



INNOVATION AT FIVEN



SIKA® TECH



Silicon Carbide

FIVEN - WE SHAPE INDUSTRIES

Fiven is the world's leading producer of Silicon Carbide. Based on long time experience and industrial expertise we are delighted to provide a wide range of high quality products combined with excellent services. Together with our customers we are expanding in growing markets by increasing our production and processing capacities. Environmental protection and safety aspects are crucial for us, which we continuously develop by optimizing our production processes.

Silicon carbide is an attractive material for a variety of technical ceramic applications due to its specific properties such as:

- Chemical inertness at all temperatures
- Thermal shock resistance
- Abrasion resistance
- Sinterability

Fiven offers powders with different degrees of purity and particle sizes down to the submicron range, specially developed for very high density, excellent oxidation resistance, superior hardness and high strength. The manufacturing process and thus, the following applications in the technical ceramics industry benefit from the use of silicon carbide:

- Kiln furniture
- Burner nozzles
- Components for the semiconductor industry
- Fluid handling
- Bearings
- Wear parts as well as ballistic protection
- Diesel particulate filters

SiC-based ceramic components can be manufactured using several processes:

- Nitride-bonded SiC
- Reaction bonded SiC
- Re-crystallized SiC
- Solid-state sintered SiC
- Liquid-phase sintered SiC

Leveraging our in-depth market expertise and our global footprints, we deliver customized solutions to our customers' technical needs.





Co-development – A source of innovation

At the core of the corporate innovation strategy is a strong focus on innovation through co-development programs with our customers or external partners. Co-development is a form of close partnership to design and create a product specifically designed to meet a market need.

In such development processes, the R&D teams involved are working together with manufacturing and sales/marketing specialists on both sides to identify optimal solutions that will benefit both parties. Significant new product developments are therefore often made in close cooperation with leading customers, with whom we enter into strict confidentiality agreements. Our partners are then 100% assured that confidential information will not be shared to a third party.

Properties to customer specification

Developing special, tailor-made silicon carbide powders together with our customers, makes up a significant portion of the ongoing effort in the global silicon carbide innovation teams. At the end of such a development process, we end up with a silicon carbide powder having unique properties that will improve the customer's manufacturing process or their end products.

PSD – Particle Size Distribution

Having the optimal PSD for the application is of key importance in most applications, whether sub-micrometer sized particles or large, millimeter-sized crystals are used. By carefully selecting the optimal crushing or milling technology together with the appropriate dry or wet classification techniques, the PSD can be optimized for the customer's specific application.

Chemistry / Composition

By applying various chemical treatment procedures, Fiven can purify the powder and certain elements, like silicon, carbon, iron and oxygen. For certain high-tech applications very low content of specific elements (including trace elements) are required, something tailor-made-products which can be addressed on a case-to-case basis. For other applications, there might be a need to dope certain elements into the silicon carbide to get the optimal chemistry.

Grain Shape

The shape of the grains (from very sharp to round) can be addressed using various crushing and milling technologies. For some end applications, the correct grain shape can be crucial to achieving optimal performance.

Surface Properties

Thickness and composition of the silica-layer present on the surface of the SiC-crystals will influence the reactivity of the powder and can be carefully controlled by our manufacturing processes. The surface properties will also affect the pH of SiC-based slurries that customers produce for their casting processes. Being able to adjust the surface properties is, therefore, of great importance.

Thermal And Electrical Properties

Having a certain electrical and/or thermal conductivity can be critical for some specific applications and having necessary knowhow to adjust such parameters is crucial.

Density And Flow

The PSD and the particle shape will together profoundly influence the bulk density and the flow of most powders. In some cases, there is still room to optimize the flow or the density of the powders. The combination of these properties and the customers own processes determine the quality of the end-product. By working closely together, within the framework of confidential agreements, we can achieve the best end results, like sintered density very close to the theoretical value, combined with extreme strength and excellent wear resistance. Typical applications are seal rings and hot-pressed armor protection. Controlled porosity while maintaining high strength and superior resistance to thermal shock is, for example, important when used in high-temperature filtration applications. Superb high-temperature oxidation resistance, for instance, in kiln furniture applications.





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Products for Technical Ceramics



SIKA® TECH G13 / GC18

Green silicon carbide powders for reaction bonded (SiSiC) technical ceramics, or intermediate products for further processing.

Applications: Burner nozzles, rollers and seal rings as well as feedstock for production of sinterable powders.



SIKA® Unikiln FCP-05 / FCP-07 / 100-F

Green silicon carbide powders for re-crystallized (RSiC) and nitride-bonded (NSiC) technical ceramics.

Chemically treated green silicon carbide designed for production of re-crystallized and nitride-bonded ceramic parts. The FCP07 with its unique slip properties used in combination with 100F provides a maximum green density and high oxidation resistance in applications such as kiln furniture, semiconductor components and process materials.

Applications: Kiln furniture for tableware and sanitary porcelain like beams, plate setters and roller; burner nozzle and flame tubes.



SIKA® Sintex 10-C / 13 / 13-C / 15 / 15-C / 25

Silicon carbide powders for solid-state (SSiC) or liquid-phase (LP-SiC) sintered technical ceramics.

Fine silicon carbide powders produced to specific surface area and purity for high performance structural ceramic applications. The powders are specially designed to obtain optimum sinterability in production of solid state (SSiC) and liquid phase (LP-SiC) sintering applications.

Applications: Seal rings for fluid handling in automotive water pumps and industrial seals; structural ceramics and tiles for ballistic protection.

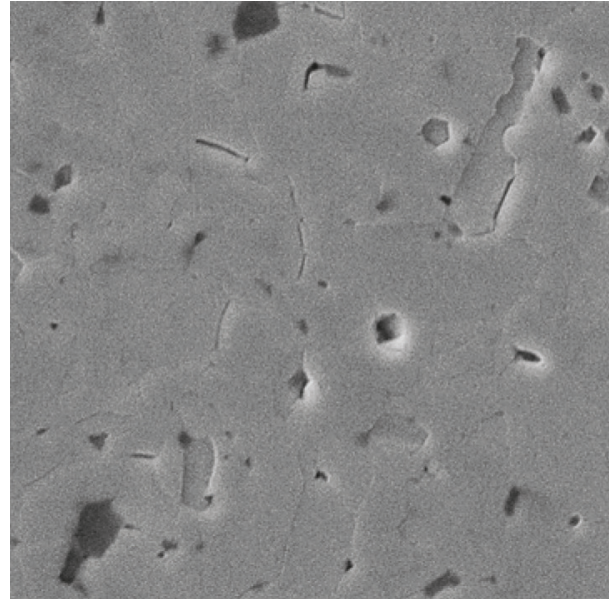


SIKA® Densitec 13 / 15

Silicon carbide ready-to-press granules for solidstate (SSiC) sintered technical ceramics.

SIKA® DENSITEC powders are spray dried granules. The powder is doped with sintering additives, temporary binders and pressing aids and is ready to be pressed into a green body by uniaxial or isostatic dry pressing.

Applications: Seal rings for fluid handling in automotive water pumps and industrial seals, wear applications, structural ceramics and tiles for ballistic protection.



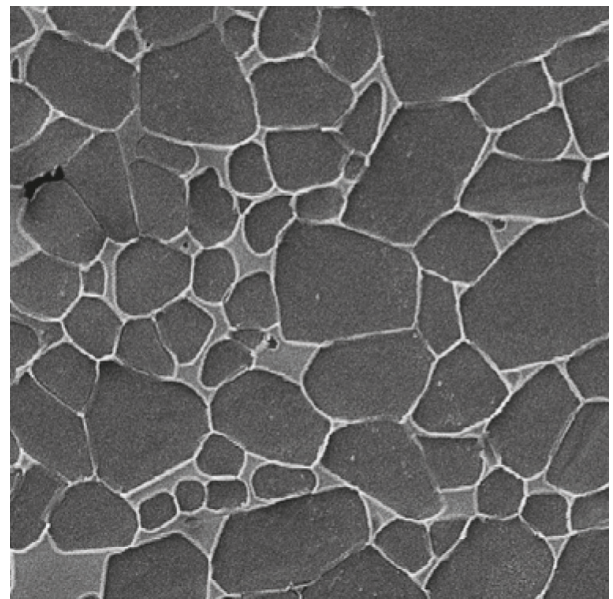
Microstructure SIKA® DENSITEC 15

SIKA® Densitec L

Silicon carbide ready-to-press granules for liquid phase (LP-SiC) sintered technical ceramics.

SIKA® DENSITEC L is used for production of liquid phase sintered SiC and is a spray granulated powder based on our standard black SIKA® SINTEX 13C. The powder is doped with oxides, temporary binders and pressing aids, and is ready to be pressed into a green body by uniaxial or isostatic dry pressing.

Applications: Seal rings for fluid handling in automotive water pumps, tiles for armor applications.



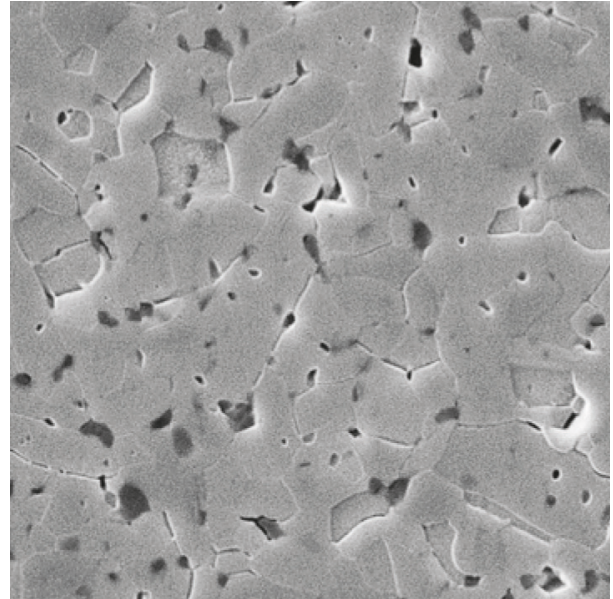
Microstructure SIKA® DENSITEC L

SIKA® Densitec 13H

Silicon carbide ready-to-press granules for solidstate (SSiC) sintered technical ceramics

SIKA® DENSITEC 13H is used for production of hot-pressed SiC and is spray dried granules. The powder is doped with sintering additives and some temporary binders ready to be hot-pressed.

Applications: Big components of sintered SiC, like tiles for ballistic protection where hot pressing is necessary.



Microstructure SIKA® DENSITEC 13H

Regional Offices and Contacts

Headquarter (Norway) Fiven AS

Apotekergata 10, 0180 Oslo, Norway

Europe

Belgium

Fiven Belgium
Matériaux Céramiques SA
Route de Villers 19
B-4162 Hody
Belgium

Customer Service:
Phone: +32 4 383 98 20
Mail: order.be@fiven.com

Germany

Fiven GmbH
Gertrudenstraße 30-36
DE-50667 Cologne
Germany

Phone: +49 221 6507 6097
Mail: sika_emea@fiven.com
Web: www.fiven.com

Norway

Fiven Norge AS
P.O. Box 113
N-4790 & N-4792 Lillesand
Norway

Customer Service:
Phone: +47 372 60 000
Mail: order.no@fiven.com

South America

Brazil

Fiven Brazil
Carbeto de Silício SIKA Brasil
Rod. Br 265 km, km 208-Zona Rural
36202-630 Barbacena-Minas Gerais-MG
Brazil

Customer Service:
Phone: +55 32 3339 1700
Mail: sika_sa@fiven.com

North America

The United States

FIVEN North America, Inc.
651 Holiday Drive
Plaza 5 – Suite 400
Pittsburgh, PA 15220

Sales
Phone: +1 (412) 706-1544
Mail: sika_na@fiven.com

Asia

China

Fiven AS
Room 329, F-space, 198 Le Yuan Road,
Pu Dong new district 201206,
Shanghai
China

Mobile: +86 139 17729448
Mail: jack.zhong@fiven.com



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