PYROGENIC SILICA I COSMETICS

HDK®

Personal Care and Cosmetics Factbook
WELCOME TO THE WACKER FAMILY OF PERSONAL CARE AND COSMETICS PRODUCTS
WACKER has been producing and refining its brand of HDK® pyrogenic silica for over 40 years. Our integrated manufacturing protocols, statistical process control and highly efficient reactor dynamics produce exceptionally pure grades of inorganic, pyrogenic silica. These grades are especially well-suited for personal care and cosmetics applications.

Fascinatingly Versatile
Although HDK® pyrogenic silica is an established and highly successful product, WACKER continues to push forward with its R&D to seek new potential solutions to further boost product performance and quality. The exclusive selection of both hydrophobic and hydrophilic HDK® grades offers highly versatile and comprehensive solutions for a wide range of personal care and cosmetic applications.

### HDK® in Personal Care and Cosmetics

<table>
<thead>
<tr>
<th>Application</th>
<th>Weight Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipstick/lip gloss</td>
<td>Up to 2 % by weight</td>
</tr>
<tr>
<td>Hair care products (bleach, dyes, shampoo)</td>
<td>Up to 4 % by weight</td>
</tr>
<tr>
<td>Creams and ointments</td>
<td>Up to 4 % by weight</td>
</tr>
<tr>
<td>Aerosol antiperspirants</td>
<td>Up to 8 % by weight</td>
</tr>
<tr>
<td>Pressed powders (make-up)</td>
<td>Up to 10 % by weight</td>
</tr>
<tr>
<td>Gels</td>
<td>Up to 7 % by weight</td>
</tr>
<tr>
<td>Nail varnish/lacquer</td>
<td>Up to 4 % by weight</td>
</tr>
<tr>
<td>Tooth pastes (gels)</td>
<td>Up to 10 % by weight</td>
</tr>
<tr>
<td>Foundations</td>
<td>Up to 6 % by weight</td>
</tr>
<tr>
<td>Creams/sun care</td>
<td>Up to 6 % by weight</td>
</tr>
</tbody>
</table>

HDK® is a registered trademark of Wacker Chemie AG.
Isolated primary particles do not exist as individual units outside the flame.

Particle diameter

$\text{SiCl}_4 + 2\text{H}_2 + \text{O}_2 \rightarrow \text{SiO}_2 + 2\text{HCl}$

$\text{SiO}_2$

$\text{SiO}_2$

$\text{SiO}_2$

$\text{SiO}_2$

Air

HDK® pyrogenic silica – formation in a flame

Reactor

Molecules

Protoparticles

Primary particles

Aggregates

Agglomerates

$\text{SiO}_2$

$\text{SiO}_2$

$\text{SiO}_2$

$\text{SiO}_2$

5 – 50 nm

100 – 500 nm

$\gg 1 \mu m$

On cooling, the aggregates mechanically entangle to form agglomerates, known as tertiary structures. The aggregates have sizes in the range of microns. HDK® has a very high specific surface area (BET) because of the small diameters of its primary building blocks. The primary particles that are fused together in the aggregates finally arrange themselves into agglomerates. This inherently large surface area-to-mass ratio causes intense interparticulate interactions, which are the result of attractive dispersion and dipolar forces. And that is precisely the reason for the outstanding properties of HDK®.

**HDK® is produced at multiple sites by an integrated, efficient and environmentally compatible process that saves energy and raw materials.**

**Hydrophilic HDK® with a Large Surface Area**

The production parameters are responsible for the excellent properties of hydrophilic, pure and odorless HDK®.

Pyrogenic silica is formed by hydrolysis at over 1,000 °C. This is achieved by introducing chlorosilanes into an oxyhydrogen flame, producing SiO₂ primary particles about 5–50 nanometers (10⁻⁹ m) in size. In the flame, the primary particles fuse together permanently to form large units, or aggregates (100–1,000 nm in size). That is to say, individual primary particles only exist in the reaction zone itself.

**THE BASIC PYROGENIC SILICA REACTION PROCESS – PURITY OF THE HIGHEST CLASS**
# HDK® Pyrogenic Silica Product Range

## Standard Grades

<table>
<thead>
<tr>
<th>Specific Surface Area [m²/g]</th>
<th>Hydrophilic HDK®</th>
<th>Hydrophobic HDK®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undensed</td>
<td>Densed</td>
<td>Dimethylsilox</td>
</tr>
<tr>
<td>50</td>
<td>HDK® D05</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>HDK® C10</td>
<td>HDK® C10P</td>
</tr>
<tr>
<td>130</td>
<td>HDK® S13</td>
<td>HDK® S13P</td>
</tr>
<tr>
<td>150</td>
<td>HDK® V15</td>
<td>HDK® V15P</td>
</tr>
<tr>
<td>200</td>
<td>HDK® N20, HDK® N20ST, HDK® N20 Pharma</td>
<td>HDK® N20P</td>
</tr>
<tr>
<td>300</td>
<td>HDK® T30</td>
<td>HDK® T30P</td>
</tr>
<tr>
<td>400</td>
<td>HDK® T40</td>
<td>HDK® T40P</td>
</tr>
</tbody>
</table>

## INCI Names of HDK® Products According to PCPC (former CTFA):

<table>
<thead>
<tr>
<th>INCI Names</th>
<th>HDK® Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>HDK® N20, HDK® T30</td>
</tr>
<tr>
<td>Silica dimethyl silylate</td>
<td>HDK® H15, HDK® H20, HDK® H30, HDK® H18</td>
</tr>
<tr>
<td>Silica silylate</td>
<td>HDK® H2000</td>
</tr>
</tbody>
</table>

Within the complete HDK® product portfolio, selective grades correspond to personal care and cosmetic application requirements.
HDK® – EXCELLENT AS A PERFORMANCE MODIFIER FOR OPTIMUM QUALITY

**Standard Uses**

**Thixotropy**
HDK® helps a liquid to reduce viscosity under the influence of shear and to recover viscosity when the shear is removed.

**Thickening**
HDK® helps increase the viscosity of a liquid by its addition.

**Free-flow**
HDK® helps in the movement of dry powders/particles by reducing the cohesion of particles.

**Anti-sag**
HDK® helps a liquid or semisolid paste to remain where applied and to resist flow and levelling.

**Anti-settling**
HDK® helps a liquid to have all of its components remain in suspension and not to striate or settle non-uniformly during shipment and storage.

**Flow and leveling**
HDK® helps a liquid when applied to a surface to spread uniformly across the available space.

**Specialty Uses**

**Filler/diluent**
HDK® helps as an inert ingredient in a formulation while expanding the space available for active ingredients.

**Lubricant**
HDK® helps as a spacer to improve release properties and/or to separate materials during processing.

**Binder**
HDK® helps maintain the structural strength of materials compacted during manufacturing.

**Glidant**
HDK® helps enhance the uniform flow and mixing of materials.

**Sorbent**
HDK® helps as a moisture scavenger to maintain and improve free flowability of the materials to which it is added.
HDK® – CERTIFIED QUALITY

GRAS
Pyrogenic hydrophilic silica is generally regarded as safe material according to FDA § 182.90.

REACH compliance status
Herewith we confirm that HDK® is in compliance with the EC Regulation 1907/2006 (REACH).

HDK® was successfully registered in the “silicon dioxide” substance group according to the REACH regulation on the registration, evaluation, authorization and restriction processes for chemical substances. This was announced by the European Chemicals Agency ECHA in mid-March 2009.

Compliance Cosmetic Directive
HDK® complies with Regulation 1223/2009 (recast of the Cosmetic Directive 76/768/EC and all its amendments). The product neither contains any of the restricted compounds included in Annex III as per recipe nor are any CMR cat. 1 or 2 compounds intentionally introduced.

COLIPA
Herewith we confirm that we registered for HDK® H20 all uses listed on COLIPA’s use mapping.

Food
Hydrophilic HDK® grades may be used as direct food additives in accordance with EU-Directive 95/2/EC.

Kosher
HDK® N20, HDK® T30, HDK® H15, HDK® H20, HDK® H18 grades are Kosher certified for use in Kosher milk and meat products.

Halal
Hereby it is certified that hydrophilic HDK® – which is approved for direct and indirect food contact according to the relevant Directives such as the German BfR Recommendation LII “Fillers”, the European Directive 2002/72/EC and the US Code of Federal Regulations (e.g. §173.340, §182.1711 and others) – meets the criteria of “Halal”.

HDK® is a fully synthetic product that does not contain any “Haram” substances.

CONSISTENCY AND PURITY

Typical analytical data of HDK®

Trace element impurities

<table>
<thead>
<tr>
<th>Element</th>
<th>Measured levels (mg/kg)</th>
<th>Element</th>
<th>Measured levels (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag</td>
<td>&lt; 2</td>
<td>K</td>
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<tr>
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<td>As</td>
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<td>Mn</td>
<td>&lt; 2</td>
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<td>Ba</td>
<td>&lt; 2</td>
<td>Mo</td>
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<td>Ca</td>
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<td>Cd</td>
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<td>Cr</td>
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<td>Fe</td>
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<td>Zn</td>
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<tr>
<td>Ge</td>
<td>&lt; 2</td>
<td>Zr</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt; 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>&lt; 20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inorganic impurities

<table>
<thead>
<tr>
<th>Element</th>
<th>Measured levels (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cl</td>
<td>&lt; 100</td>
</tr>
</tbody>
</table>

Standard tests:
- BET surface area
- Sieve residue
- pH in a 4 % aqueous dispersion

Typical general properties:
Tap density: approx. 40 grams/liter
Loss on drying (2 hours at 105 °C): < 1.5 %
SiO₂ content: > 99.8 %

Analytical methods for elements:
- Flame AES and ICP
- “<” indicates the detection limit has been reached

The figures are only intended as a guide and should not be used in preparing specifications.
HDK® pyrogenic silica has a wide variety of uses in cosmetics and personal care products. From lipstick to shampoo, HDK® pyrogenic silica can greatly help improve the versatility and performance of your products.

**Effects**
HDK® has wide uses in cosmetics and personal care products for its variety of specific properties.

**Rheology control**
HDK® increases viscosity and imparts thixotropy. As a gelling agent, HDK® modifies the viscosity of oils, waxes and emulsions.

**Sedimentation and separation**
HDK® delays or prevents settling of pigments and powders (in suspensions).

In creams, lotions, lipstick and foundation products, HDK® improves stability and structure.

HDK® stabilizes formulations by reducing sensitivity to temperature, electrolytes and pH.

**Free-flow and anticaking additive**
HDK® improves the free-flow of powders.

**Applications**

**Color Cosmetics**
In foundations, eyeliners und mascara, HDK® regulates consistency, controls viscosity and prevents the agglomeration of color pigments.

**Powders**
HDK® enhances the free flow of powders.

**Nail lacquers**
HDK® assures uniform distribution of pigments, reduces sedimentation and allows rheology control.

**Lipsticks**
HDK® acts as a thickener and improves the consistency of lipsticks.

HDK® facilitates the uniform distribution of pigments and enhances thermal stability.

**Antiperspirants**
HDK® stabilizes suspensions, prevents the agglomeration of active ingredients and ensures their uniform distribution; it increases the viscosity of creams and sticks; either hydrophilic or hydrophobic HDK® can be used.
PACKAGING

Pallets with Paper Bags
HDK® is available in multilayer valved paper bags which contain 10 kg of product. The bags are delivered on pallets which are shrink-wrapped with a polyethylene foil to protect the HDK® against moisture. This allows the product to be stored without any moisture uptake. If the shrink foil is damaged or single bags are removed, care must be taken to protect the remaining bags/individual bags against moisture by either wrapping in plastic or other appropriate measures.

- Palletized and shrink-wrapped for good product protection, storage and handling
- Three-ply paper for added strength
- Bags are disposable

Big bags
The big bag solution is available for most HDK® grades, a woven polypropylene bag containing 150–200 kg of product, depending on the respective bulk density of the product. Big bags are delivered on a pallet shrink-wrapped with a polyethylene film to protect against moisture.
EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS

WACKER is one of the world’s leading and most research-intensive chemical companies, with total sales of €4.63 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment. Spanning the globe with five business divisions, operating 24 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 16,300, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps them boost their own success.

Our technical centers employ local specialists who assist customers worldwide in the development of products tailored to regional demands, supporting them during every stage of their complex production processes, if required.

WACKER solutions are online services provided via our customer portal and as integrated process solutions. Our customers and business partners thus benefit from comprehensive information and reliable service to enable projects and orders to be handled fast, reliably and highly efficiently.

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www.wacker.com
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All figures are based on fiscal 2012.
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