

WACKER

CREATING TOMORROW'S SOLUTIONS

IMAGINATION

WITH HDK®.



MARKET OVERVIEW/SYSTEM COMPONENTS & PERFORMANCE ADDITIVES

HDK® – PYROGENIC SILICA WITH PERSONALIZED SERVICE

Product Overview

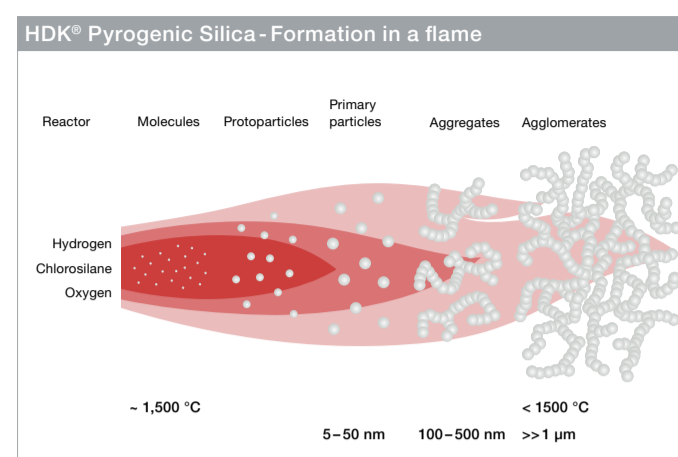
HDK® TURNS IMAGINATION INTO INTELLIGENT SOLUTIONS

Imagination, opportunity, versatility – HDK® pyrogenic silica opens up a whole world of applications for truly innovative ideas. Whatever it is you have in mind, together we will find the optimal solution for your specific requirements. Tell us about your ideas and we will support you with our expertise in research and application as well as reliable global logistics.

Realize your own concepts of modern products and smart features with WACKER as a strong and reliable partner at your side. HDK® pyrogenic silica is designed to deliver peak performance every day. Our portfolio comprises a multitude of HDK® grades for a vast range of applications in different industries – from foods, cosmetics, pharmaceutical products, paints and surface coatings, composites, adhesives, sealants and elastomers to toners and paper coatings. HDK® adjusts and optimizes product properties precisely to your requirements.

The HDK® production sites are certified worldwide in accordance with the ISO 9001 and ISO 14001 standards, which are a constituent part of WACKER's Group certification.

We dedicate our extensive experience in the production of high-purity pyrogenic silica, our strong commitment to research and development, our customer-focused service, as well as our own technical centers and logistics solutions to one single goal: your success.



It takes extensive experience to produce high-purity pyrogenic silica – and WACKER is one of the world's leading producers.

Typical General Properties	
Appearance	Fluffy white powder
Solid structure of SiO₂	Amorphous
Loss on ignition¹ DIN EN ISO 3262-19, at 1,000 °C/2 h	[wt. %] <2% (hydrophilic)
SiO₂ content² DIN EN ISO 3262-19	[wt. %] >99.8 %
Density of SiO₂ DIN 51757	[g/cm³] approx. 2.2
Refractive index	1.46 (hydrophilic)
Silanol group density	2 SiOH/nm ² (hydrophilic)

¹ Based on the substance dried for 2 h at 105 °C

² Based on the substance incinerated for 2 h at 1,000 °C

Hydrophilic HDK®

Hydrophilic HDK® is manufactured by the hydrolysis of volatile chlorosilanes in an oxyhydrogen flame. In chemical terms, it consists of highly pure amorphous silicon dioxide with the appearance of a fluffy white powder. Hydrophilic silica is wetted by water and can be dispersed in water.

Hydrophobic HDK®

Hydrophobic HDK® is produced by the chemical reaction of hydrophilic HDK® with reactive silanes, e.g. methyl chlorosilanes or hexamethyldisilazane. It has water-repellent properties and is no longer dispersible in water.

HDK® Dispersions

HDK® dispersions are produced by the dispersion of hydrophilic HDK® in water using high shear forces. They obtain their stability by electrostatic and steric stabilization.

HDK® is a registered trademark of Wacker Chemie AG.

HDK® Hydrophilic Grades – General Product Range									
HDK®		D05	S13	V15	V15A	V16	N20	T30	T40
BET surface area	[m²/g]	30–70	110–140	130–170	130–170	130–170	175–225	270–330	360–440
DIN EN ISO 9277/DIN 66132									
pH in 4% dispersion	approx.	4.3	4.1	4.1	4.1	4.1	4.1	4.1	4.1
DIN EN ISO 787-9									
Tamped density	[g/l] approx.	50	50	50	50	50	40	40	40
DIN EN ISO 787/11									
Loss on drying, ex works	[wt. %]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.5	<1.5	<1.5
(2 h at 105 °C) DIN EN ISO 787-2									
Sieve residue	[wt. %]	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
DIN EN ISO 787-18									

Note: these figures are intended as a guide and should not be used in preparing specifications.

HDK® Hydrophilic Grades	Densified				Pressed				Pharma/Nutrition				
	V15D	V16D	N20D	T30D	V15P	N20P	T30P	T40P	N20Pharma	N20PPharma	N20Nutrition	T40Nutrition	
BET surface area	[m²/g]	130–170	130–170	175–225	270–330	130–170	175–225	270–330	360–440	175–225	175–225	175–225	360–440
DIN EN ISO 9277/DIN 66132													
pH in 4% dispersion	approx.	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
DIN EN ISO 787-9													
Tamped density	[g/l] approx.	70	70	70	70	100	100	100	100	40	100	40	40
DIN EN ISO 787/11													
Loss on drying, ex works	[wt. %]	<1.5	<1.5	<1.5	<1.5	<1.0	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
(2 h at 105 °C) DIN EN ISO 787-2													
Sieve residue	[wt. %]	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
DIN EN ISO 787-18													

Note: these figures are intended as a guide and should not be used in preparing specifications.

HDK® Hydrophobic Grades – General Product Range														
HDK®		H13L	H15	H15L	H16	H17	H18	H2000	H20	H20RH	H21	H30	H30RM	H30LM
BET surface area of hydrophobic silica	[m²/g]	110	120	120	100	90	120	150	170	130	110	250	200	220
DIN EN ISO 9277/DIN 66132														
pH in 4% dispersion (1:1 mixture of water - methanol)	approx.	4.3	4.3	4.3	5.0	5.0	5.0	7.0	4.3	6.5	5	4.3	6.5	6.5
DIN EN ISO 787-9														
Tamped density	[g/l] approx.	60	40	70	50	50	50	200	40	50	50	40	50	50
DIN EN ISO 787/11														
Loss on drying, ex works	[wt. %]	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<1	<0.6	<0.6	<0.6	<0.6
(2 h at 105 °C) DIN EN ISO 787-2														
Sieve residue	[wt. %]	<0.05	<0.05	<0.05	<0.3	<0.1	<0.1	n.a.	<0.05	<0.5	<0.3	<0.05	<0.5	<0.5
DIN EN ISO 787-18														
Treatment/hydrophobic character		Silane/high	Silane/medium	Silane/medium	Siloxane/very high	Siloxane/very high	Siloxane/very high	HMDS/high	Silane/medium	Alkylsilane/high	Siloxane/very high	Silane/medium	HMDS/high	HMDS/medium

Note: these figures are intended as a guide and should not be used in preparing specifications.

Further information about HDK® grades upon request.

THE MANY USES OF HDK®

Application	HDK® grade	Amount used [%]	Effect achieved
Adhesives			
Amine curing agents	H18, H20RH, N20	0.8–5.0	Thickening, thixotropy, antisedimentation, processing aid, adhesion improvement, storage stability
Dispersion-based	N20, H2000	0.8–5.0	
Epoxy-, polyurethane-based	N20, H13L, H16, H17, H18, H21	0.8–5.0	
Polychloroprene-based	N20, H2000	0.8–5.0	
Sealants			
Acrylates	V15, V15A, V16, H20, H30RY	0.5–1.5	Reinforcement, thixotropy, free-flow, mechanical properties
Polysulfides (thiokols)	V15, V15A, V16, N20, H15, H20	0.7–3.0	
Polyurethanes	V15, V15A, V16, H20	3.0–25.0	
RTV-1 silicon rubber	S13, V15, V15A, V16, H15, H20, H2000	3.0–30.0	
Unsaturated polyester composite resins			
Gel coats	N20, T30	2.0–3.0	Thickening, thixotropy, antisedimentation, mechanical profile
Laminating resins	N20	0.8–1.5	
Polar resin systems, e.g. vinyl ester resins	H13L, H18, H21	0.5–3.0	
Putties	N20	0.5–1.0	
PVC			
Cable compounds	T30, T40	1.0–3.0	Thickening, thixotropy, antisedimentation, anti-sticking, free-flow, anti-blocking
Dry blend compounds	H20	0.05–0.5	
Film & sheet	N20, T30, H20	0.1–1.0	
Organosols	N20, T30, T40	0.3–2.5	
Plasticized PVC compounds	N20, T30	0.1–0.8	
Plastisols	N20, T30, T40	0.3–2.5	
Paints and coatings			
Acrylic resin coatings	N20, T30, T40	0.3–2.0	Thickening, thixotropy, antisedimentation, free flow, scratch resistance
Alkyd resin coatings	N20, T30, T40, H15, H18, H20, H30	0.5–5.0	
Epoxy resin and polyurethane coatings	H15, H17, H18, H20, H21, H30, H30LM, H30RM	1.0–4.5	
Polyester coatings	N20, T30, T40	0.5–2.5	
Powder coatings	V15, N20, H15, H20, H30LM, H30RM, H2000	0.5–5.0	
Zinc-rich paints	N20, H13L, H15, H17, H18, H20, H21	0.5–2.0	

Application	HDK® grade	Amount used [%]	Effect achieved
Printing inks			
Flexographic printing	N20, T30, H13L, H15, H20, H30	0.5–2.5	Thickening, thixotropy, antisedimentation, regulation of water content, improved brilliance and contrast, gloss, water adsorption, regulation of drying
Letterpress and gravure printing	N20	0.5–2.0	
Offset printing	H13L, H15, H20	0.5–2.5	
Photo-glossy paper	N20, T30, T40	25.0–30.0	
Screen printing	N20, T40	1.0–10.0	
Elastomers			
Natural and synthetic rubber	N20, N20P, H15, H15L, H20, H2000	5.0–40.0	Reinforcement
Silicone elastomers	S13, V15, N20, T30, H30, H2000	3.0–35.0	
Thermal Insulation			
Insulation panels	V15, N20, T30	50.0–95.0	Thermal insulation
Vacuum insulation panels	N20, T30	80.0–90.0	
Accumulators			
Battery acids	N20, N20P	2.0–6.0	Thickening, thixotropy
Insulating gels			
Cable and splice fillings for conventional copper and fiber-optic technology	N20, H15, H20, H30	5.0–10.0	Thickening, thixotropy, water repellency
Bulk materials			
Fire-extinguisher powders	H15, H2000	0.5–1.0	Free-flow processing aid, flow enhancement, adhesion improvement
Pigments	N20, H20, H2000	0.1–1.0	
Plastic powder	N20, H15, H20, H2000	0.05–1.0	
Salts	N20, H20, H30	0.1–1.0	
Cosmetics and personal care			
Aerosols	N20	0.1–3.0	Thickening, thixotropy antisedimentation, free-flow
Ointments, creams, lotions	N20, H15	2.0–10.0	
Powders	N20, H20, H2000, H30RM	0.1–2.0	
Suspensions	N20, H15	0.2–3.0	
Toothpaste	N20, N20P	1.5–5.0	
Pharmaceuticals			
Dragees	N20Pharma, N20PPharma	3.0–12.0	Free-flow, processing aid, disintegrant
Tablets	N20Pharma, N20PPharma	1.5–10.0	
Nutrition			
Spice- and vegetable powders, carbohydrates	N20Nutrition, T40Nutrition	0.5–3.0	Free-flow

Further Information

More detailed information on particular applications is given in the following application brochures: Coatings and Printing Inks, Toners, Adhesives and Sealants, Synthetic Resins and Composites, Personal Care and Cosmetics and Pharmaceuticals.

Copies of the brochures can be obtained from WACKER, from your technical support staff, or via the internet at: www.wacker.com/hdk

CUSTOMIZED LOGISTICS AND SERVICES

New Capacity in North America

WACKER's state-of-the-art facilities in Europe and China produce a variety of pyrogenic silica grades, including nutritional and pharmaceutical products.

Furthermore, our newest production plant is set to go on-stream in Charleston, TN, USA, in 2019. With an annual capacity of about 13,000 metric tons, the new facility will be a key component of the Charleston site, which produces polysilicon for the solar and semiconductor sectors.

By integrating the polysilicon and HDK® production systems, WACKER can achieve maximum flexibility, less waste, and enhanced efficiency. This facility will open up new avenues for customers seeking an on-shore supplier in North America.

Optimal Packaging, Optimal Performance

In order to ensure maximum effectiveness of your products and formulations, we offer various forms of packaging to suit your logistics and workflow requirements. Packaging size, effective moisture protection, and your specific requirements are important factors in determining the optimal HDK® packaging for your productivity.

Pallets with Paper Bags

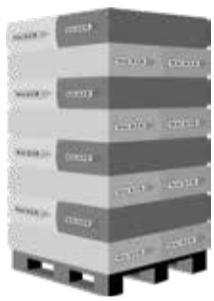
HDK® is available in multilayer, valved paper bags, which can accommodate 5 to 20 kg of product, depending on bulk density. The bags are delivered on pallets that are shrink-wrapped with a polyethylene film for moisture protection. If the shrink film is damaged accidentally or single bags are removed, it is advisable to protect the remaining or individual bags either by wrapping them in plastic or adopting other appropriate measures.

Big Bags

The big bag solution is available for most HDK® grades. Big bags are made of woven polypropylene and are suitable for 150 to 200 kg of product, depending on bulk density. Big bags are delivered on pallets, shrink-wrapped with a polyethylene film as a safeguard against moisture. We also provide advice on how to handle the material and, in particular, how to fluidize and unload big bags.

Bulk deliveries

For customers with higher consumption rates, we offer delivery in a silo truck. A silo truck holds 3,000 – 5,000 kg of HDK®. Please be aware that bulk deliveries will require a storage silo at your site. For overseas deliveries a mega big-bag solution can be provided. Please contact us for further information.



Pallets with paper bags



Big bag



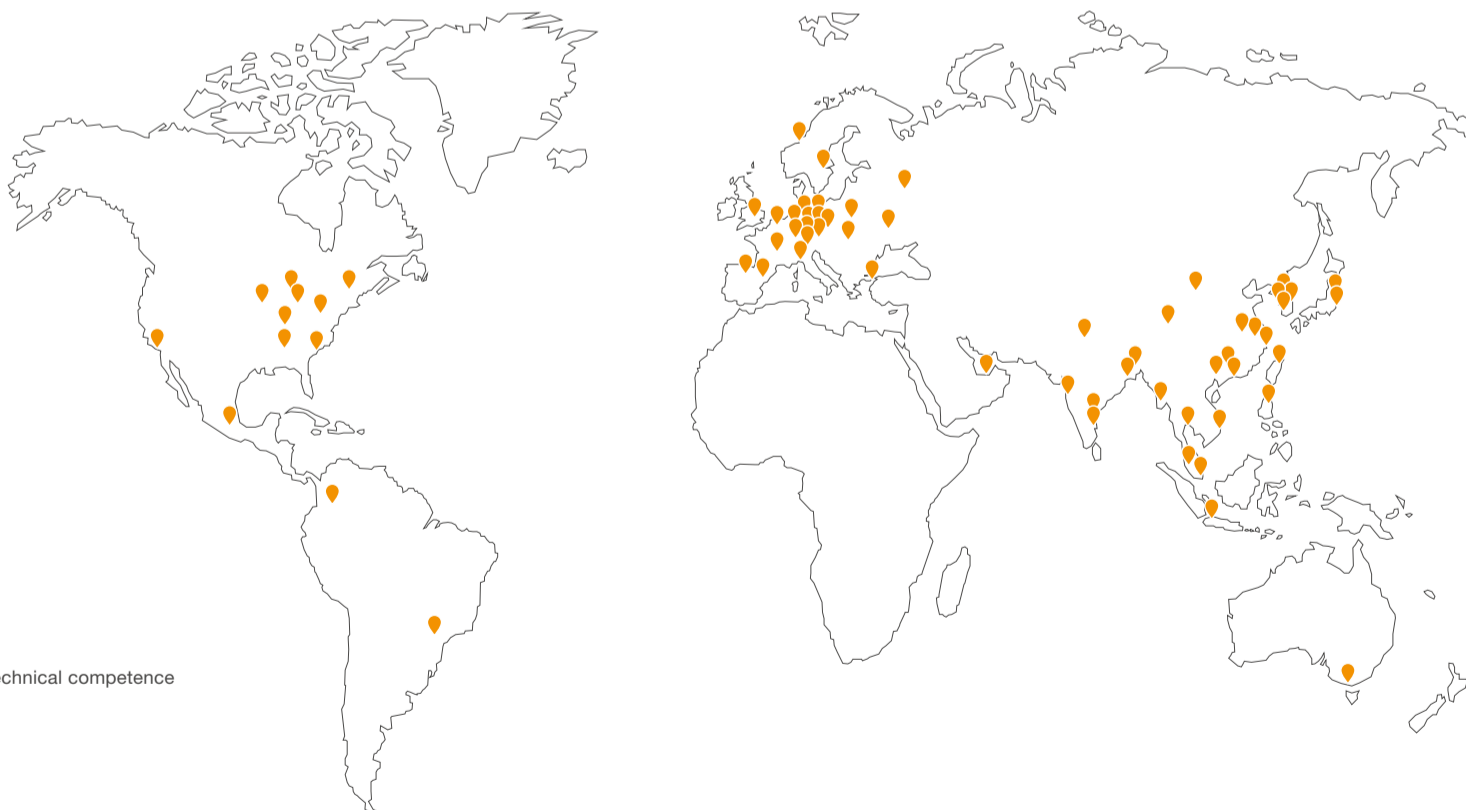
Silo truck



Bulk deliveries

Other HDK® packaging forms available on request.

EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS



● Sales offices, production sites and technical competence centers around the world.

All figures are based on fiscal 2018.

WACKER is one of the world's leading and most research-intensive chemical companies, with total sales of €4.98 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bioengineered 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 4 business divisions, we offer our

customers highly-specialized products and comprehensive service via 24 production sites, 22 technical competence centers, 13 WACKER ACADEMY training centers and 50 sales offices in Europe, North and South America, and Asia – including a presence in China.

With a workforce of some 14,500, we see ourselves as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, our customers. We also help them boost their own success. Our technical competence 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 e-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.

Visit us anywhere, anytime around the world at: www.wacker.com

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The data presented in this medium are in accordance with the present state of our knowledge but do not absolve the user from carefully checking all supplies immediately on receipt. We reserve the right to alter product constants within the scope of technical progress or new developments. The recommendations made in this medium should be checked by preliminary trials because of conditions during processing over which we have no control, especially where other companies' raw materials are also being used. The information provided by us does not absolve the user from the obligation of investigating the possibility of infringement of third parties' rights and, if necessary, clarifying the position. Recommendations for use do not constitute a warranty, either express or implied, of the fitness or suitability of the product for a particular purpose.