

Eco-Light®-Advancing Efficiency

Eco-Light® (SiSiC) Beams for the Sanitaryware Industry

Introduction

Eco-Light® (SiSiC) beams of *Schunk Ingenieurkeramik GmbH* set new standards in the sanitary industry as far as efficiency is concerned.

This high-strength material with excellent hot-bending and creep-resistance properties allows for the efficient application of tailor made load respectively mass-optimized beams with square cross-sections $\leq 30 \text{ mm} \times 30 \text{ mm}$. Apart from lower investment costs, the use of Eco-Light®-beams has a positive impact on the energy costs due to decrease in thermal mass.

Eco-Light® evolution of beam cross-sections

The majority of the beams in tunnel- and shuttle kilns are "oversized" based on a historical development of the SiC-grades for kiln-furnitures. A few decades ago, the RSiC (recrystallized SiC) used to be implemented as a lightweight material to design supporting structures for kiln-car-superstructures.

Due to ongoing efforts with the goal to increase the product-lifetime of these construction elements, leading manufacturers – like *Schunk Ingenieurkeramik* – used to develop the gas-tight SiSiC (silicon-infiltrated, reaction-bonded SiC) with superior quality performance in particular as far as oxidation-, creep-resistance and bending-strengths are concerned.

Schunk Ingenieurkeramik has meanwhile become a world leading supplier of this grade in a broad spectrum of various market-segments. The SiSiC has displaced RSiC and the majority of NSiC-beams in sanitary industry due to the excellent quality performance. The logical step in the innovation of increasing the efficiency was the combination of SiSiC with the benefit of tailor-made beam cross-sections which are based on individual loading scenarios of each customer.

As the worldwide first supplier, *Schunk Ingenieurkeramik GmbH* launched in 2009 a global strategy moving away from the "stock-drop-shipping" of the i.e. standard $40 \text{ mm} \times 40 \text{ mm}$ longitudinal

beams towards engineered solutions for customers specific needs (Fig. 1). The superior microstructure of Eco-Light®-beams combined with a high density and a low content of free Si are the base for outstanding quality-performance records with references for $25 \text{ mm} \times 25 \text{ mm}$ and $30 \text{ mm} \times 30 \text{ mm}$ beams being in operation for in excess of 15 years within the sanitary industry (Tab. 1, Fig. 2). Switching-over from the traditional beam cross-sections to Eco-Light®-beams does have a significant monetary benefit.

Apart from the reduced costs of purchase for replacement business and/or capital investments to equip new kilns, the reduction of the thermal mass has a positive impact on the annual gas-consumption as well (Example: $\approx 1100 \text{ kg}$ less weight for SiSiC-beams $30 \text{ mm} \times 30 \text{ mm}$ beams vs. $40 \text{ mm} \times 40 \text{ mm}$, base: 120 kiln-cars with 8 beams $L = 1500 \text{ mm}$ each).

Fig. 3 shows the approx. cost-savings for unit-prices in correlation to the cross-sections. Fig. 4 shows a comparison of bending-strengths of commercially available SiSiC grades

Tab. 1 Properties of Eco-Light® beams¹⁾

Grade	SiSiC
Bulk density [g/cm ³]	3,11
Apparent porosity [vol.-%]	0
Modulus of rupture/ 4-point loading [MPa]	280
Modulus of elasticity [GPa]	360
Thermal expansion coefficient RT–1000 °C [10 ⁻⁶ /K]	4,9
Thermal conductivity [W/m·K] 1200 °C	24
Specific heat [J/kg·K] 20 °C	600
1300 °C	1200
Limit of application [°C]	1380
Chemical composition [mass-%]	
SiC	90
Si (free)	9

¹⁾ The values quoted above were determined on test specimens and cannot generally be applied to all shapes



Eco-Light®-Advancing Efficiency and unrivaled Service Package

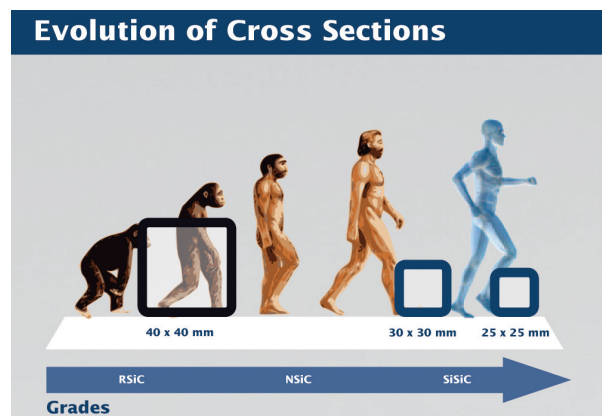


Fig. 1 Eco-Light® (SiSiC) beams – evolution of beam cross-sections

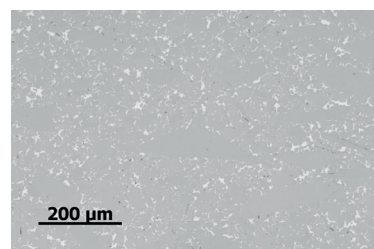


Fig. 2 Microstructure of Eco-Light® beams: dark phase – SiC, light phase – free Si

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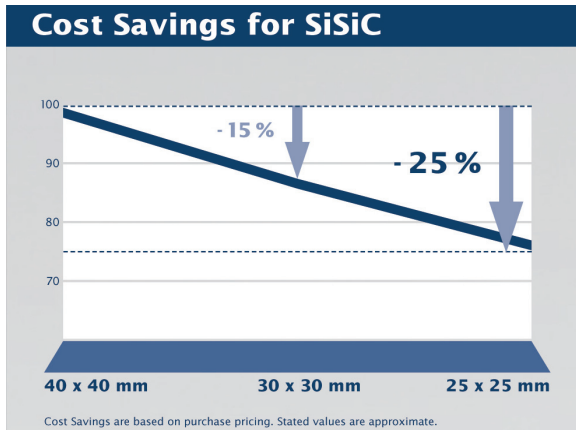


Fig. 3 Approx. cost-savings of small cross-section Eco-Light® (SiSiC) beams vs. 40 mm × 40 mm

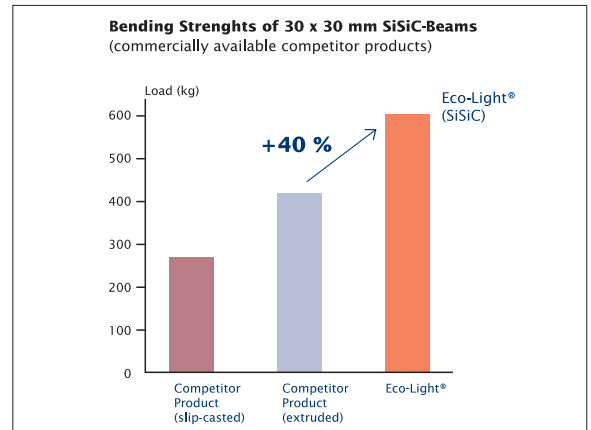


Fig. 4 Extrapolated fracture-stress based on a typical kiln-car-superstructure in sanitary industry

based on a common standard kiln-car-superstructure for a tunnel kiln-car in the sanitary industry. The figures indicated as “load [kg]” are based on statistically evaluated fracture stresses with an extrapolation on the specific loading scenario of the selected beam set-up. The indicated higher fracture-stress of ≈ 40 % vs. competitor products is the result of the superior material properties of Eco-Light®.

Innovative product-package

The most efficient result in terms of a high degree of reliability and economy in service will be achieved in using Eco-Light® beams (Fig. 5) and NSiC Bore-Grids made of CarSIK-NG (Fig. 6–8, Tab. 2). The convective heat flow of the Bore-Grids has a positive impact on the first-pass-yield of various complex sanitary ware parts.

Superior product innovations of Eco-Light® beams

The summary of the advantages in using Eco-Light® beams are as follows:

- Tailor made cross-sections (to eliminate “oversized” beams with a positive impact on the annual gas consumption and to reduce investment costs)



Fig. 5 Eco-Light® (SiSiC) beams 30 mm × 30 mm combined with CarSIK-Z transverse beams and cordierite batts



Fig. 6 Eco-Light® (SiSiC) beams 25 mm × 25 mm combined with CarSIK-NG Bore-Grids

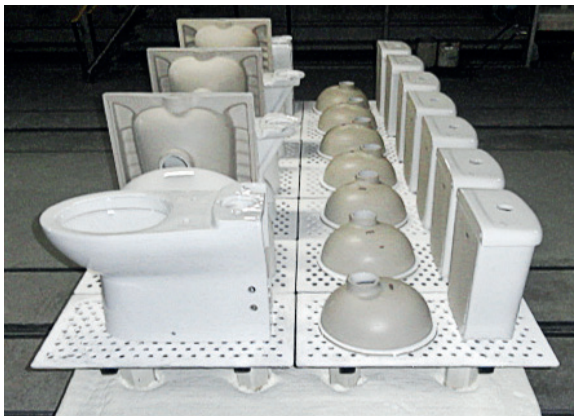


Fig. 7 CarSIK (SiSiC) beams combined with CarSIK-NG Bore-Grids

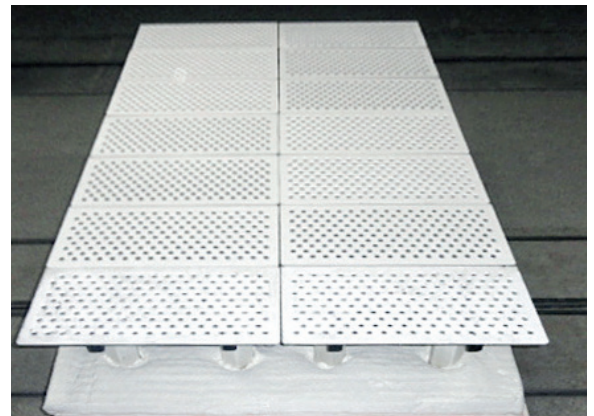


Fig. 8 CarSIK (SiSiC) beams combined with CarSIK-NG Bore-Grids

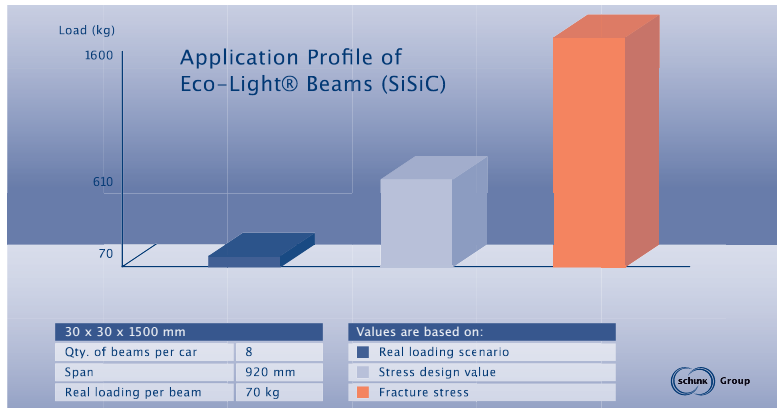


Fig. 9 Individual Loading Profile of Eco-Light® (SiSiC) beams



Life Time Warranty is equal to a max. duration of 10 years according to the conditions of Schunk Ingenieurkeramik GmbH

*Warranty according to the conditions of Schunk Ingenieurkeramik GmbH

Tab. 2 Properties of Eco-Light® beams and NSiC Bore-Grids made of CarSiK-NG

	Eco-Light® Beams	CarSiK-NG Grids
Grade	SiSiC	NSiC
Bulk density [g/cm³]	3,11	2,85
Apparent porosity [vol.-%]	0	<1
Modulus of rupture /4-point loading [MPa]	280	200
Modulus of elasticity [GPa]	360	220
Thermal expansion coefficient RT-1000 °C [10 ⁻⁶ /K]	4,9	4,6
Thermal conductivity [W/m·K] 1200 °C	24	12
Specific heat [J/kg·K] 20 °C	600	750
1300 °C	1200	1100
Limit of application [°C]	1380	1450
Chemical composition [mass-%]		
SiC	90	65
Si (free)	9	-
Si ₃ N ₄ + Si ₂ ON ₂	-	27

Innovative Light-Weight structures are not only available in nature

Eco-Light®-Advancing Efficiency

Eco-Light®-Systems by Schunk Ingenieurkeramik improve firing-processes in various industries. Mass-optimized kiln-furniture made of innovative ceramics ensures a high degree of efficiency and introduction of cost saving potentials.

Minimum input of energy and material for highly efficient performance of function.

Copied from nature.



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- Product warranty of 5 years with option for **extension up to 10 years***
- Superior low warpage-specification of $\leq 0,1\%$ over the entire lengths (on the application side)
- Bending strengths up to 40 % higher (vs. competitor products in SiSiC)
- Unrivaled service package.

Unrivaled service package

Based on ongoing efforts to design unique selling propositions with the goal to provide outstanding service to customers, Schunk Ingenieurkeramik recently released the following currently unrivaled service package for Eco-Light® beams which consist of:

- Economical assessment
- Warranty
- Technical advise
- Service.

To provide kiln furniture which are as economical as possible, Schunk Ingenieurkeramik offers to its customers various special services.

Apart from cost calculations as far as potential savings on the gas consumption for tunnel-kilns is concerned, one of the core-competences is the preparation of an individual loading-profile for Eco-Light®-beams including a graphic presentation of the static loading parameters (Fig. 9). This serves to demonstrate the combination of economic efficiency and safety resulting from the substitution of "oversized" beams by Eco-Light®.

The Eco-Light® product-line is a distinguished example of the development competence of the company's engineers. Not to settle for what has already been achieved, but to challenge for further innovation is the company's goal even in the area of safety. As an additional superior and

currently worldwide unique service feature, Schunk Ingenieurkeramik offers apart from the regular 5 year product warranty for Eco-Light® beams a new dimension of safety – a warranty extension up to 10 years*. Eco-Light® systems by Schunk Ingenieurkeramik GmbH improve firing processes in various industries. Mass-optimized kiln-furniture made of innovative ceramics ensures a high degree of efficiency and introductions of cost saving potentials – minimum input of energy and material for highly efficient performance of function.

