## **DIABON®**

# **Block Heat Exchangers**

# **Process Technology**



Broad Base. Best Solutions.



# Carbon is Future.

SGL Group – The Carbon Company.

Carbon has unique properties. It is indispensable in the production of steel, aluminum and solar energy systems. Carbon increases the performance of wind turbines and reduces the weight of airplanes, cars and sports equipment.



Carbon substitutes other materials and contributes to a reduction in CO<sub>2</sub> emissions.



SGL Group is one of the leading manufacturers of carbonbased products and has the broadest product and technology portfolio, a global sales network and state-of-the-art production sites in Europe, North America and Asia.

### **Process Technology**

The Business Unit Process Technology is a premium technology provider for chemical and related industry process systems, equipment and after sales services. Our focus are high-tech materials for demanding chemical applications. With smart and sustainable solutions for an increasing number of industry we give proof of our strong innovation culture.

### **Broad Base**

Our range of materials:

- ▶ graphite
- ► SiC
- ► PTFE
- ► reactive metals
- ► steel

Our range of services:

- ► process design
- ▶ engineering
- project management
- production and assembly
- commissioning
- ▶ after sales services.

With 9 manufacturing sites in 8 countries and a continually growing worldwide sales and service network, we are always close to our customers.

## RELIABILITY. EFFICIENCY. SUSTAINABILITY.



Powered by our **Broad Base** of competencies, products and services, we offer **Best Solutions** to our customers. For the Business Unit Process Technology, those solutions are characterized by reliability, efficiency and sustainability.

### **Best Solutions**

► Reliability	In a business that strongly depends on reliability we never compromise on quality and safety. Our products deliver dependable results; our services are fast and competent. The long-standing loyalty of our customers proves that we keep our promises – on-time, on-spec, on-budget.
► Efficiency	Tailor made, innovative solutions and an integrated approach on chemistry, materials, technology and design, ensure outstanding efficiency and improved customer value: higher yields, lower operating cost, lower service and maintenance cost, longer service intervals and less downtimes, and the extended product lifetime sum up to significant lower total cost of ownership and to a higher return on investment for our customers.
► Sustainability	In all industries that deal with resource- and energy- consuming processes sustainability is of crucial importance. Based on innovative solutions, more than 60 % of our sales contribute to the saving of resources and energy and to the reduction of greenhouse gases.

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# DIABON<sup>®</sup> Block Heat Exchangers Product Line

DIABON graphite block heat exchangers are flexible in use. They are suitable for all heat exchange and mass transfer processes involving corrosive media. SGL Group's block heat exchangers are used in all branches of the organic and inorganic chemical industry.

Our range of DIABON block heat exchangers includes:

### **Cylindrical Block Heat Exchangers**

- ► CK
- ► CM (new design)

### **Cubic Block Heat Exchangers**

- ► NEC
- ► EC

### **Monoblock Heat Exchangers**

► KU

## All our block heat exchanger series combine the following advantages:

- Suitability for corrosive media on both service and product sides, depending on the design
- High thermal efficiency even with low mass flows
- Easy servicing (easy cleaning and block replacement)
- Increase of block heat exchanger transfer area by adding block elements
- Modularity

### They can be used:

- For cooling and heating of corrosive media
- For heat exchange between two corrosive media



Cylindrical DIABON<sup>®</sup> graphite blocks

- ► As forced and natural circulation evaporators
- ► For full and partial condensation (extended
- bottom header for phase separation on request)
- ► For absorption with simultaneous cooling

### Due to their compactness and modularity our block heat exchangers can be used as:

- Pickling line heaters
- ► Reactor coolers
- ► Vent condensers and sump coolers
- ► Circulation coolers for quenchers
- Preheaters for evaporators
- ► Reboilers
- Steam heaters
- ► Condensers

# Characteristic Features and Applications of DIABON® Graphite



Micrograph of DIABON<sup>®</sup> NS1

### **DIABON® NS1**

### **Properties**

DIABON NS1 is an impervious, synthetic resin-impregnated process equipment graphite with a homogenous material structure. The maximum permissible material temperature is 200°C.

#### Application

Standard material for the production of heat exchangers and HCl synthesis plants as well as for all other pressure- and temperature-stressed components.



Micrograph of DIABON<sup>®</sup> NS2

## **DIABON® NS2**

### **Properties**

Graphite material for superior demands. DIABON NS2 is characterized by higher strength, better corrosion resistance and lower sensitivity to swelling than DIABON NS1 graphite. The homogenous material structure has small pore sizes and a uniform pore size distribution. The maximum permissible material temperature is 200°C.

### Application

Tube sheets, blocks and tubes for heat exchangers in case of higher mechanical stress and/or extremely corrosive media and solvents.



Micrograph of DIABON® CT

## DIABON® CT

### **Properties**

DIABON CT is an impervious, PTFE-impregnated process equipment graphite with a very homogenous material structure. The maximum material temperature is 200° C. DIABON CT is suitable for oxidizing or basic environments and has antiadhesive properties.

### Application

Blocks for block heat exchangers, especially for stainless steel pickling and pharmaceutical industries.

# Carbon Fiber-Reinforced DIABON® Blocks for Improved Reliability



Highly pretensioned carbon fibers are wrapped around the DIABON blocks. The high modulus of elasticity of the carbon fiber ensures that the tension on the reinforcement is retained even under sharply fluctuating load or stress surges – no fatigue is experienced.

The DIABON HF carbon fiber reinforcement does not impair resistance to corrosion because its chemical resistance is identical to that of synthetic resin-impregnated graphite.

Carbon fiber-reinforced block component

Due to the carbon fiber's negative coefficient of thermal expansion (volume increase in diameter), the tension on the reinforcement is further increased when the temperature rises. As a result, the bursting pressure and maximum leakage resistance pressure are improved at higher temperatures than room temperature.

The reinforcement with carbon fibers markedly improves the mechanical properties of graphite components. Today, many DIABON graphite heat exchangers subject to special stresses are fitted with carbon fiber-reinforced blocks and headers.

# **DIABON® Block Heat Exchangers** Cylindrical Design

Cylindrical block heat exchanger, series CK

DIABON block heat exchangers of this design consist of DIABON graphite blocks that incorporate horizontal and vertical passages. The blocks are stacked on a baseplate with corrosion-resistant gaskets between each.

A steel shell fits over the block column and is bolted to the baseplate. The block column is secured by a top pressure plate bolted to the steel shell. The joint between the steel shell and top

header is sealed with an O-ring to allow free movement of the shell. The difference in thermal expansion between graphite and steel is compensated for by helical compression springs.

As a rule, the corrosive medium flows through the vertical passages of the DIABON blocks. Fluid enters the heat exchanger through a DIABON header, flows through all the blocks and is collected on the opposite side in another DIABON header before leaving the equipment.

The service medium, usually in the shell space, passes through the horizontal passages of the DIABON blocks. A baffle cage optimizes the flow through the horizontal passages on the service side.

When two corrosive fluids are involved, a suitable anti-corrosion coating or lining can be offered on the shell side (e.g. in rubber, PTFE, special metal).



Base plate and bottom header, series CK



Base plate, bottom header and one block, series CK



Block column with steel shell, series CK

# Our Cylindrical Design Advantages and Design

### **Advantages**

- Monolithic blocks
- ▶ 200 to 1500 mm diameter
- Modular design
- Outstanding corrosion resistance of DIABON
- ► High heat transfer efficiency
- Multipass operation

### **Field of application**

- ► Condensers
- Coolers
- Heaters
- Evaporators
- ► Falling-film absorbers

### Designs

- Maximum pressure on product and service side: 7 bar
- Maximum material temperature: 200°C
- ▶ Number of blocks: up to 15
- Product passage diameter: 8 or 16 mm
- Heat exchange area:
  - CKS: 0.91 to 600  $\ensuremath{\mathsf{m}}^2$
  - CKDS: 1 to 850 m<sup>2</sup>
  - CKL: 0.72 to 500 m<sup>2</sup>
  - CKDL: 1 to 660 m<sup>2</sup>
  - CM: 1.1 to 171 m<sup>2</sup>
  - CM: 1.1 to 246 m<sup>2</sup>
- Block material brands:
  - DIABON® NS1
  - DIABON® NS2
  - DIABON® NS+
  - DIABON® HF1
  - DIABON® HF2
  - DIABON® CT
  - DIABON® CT+



Cylindrical block column with baffle cage

- ► Seals:
  - PTFE
- SIGRAFLEX®
- Installation options:
  - vertical
  - horizontal
  - tilted
- Inspections according to:
  AD 2000 specification
  - ASME
  - Stoomwezen
  - CODAP

- Main options:
  - Graphite header for gas-liquid separation
  - Distribution header for falling-film absorbers
  - Detachable header for in-situ cleaning of blocks
  - Steel shell lining (rubber, PTFE, etc.) for processes involving corrosive fluids on the service side
  - DURABON plate to minimize erosion by abrasive fluids containing solids, for instance

# Our Cylindrical Design Series CK / CM

## Series CKS

### Features

- Product passage diameter 8 mm
- ► Suitable mostly for clean media
- Suitable for evaporation and condensation stage
- Suitable for low product flows

## Series CKDS

### Features

- Double-row drilling on process side
- Product passage diameter 8 mm
- ► Suitable mostly for clean media
- Suitable for evaporation and condensation stage
- ► Suitable for low product flows
- Suitable for applications requiring a large flow cross-section on the product side

## Series CKL

### Features

- Product passage diameter 16 mm
- Suitable for contaminated media
- ► Easy to clean
- Condensation under vacuum
- Reflux condensation
- ► Falling-film absorption



Block heat exchanger, series CM

## Series CKDL

### Features

- Double-row drilling on process side
- Product passage diameter 16 mm
- ► Suitable for contaminated media
- ► Easy to clean
- Suitable for applications requiring a large flow crosssection on the product side
- Condensation under vacuum
- Reflux condensation

## Series CM

### Features

- Modular design
- Outstanding corrosion resistance
- ► Low weight
- Carbon fiber reinforcement is possible
- Short lead time
- ► Corrosive fluids on both sides
- No external corrosion
- Steel shell-free design
- No risk of cross contamination

# **DIABON® Block Heat Exchangers**

## Cubic Design



Cubic block heat exchanger, series NEC



Base plate and bottom header, series NEC



Base plate, bottom header and one element, series NEC



Cubic block heat exchanger, series NEC

### **Advantages**

- Modular design
- Outstanding corrosion resistance of DIABON
- ► High heat transfer efficiency
- ► Easy servicing and repair
- ► Vertical, horizontal or tilted design
- Multipassing and multiple adaptation features (e.g. cooling water and brine)
- Suitable for pharmaceutical and fine-chemical industries
- ► No risk of cross-contamination

### **Field of application**

- ► Coolers
- ► Condensers
- Heaters
- Interchangers



DIABON® block heat exchanger, series NEC

## Series NEC

### Features

- Lateral distribution chambers are machined within the graphite block
- Lateral plates are manufactured in carbon steel



DIABON® block heat exchanger, series EC

## Series EC

### **Features**

 The service medium in this heat exchanger series is distributed by machined carbon steel plates

Maximum permissible service data				
	EC	NEC		
Max. service pressure	Product side 5 bar	Product side 7 bar		
	Service side 5 bar	Service side 7 bar		
Max. service temperature	200°C	200°C		
Heat exchange area	0.5 to 259 $\ensuremath{m}^2$	0.8 to 145 $\ensuremath{m}^2$		
Block no. / heat exchanger	max. 12 items	max. 12 items		
Product passage diameter	10, 12, 18 and 20 mm	10 mm		

# DIABON® Block Heat Exchangers Monoblock Design

Our KU design can be used successfully between two highly corrosive, pressurized media. This monoblock heat exchanger series is made from a single monolithic DIABON graphite block that includes integrated baffles on the product and service sides produced by milling. The graphite block is sealed on four faces with PTFE-lined steel plates that are braced together.

The heat exchange area varies from 0.5 to 110 m<sup>2</sup>. The maximum product and service pressure is up to 10 bar, the maximum temperature is 200°C.

## Series KU

### **Features**

- Processes with low temperature differential and/or temperature cross
- ► Heat exchange between two corrosive fluids
- Outstanding corrosion resistance of DIABON
- Limited number of gaskets since it is produced out of one single monolithic block
- Very versatile design as far as the flow rates on both sides are concerned
- Rugged design



Base plate and DIABON® block, series KU



Open DIABON® monoblock heat exchanger, series KU



DIABON® monoblock heat exchanger, series KU

### **Field of application**

- Interchanger
- ► Heater
- ► Cooler

# Technical Specifications for Block Design

The design calculations for DIABON graphite block heat exchangers are carried out by our experienced application engineers. The thermal design calculations are performed with a tried and tested program developed by ourselves or with the help of internationally proven and recognized software such as

- Aspen Tasc+
- ► HTRI



Screen shot of an HTRI design calculation

Heat and mass transfer processes are modeled using Aspen Plus and the equipment is then designed separately.



Screen shot of an Aspen Plus design calculation

HTRI software is used to optimize the geometry of the DIABON graphite block heat exchangers and to calculate the necessary mechanical strength.

On request, we would be pleased to assist you in the selection of the most suitable heat exchanger for you application and provide a free quote.



## **Quality Management** and After Sales Service



### **Quality Management**

Continuous quality assurance is an integral part of the SGL Group corporate philosophy.

Our quality management system is certified in accordance with ISO 9001:2008. In order to guarantee consistently high quality to our customers, we work according to a key performance indicator orientated quality management system. Depending on specifications we are able to meet specific requirements like the Pressure Equipment Directive 97/23/EC Annex III, Module H/H1, AD 2000 Merkblatt N2 as well as ASME "U" Stamp, Section VIII, Part UIG.



After Sales Services – Anytime and Everywhere

We take care of our products during the entire operational lifetime. We aim to provide the best customer service anytime and everywhere.

- Maintenance genuine spare parts supply, failure analysis, repair, field service
- ► Fast emergency support
- ► Start-up assistance
- ► Consulting for continuous improvement

Our service specialists as well as our service centers work in a global network to support you best.

## Process Technology Our Products



### **System Solutions**

- ► Syntheses
- ► Distillation and concentration
- ► Purification
- ► Dilution
- Absorption
- Desorption
- Thermal destruction and recycling
- Reactors and converters
- ► Heat storage
- ▶ ...



### **Equipment Solutions**

- Graphite and SiC heat exchangers shell & tube, block and plate type
- ► Columns and internals
- ► Vessels
- ► Quenchers
- Pumps
- ► Rupture discs
- PTFE piping and bellows
- PTFE hoses
- ▶ ...



### **After Sales Services**

- ► Maintenance
- Emergency support
- ► Start-up assistance
- ► Consulting
- ▶ ...

## **Regional Sales & Service Center**

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The data contained herein represent the current state of our product knowledge and are intended to provide general information on our products and their application spectra. In view of the variety and large number of application possibilities, these data should be regarded merely as general information that gives no guarantee of any specific properties and/or suitability of those products for any particular application. Consequently, when ordering a product, please contact us for specific information on the properties required for the application concerned. On request, our technical service will supply a profile of characteristics for your specific application requirements without delay.

Process Technology

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