Morgan Advanced Materials

HALDENWANGER

→ Halsic

morgantechnicalceramics.com

The Halsic brand stands for exceptional high-performance ceramic materials made from silicon carbide (SiC). We supply firing structures, setter plates, beams, rollers and special constructions with excellent heat transfer values for efficient use of energy and an optimal ratio between kiln furniture and sinter ware.

They have the following properties in common:

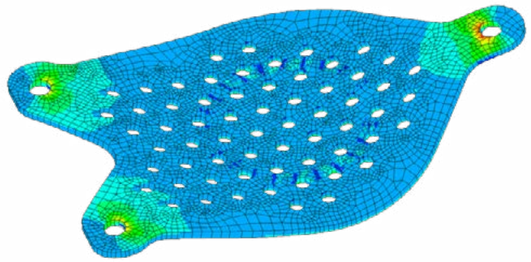
- High fire resistance
- Very good oxidation resistance
- Very good thermal shock resistance
- Extremely high corrosion resistance
- High mechanical strength
- Low specific weight

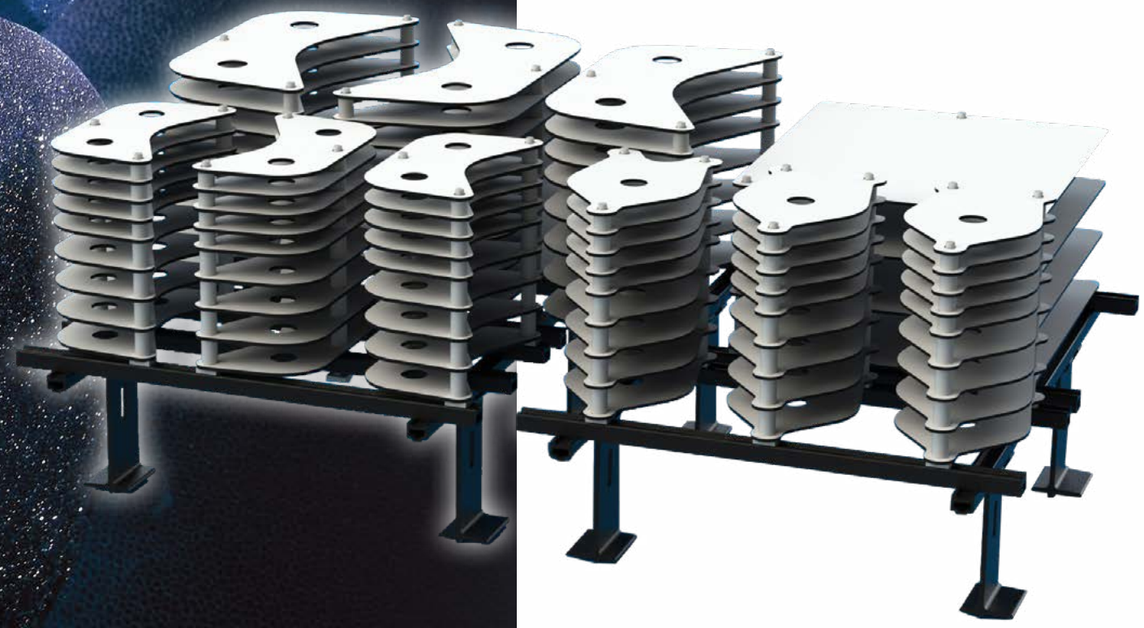
Strength design of kiln furniture

The use of Halsic kiln furniture requires careful calculation for all supporting components. We carry out these static calculations for our customers, and together with them, we determine the required cross-sectional dimensions of the components for their specific application.

Compared to metals, ceramic materials have a wider range of physical properties. Thus, an increased factor of safety is necessary. Depending on the application, a multiple factor of safety is used for the dimensioning of beams and rollers.

FEM analysis of principal stresses in ceramic components

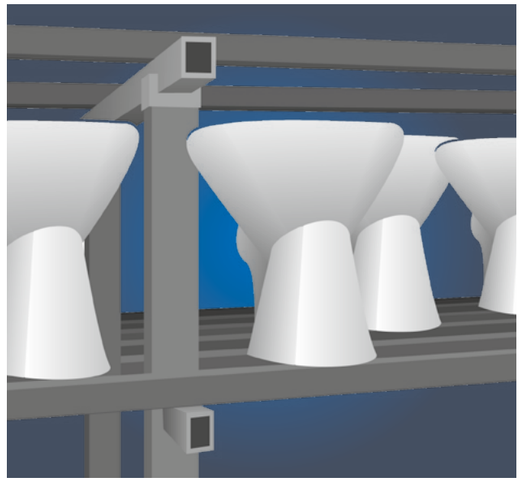




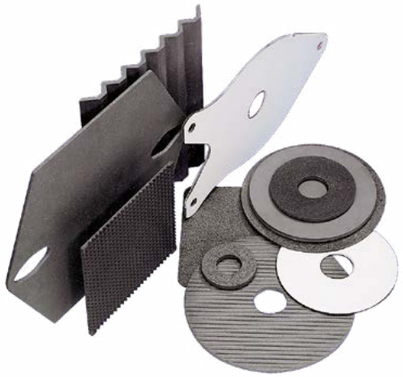
Halsic product group

Beams and profiled supports

Beams and profiled supports made with Halsic-I are used for single-layered and multilayered firing of larger ceramic components up to a temperature of 1350°C (e.g. sanitary fixtures, high-tension insulators, bricks, larger stoneware or earthenware, etc.). Beams and profiles can be used up to a temperature of approx. 1600°C for Halsic-R.

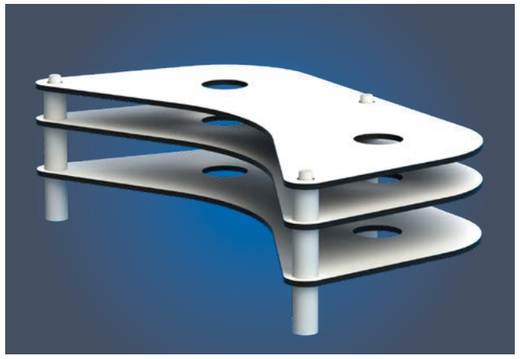


Hollow profiled supports in the above-mentioned materials can be produced in different cross sections and up to a length of 3,500 mm. They are used as single supports with high load-carrying ability, system-building structures for kiln cars or as load support components for furnace construction and mechanical engineering. The long free span made possible by Halsic beams allows optimisation of usable setting space in the kiln. In case of heavy loads, it is important that sufficient thermal expansion of the beams between the beam and support is allowed through a suitable coating (for example our engobe).



Slabs and setter plates

Kiln furniture made from Halsic-R, -RX and -N has excellent refractoriness and is particularly suitable for fast firing cycles due to its high thermal shock resistance. Infestation of the firing goods with our Halsic kiln furniture is largely impossible. The material developed by us, Halsic-RX, demonstrates a significantly longer service life due to increased oxidation resistance.



We manufacture dimensions up to 3,000 cm² and thicknesses from 5 to 10 mm according to customer specifications, on request also with engobe on one or both sides. For special applications, we supply Halsic plate setters according to your individual requirements with:

- Reinforced corners and holes, e.g. for the mechanical cohesion of the setter plate carpet in the roller kiln (porcelain fast firing)
- One-sided or all-round border
- Holes for positioning supports
- Perforation to reduce weight and optimise convection
- Grooves or profiles for debinding or for optimised convection
- Milling and/or hard machining for special tolerance and surface requirements

Tubes, burner nozzles and rollers

We offer Halsic tubes in a typical exterior diameter range of 15 to 80 mm and lengths of up to 3,500 mm. Versions that are open at both ends or closed at one end, and with a flange on request, are available. Different dimensions or designs according to your individual requirements (e.g. cooling/injection tubes with axially arranged rows of holes) as well as burner nozzles on request.

Tubes closed at one end in the materials Halsic-I (gas-tight) and Halsic-R/-RX (porous) are used as thermocouple protection tubes in gas atmospheres due to their high thermal shock resist-ance and very good corrosion resistance. Protection tubes made of Halsic-N are ideally suited for use in light metal melts, such as aluminium and magnesium, as well as in non-ferrous metal melts, as the surface of the material is melt-repellent. This explains the high expected service life in this application.

Halsic-I rollers can be used up to a temperature of 1350°C, those made of Halsic-R up to 1600°C. Due to their high load-bearing capacity, they can be used in roller kilns for the production of sanitary fixtures, porcelain, heavy clayware and technical ceramics even at very high temperatures and in highly oxidising atmospheres. In order to insert the rollers into the mechanical drive systems, their ends can be ground and/or drilled (round or elongated holes, slots, etc.). Standard rollers in the described materials can be manufactured in diameters from 20 to 60 mm and lengths of over 3,500 mm.

Application note for Halsic materials

In applications for heat treatment of metals and sintering of metal powder compacts, in which silicon carbide and metal are in direct contact, precautionary measures are required. At temperatures above 900°C, chemical reactions between SiC and various alloys occur, that ultimately will damage or destroy the SiC as well as the metal. This is facilitated by the formation of low-melting eutectics. This process is largely independent of the furnace atmosphere, although extremely low oxygen levels such as those under strongly reducing conditions and in inert atmospheres can increase the severity of the damage.

Silicon carbides

Material	Description	Properties and applications
Halsic-R	Recrystallised silicon carbide (RSiC)	• Working temperature up to 1600°C (oxidising), up to 2000°C (inert atmosphere) • High thermal shock resistance • High corrosion resistance • Standard applications: kiln furniture for high-temperature applications as well as tubes for temperature measurement in the gas phase • Standard geometries: plates, beams, supports, tubes, protection tubes, rollers, saggars, crucibles, burner nozzles; customised dimensions upon request
Halsic-RX	Chemically modified recrystallised silicon carbide ($RSiC_{dot}$)	• Working temperature up to 1650°C (oxidising) • Very good oxidation resistance • Standard applications: kiln furniture for the porcelain industry as well as heavy-duty beams for high-temperature applications • Standard geometries: plates and beams
Halsic-N	Nitride-bonded silicon carbide (NSiC)	• Working temperature up to 1450°C • High mechanical strength • Very good oxidation resistance • Standard applications: kiln furniture and tubes for temperature measurement in non-ferrous metal melts • Standard geometries: plates, beams, supports, protection tubes; customised dimensions upon request
Halsic-I	Silicon-filtrated, reaction-bonded silicon carbide (SiSiC)	• Working temperature up to 1350°C • Very good thermal shock resistance • Very good corrosion resistance • Standard applications: heavy-duty beams as well as tubes for temperature measurement in the gas phase • Standard geometries: beams, tubes and protection tubes
SiC mullite-bonded	Mullite-bonded silicon carbide	• Working temperature up to 1300°C • Good thermal shock resistance • Standard applications: tubes for temperature measurements in the gas phase • Standard geometries: tubes and protection tubes in defined diameters and lengths

Material properties

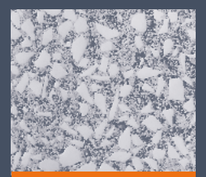
	Property	Unit	Halsic-R	Halsic-RX	Halsic-N	Halsic-I	SiC mullite-bonded
GENERAL	Main components	%	99 SiC	99 SiC	70 SiC 25 Si_3N_4 5 Oxide	85–90 SiC 10–15 Si	70–90 SiC
GENERAL	Bulk density	$\frac{g}{cm^3}$	2.7	2.7	2.8	3.0–3.1	2.2–2.5
GENERAL	Water absorption capacity	%	–	–	–	0	–
GENERAL	Porosity	Vol. %	10–15	10–15	8–15	vacuum-tight	–
MECHANICAL	Medium flexural strength at: 20°C 700°C 1300°C	MPa	80–100 – 90–110	80–100 – 90–110	160 – –	240–280 – 250–300	30 – –
MECHANICAL	Young's modulus at 20°C	GPa	280	280	250	370	–
THERMAL	Linear coefficient of thermal expansion at 20–1000°C	$\frac{1}{10^6\ K}$	4.5	4.5	4.2	4.3–4.5	5.0
THERMAL	Thermal conductivity: 200°C 1000°C 1700°C	$\frac{W}{m\ K}$	100 25 –	100 25 –	100 20 –	100 30 –	– – –
THERMAL	Tmax depends on the area of application, but is max.	°C	1600 (ox.) 2000 (red.)	1650 (ox.)	1450	1350	1300
THERMAL	Thermal shock resistance	–	excellent	excellent	good	good	excellent
	Feasibility/Availability						

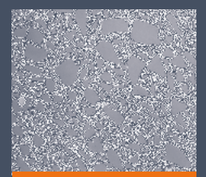
The physical and chemical values specified above have been determined acc. to standard DIN-EN 60672 and are applicable for the standard test specimens described in this norm. Given the material-specific properties of ceramic materials, these values may not be applied directly to components deviating from the norm in size and shape. The values specified above do not constitute guaranteed properties as defined by law.

Microstructure – 50x magnification

Halsic-R

Halsic-RX


Halsic-N


Halsic-I

SiC mullite-bonded

Morgan
Advanced Materials

HALDENWANGER

Morgan Advanced Materials Haldenwanger has developed from its foundation in 1865 to become one of the world's leading manufacturers of high-tech ceramics. We offer you an extensive range of products made of oxide and non-oxide materials, which are primarily used in demanding thermal, chemical or even mechanical applications. Thanks to our wealth of expertise in ceramics, we serve you not only as a supplier, but also as a reliable partner in developing **solutions for your challenges.**

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