tr>
<tr>
<td>After immersion test in water²</td>
<td>3 x 10¹¹</td>
<td>&gt; 10¹⁵</td>
</tr>
<tr>
<td>After heating test²</td>
<td>8 x 10¹⁰</td>
<td>&gt; 10¹⁵</td>
</tr>
</tbody>
</table>

(Not specified values)

### Mechanism of Silicone Action

![Mechanism of Silicone Action]

### Resulting Properties

- Excellent antistatic agent
- Improving releasability

### Antistatic Properties Test Result

<table>
<thead>
<tr>
<th>Parameter</th>
<th>X-40-2450</th>
<th>Ionic liquid¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface resistivity²</td>
<td>Initial</td>
<td>4 x 10¹⁰</td>
</tr>
<tr>
<td></td>
<td>After wipping test¹</td>
<td>1 x 10¹¹</td>
</tr>
<tr>
<td></td>
<td>After immersion test in water²</td>
<td>3 x 10¹¹</td>
</tr>
<tr>
<td></td>
<td>After heating test²</td>
<td>8 x 10¹⁰</td>
</tr>
</tbody>
</table>

(Not specified values)

### TMPS-E: Light-resistance improver

TMPS-E is a silane coupling agent that contains photostabilizing groups. TMPS-E neutralizes free radicals formed through exposure to light, thus protecting resins against degradation.

### Resulting Properties

- Improves UV resistance
- Improves adhesion

### General Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TMPS-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 25℃</td>
<td>8.0</td>
</tr>
<tr>
<td>Specific gravity 25℃</td>
<td>0.95</td>
</tr>
<tr>
<td>Refractive index 25℃</td>
<td>1.44</td>
</tr>
<tr>
<td>Active ingredient</td>
<td>%</td>
</tr>
<tr>
<td>TSCA</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

(Not specified values)

### Chemical Structure of TMPS-E

![Chemical Structure of TMPS-E]

### Reaction Mechanism

![Reaction Mechanism]

### Glass Adhesion Test Data / Epoxy Resin Interface

<table>
<thead>
<tr>
<th></th>
<th>Untreated</th>
<th>KBM-403</th>
<th>TMPS-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfacial shear strength (Relative value)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>80</td>
<td>100</td>
<td>160</td>
</tr>
<tr>
<td>KBM-403</td>
<td>100</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>TMPS-E</td>
<td>100</td>
<td>150</td>
<td>160</td>
</tr>
</tbody>
</table>
KP-912, KP-913, KP-914: Hydrophilicity improvers

KP-912, KP-913 and KP-914 are silicone oligomers that contain alkoxyxsilyl groups. When mixed with water, alkoxyxsilyl groups hydrolyze to form hydrophilic silanols groups, properties which allow these products to function as antifouling agents in paints for construction materials. KP-913 shows its hydrophilic properties earlier.

### General Properties

<table>
<thead>
<tr>
<th>Product name</th>
<th>Alkoxy Groups</th>
<th>Viscosity at 25°C mm²/s</th>
<th>Refractive index at 25°C</th>
<th>Alkoxy group content wt%</th>
<th>TSCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP-912</td>
<td>Methoxy / Ethoxy</td>
<td>12</td>
<td>1.414</td>
<td>50</td>
<td>Not Listed</td>
</tr>
<tr>
<td>KP-913</td>
<td>Methoxy</td>
<td>350</td>
<td>1.448</td>
<td>9.5</td>
<td>Not Listed</td>
</tr>
<tr>
<td>KP-914</td>
<td>Methoxy / Ethoxy</td>
<td>20</td>
<td>1.418</td>
<td>50</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

### Antifouling Mechanism

![Antifouling Mechanism Diagram]

### Hydrophilicity of Coatings with Added Oligomers

![Hydrophilicity Graph]

- **Test conditions:** Fluoropolymer paint with 5 phr of oligomer
- Water contact angle measured after immersion for 16 h in 2.5% sulfuric acid solution.

### X-12-1214A: Anti-rust property improver

X-12-1214A contains a common corrosion inhibitor (benzotriazole) plus an alkoxyxsilyl group. As a result of improved adhesion to metals, X-12-1214A helps ensure long-lasting protection against corrosion.

### Resulting Properties

- Protects metal against corrosion (Especially for copper, silver and aluminum)
- Improving metal adhesion

### General Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>X-12-1214A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 25°C mm²/s</td>
<td>170</td>
</tr>
<tr>
<td>Active ingredient %</td>
<td>100</td>
</tr>
<tr>
<td>TSCA</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

(Not specified values)

### Chemical Structure of X-12-1214A

![Chemical Structure Diagram]

### Anti Rust Treatment on Copper plates

**<Specimen preparation>**

1. Copper plate is cleaned to remove sulfur and washed with water.
2. Plate is immersed in a 1 wt% solution of benzotriazole or a silane coupling agent for 5 min.
3. Drying

### Heat Resistance Test

1. Plate was left in a constant temperature chamber at 150°C for 5 hours.
2. Copper plate surface was observed.

### Sulfide Corrosion Test

1. Plates were immersed in a 100 ppm Na₂S aqueous solution for 5 min.
2. After drying, plate surface was observed.

*BT: benzotriazole
What are silane coupling agents?

In a silane coupling agent, the molecules are functionalized with groups that bond with organic materials and groups that bond with inorganic materials. Silane coupling agents function to link organic and inorganic materials together.

■ Structure of silane coupling agents

![Silane Coupling Agents](image)

Reactive groups that form chemical bonds with organic materials such as synthetic resins
- Vinyl groups
- Epoxy groups
- Amino groups
- Methacryloxy groups
- Mercapto groups, other

■ Reaction mechanism to organic materials
- Improving wettability
- Improving compatibility
- Forming chemical bonds with resins

Organic Functional Groups and Compatible Resins

<table>
<thead>
<tr>
<th>Resin</th>
<th>Thermoplastic resins</th>
<th>Thermosetting resins</th>
<th>Elastomer-Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Epoxy</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Styryl</td>
<td>++</td>
<td>+ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Methacryloxy</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Acryloy</td>
<td>++</td>
<td>+ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Amino</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Ureida</td>
<td>++</td>
<td>+ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Mercapto</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
<tr>
<td>Isocyanate</td>
<td>++ + + + + + + + + + +</td>
<td>++ + + + + + + + +</td>
<td>++ + + + + + + + +</td>
</tr>
</tbody>
</table>

+ = Very effective - Effective

All the functional groups are capable of coupling with the resins in question. This should be taken as a guide.

■ Features of Hydrolyzable Silyl Groups
- Methoxy type: Hydrolyzes rapidly.
- Ethoxy type: Hydrolyzes slowly, and compositions will be highly stable even after addition. This type is more eco-friendly, because the product of hydrolysis is ethanol.
- Dialkoxy type: Good stability after hydrolysis. Condensation products form straight-chain structures.
- Trialkoxy type: High reactivity with high crosslinking density. Strong bonding with inorganic materials.

■ Reactivity of silanol

<table>
<thead>
<tr>
<th>Reactivity</th>
<th>Inorganic material</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Glass, Silica, Alumina</td>
</tr>
<tr>
<td>Low</td>
<td>Talc, Clay, Mica, Aluminum, Iron</td>
</tr>
<tr>
<td>Medium</td>
<td>Titanium oxide, Zinc oxide, Iron oxide</td>
</tr>
<tr>
<td>Very Low</td>
<td>Graphite, Carbon black, Calcium carbonate</td>
</tr>
</tbody>
</table>

■ Reaction Mechanism of Silane Coupling Agents

![Reaction Mechanism of Silane Coupling Agents](image)

As for the product information in detail, please refer to the Silane Coupling Agents catalog.

Catalog download

https://www.shinetsusilicone-global.com/catalog/index.shtml
Shin-Etsu Chemical is developing a range of new products with many special features. Our offerings include products that not only improve functionality but allow users to achieve greener product design, and are easier to use by virtue of allowing users to eliminate certain processes.

- **Multi Functional Group Type**
  - Low volatility
  - Highly improving adhesion

- **Long-Chain Spacer Type**
  - Improving hydrophobicity and flexibility

- **Protected Functional Group Type**
  - One-component products can be used in place of two-component products
  - Highly improving adhesion

- **VOC Free Type**
  - Alcohol released: Reduced by 99% or more
  - Eliminate the step of hydrolysis

- **Dialkoxy Silane Type**
  - Compared to trialkoxy types:
    - Lower crosslinking density for better shelf life
    - Less alcohol is released

- **Ethyloxy Type**
  - Product of hydrolysis is ethanol
  - Hydrolyzes slowly, and compositions will be stable even after addition.

- **Solid Silane Coupling Agent**
  - Simply mix with solid resins to use (No solvent used when mixing.)

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**Model of Chemical Structure**

- **Long-Chain Spacer Type**
  - Conventional grade
  - (H₃CO)₂Si
  - Long-Chain Spacer Type
  - (H₃CO)₂Si

- **Protected Functional Group Type**
  - (RO)₂Si

- **Dialkoxy Silane Type**
  - Organic functional group

- **Ethyloxy Type**
  - Organic functional group—Si—(OC₂H₅)₃

- **Multi Functional Group Type**
  - Organic functional group

- **VOC Free Type**
  - Organic functional group
  - OH
  - Remaining amount of alcohol is up to 1 wt %.
Silanes and silane coupling agents can be used as surface treatments for pigments and fillers to improve their compatibility with resins and improve adhesion.

### Product List

<table>
<thead>
<tr>
<th>Product category</th>
<th>Functional group</th>
<th>Product name</th>
<th>Chemical structure</th>
<th>Features</th>
<th>TSCA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Silane coupling agents</strong></td>
<td>Alkenyl</td>
<td>KBM-1003</td>
<td>(MeO)₃Si=</td>
<td>Vinyl silane, standard product</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KBM-1083</td>
<td>(EtO)₃Si=</td>
<td>Long-chain spacer type of KBM-1003</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td>Epoxy</td>
<td>KBM-403</td>
<td>(MeO)₃Si=</td>
<td>Epoxy silane, standard product</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KBM-4803</td>
<td>(MeO)₃Si=</td>
<td>Long-chain spacer type of KBM-403</td>
<td>Not Listed</td>
</tr>
<tr>
<td></td>
<td>Methacrylic</td>
<td>KBM-503</td>
<td>(EtO)₃Si=</td>
<td>Methacrylic silane, standard product</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KBM-5803</td>
<td>(EtO)₃Si=</td>
<td>Long-chain spacer type of KBM-503</td>
<td>Not Listed</td>
</tr>
<tr>
<td></td>
<td>Amine</td>
<td>KBM-603</td>
<td>(MeO)₃Si=</td>
<td>Diamino silane</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KBE-903</td>
<td>(EtO)₃Si=</td>
<td>Monoamino silane</td>
<td>Listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KBM-6803</td>
<td>(MeO)₃Si=</td>
<td>Long-chain spacer type of KBM-603</td>
<td>Not Listed</td>
</tr>
<tr>
<td><strong>Alkox silanes</strong></td>
<td>Alkyl</td>
<td>KBE-3063</td>
<td>(EtO)₃Si=</td>
<td>Long chain alkyl (C6), ethoxy type</td>
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<td>(MeO)₃Si=</td>
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<td>(MeO)₃Si=</td>
<td>Fluorinated silane. Water repellency, oil repellency</td>
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### Model of Filler Surface Treatment

Before treatment: Alkox groups hydrolyze to form silanols, which hydrogen-bond with hydroxyls on the surface of inorganic substrates. Typically, silane coupling agents react more easily with inorganic materials having a larger number of active hydroxyl groups on their surfaces.

### Dispersibility of treated silicas

Long-chain spacer silane coupling agents improve the dispersibility of fillers, and compositions will be more transparent.

### Types of Inorganic Materials and Reactivity of Silanol

Alkox groups are hydrolyzed to form silanols, which hydrogen-bond to hydroxyls on the surface of inorganic substrates. Typically, silane coupling agents react more easily with inorganic materials having a larger number of active hydroxyl groups on their surfaces.

- **Number of Hydroxyl Group on the Surface**
  - Large
  - Small

- **Reactivity**
  - High
  - Low

- **Inorganic material**
  - Glass Silica
  - Alumina
  - Talc Clay
  - Mica
  - Titanium oxide
  - Zinc oxide
  - Iron oxide
  - Graphite
  - Carbon black
  - Calcium carbonate
Surface Modifiers for Pigments & Fillers

Spherical Silica Fine Particles

Spherical Silica Fine Particles are extremely small and have a narrow particle size distribution. Particle surfaces have been treated to be extra hydrophobic. The particles thus have excellent dispersibility, water repellency, lubricity, flow properties, and can be added to other powders, in a dry process, to improve those powder's performance. Spherical Silica Fine Particles can be used with organic pigments and fillers as well as inorganic ones.

Improved Flowability of Glass Frits

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<tr>
<th>Test Number</th>
<th>Tip Speed (m/min)</th>
<th>Stability Test</th>
<th>Flow Rate Test</th>
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Graph:

- Glass frit only
- QSG-100 added
- QSG-30 added

Product List

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<th>Parameter</th>
<th>Grade</th>
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<th>QSG-30</th>
<th>QSG-100</th>
<th>QSG-170</th>
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* The average particles size measured by dynamic light scattering (Laser Doppler) (Not specified values)

Particle Size Distribution of QSG-100

Adhesion on various surfaces by QSG-100

- Metal Silicons
- Glass Frits
- Surface of Nylon
- Styrene Particle
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- Gunma Complex
  - ISO 9001
  - ISO 14001
  - (JCQA-0004 JCQA-E-0002)

- Naoetsu Plant
  - ISO 9001
  - ISO 14001
  - (JCQA-0018 JCQA-E-0064)

- Takefu Plant
  - ISO 9001
  - ISO 14001
  - (JQA-0479 JQA-EM0298)

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