WILK-GRAPHITE
EQUIPMENT FOR THE CPI

GRAPHITE HEAT EXCHANGER AND COMPONENTS FOR CORROSIVE APPLICATIONS
Wilk - Graphite

Wilk - Graphite stands for first class graphite equipment from one of the largest producers worldwide. All the products offered exclusively to the international markets represent the state of the art of graphite manufacturing and look back on long reference lists with thousands of units installed in various chemical surroundings. Every piece of equipment installed shows an excellent, competitive life time even in severe applications.

Wilk-Graphite provides technical service, an international network and the ability to serve our clients with high quality products.

Wilk-Graphite has been founded 2005 by Andreas Wilk, who has been in the field of corrosion protection and for many years. It is our goal to support the international competitiveness of our customers with economical interesting pricing for lower investment and maintenance cost. Co Owners of Wilk-graphite are Mr. Feng as the owner of Nantong Sunshine and Ansgar Hachenberg

Nantong Sunshine Graphite Equipment Technology Co. Ltd
The equipment is produced by the privately owned, independent company Nantong Sunshine Graphite Equipment Technology Co. Ltd, who is Chinas market leader. Since 1995 graphite equipment like heat exchangers are manufactured and sold first mainly to local companies, then to Joint ventures and finally also to foreign companies. In addition to the production of high quality equipment Sunshine developed its own engineering department, mainly focusing on acid recovery processes and HCL synthesis units.
The leading position in the market made Sunshine the preferred supplier being familiar with the needs of the chemical industry.

Raw graphite supply and development is secured by own independent sources.

Tectrion

Our professional service is performed by Tectrion, who were newly founded as the follow up company of Bayer Industry Service. Many years of experience in the field of graphite equipment maintenance for the Bayer AG, a large number of skilled technicians and a fully equipped workshop make Tectrion the preferred partner for Wilk–Graphite. Both parties agrees on a long term partnership. Also the storage of Wilk-Graphite is located in Leverkusen.

A 24 hour service at our customers side is secured.

Guarantee

Guarantees on the mechanical performance and if asked for, the thermodynamic design are included and follow the European standards.

References

The heat exchangers and all other units are installed in many different applications for years with excellent results. More than 5000 references are available. Please ask for a reference for your process.

Nantong Sunshine Graphite Technology

· more than 350 Employees
· production capacity of 50,000 m²/a
· privately owned since 1995
· more than 5000 units installed
· all design and development in-house

Service

Wilk-Graphite offers full service from general technical support, thermodynamic lay out to a after sales service. In an emergency case we are set up to provide fast service.

· Service point in Germany
· Fast delivery of spare parts ex stock from Germany or by air from China
· Local support by experienced representatives
· Fast delivery from China within only a few days in case of an emergency

ISO - Certificate

Nantong Sunshine has been certified according to ISO 9001:2000 by European Bureau Veritas and is subject to routine audit.

International Standards

All products are designed and manufactured according to international standards like the European Pressure Code. The units are tested by independent authorities like the TÜV in China. The nozzle connections may follow ASME or DIN measurements. Please ask for additional norms.
Graphit

Graphite has been established in the past as a well known, reliable material for the Chemical Process Industry. Using various impregnation materials as phenolic resins or PTFE dispersions graphite offers an excellent chemical resistance. With the high thermal conductivity the material became the first choice not only for heat exchanger, which today are available in different designs for many applications, but also for many other equipments used in the CPI. Please see the table on the left for the physical properties.

Graphite made in China by Nantong Sunshine has a particle size of only 0.2 or 0.8 mm and a low surface roughness. The result is an excellent mechanical strength and thermodynamical performance. Following the international standard the units made by Sunshine can replace existing systems one by one.

Beside the high quality graphite also graphite with a particle size of 2 - 3 mm is available, which suits many applications.

Graphite has been successfully installed in all those applications where other material fail because of limited chemical resistance or the price of graphite was very favourable. The materials replaced are exotic alloys like tantalum or hastelloy, glass as a very fractal material and other materials like ceramics.

In the years 2005 to 2009 numerous long term test regarding the mechanical performance or chemical resistance have been executed by our customers or independent research laboratories. Please ask for your copy.

<table>
<thead>
<tr>
<th>Properties</th>
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<tbody>
<tr>
<td>max. Partice size</td>
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<tr>
<td>density</td>
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<tr>
<td>compressive strength</td>
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<td>tensile strength</td>
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<td>bending strength</td>
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<td>thermal conductivity</td>
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<td>lin. coeff. for thermal exp.</td>
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<td>allowable temperature</td>
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<td>bursting strength (hydr.)</td>
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<td>ash content</td>
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Impregnation
- Phenolic resin
- Furan resin
- PTFE

Application
We look back on more than 5000 references and a corrosion table including many different chemicals, temperatures and mixtures. If we do not have information about the chemical resistance of your media, we use our laboratory to test.

Pipe Materials
Carbex® pipes are available in different kinds for different applications. The variety of the pipes enables us to choose the best pipe for each of our customers application.
- Carbex® T extruded from a mixture of Graphite and Phenolic resin
- Carbex® TB extruded, calcinated and impregnated
- Carbex® TS extruded, graphitized and impregnated
- All pipes can have an optional fiber support to increase the bursting pressure

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Pipes</th>
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<tr>
<td>Carbex®</td>
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<td>mm 3</td>
<td>kg/cm³ 1,85 - 1,90</td>
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<tr>
<td>kg/cm³ 1,89 - 1,92</td>
<td>1,97 - 1,98</td>
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<tr>
<td>Mpa 65 - 74</td>
<td>Mpa 82 - 91</td>
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<td>Mpa 16 - 19</td>
<td>Mpa 24 - 26</td>
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<tr>
<td>Mpa 29 - 32</td>
<td>Mpa 40 - 44</td>
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<tr>
<td>W/mk 55</td>
<td>W/mk 58</td>
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<tr>
<td>10-6 /K bei 130°C 5,4 - 5,7</td>
<td>8,2</td>
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<tr>
<td>°C 180</td>
<td>°C 200</td>
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<tr>
<td>% 0,05</td>
<td>% 0,05</td>
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</tbody>
</table>

*All data are related to phenolic resin impregnated material  **All pipes can be offered with fibre support (T)
Cylindrical Blocks

The cylindrical block heat exchanger is based on round graphite blocks which may reach diameters of up to 1400 mm. It has pass way drillings for the product and the service medium. The size of the drilling varies with the properties of the media from 10 to 24 mm. An optimized drilling is needed to achieve best results for each process. The individual blocks are sealed with PTFE gaskets against each other and the whole package is fastened by springs. The sealing system works in the temperature range of the unit and has been established for many years. By innovative baffles the service media can be adopted to the process individually, which allows an optimized design.

Both sides of the heat exchanger may be corrosion resistant, by different shell materials like stainless steel, rubber lining other materials. Block heat exchangers are used for many applications because of their safe operation. The compact design offers low space requirement and the modular construction allows easy maintenance, cleaning and supports the adaption of the units for changed process conditions. The units have a low pressure drop and can be customized according to individual requirements for pressure, temperature, fouling and process media.

For Block heat exchanger there are 2 different designs available. The major difference of the type XYK and the type YKA is the way the service medium is let through the blocks. Please see the pictures below.
Rectangular/Cubic Blocks
In addition to the cylindrical version, rectangular designs have been developed for various tasks like condensation and successfully introduced to the industry. Compared to the cylindrical design, the service medium is not lead through a steel shell, but is transported by elbows and cast iron shields from one block to the next one. This system is very convenient for maintenance as each block can be cleaned individually. The blocks are fixed horizontally by tie rods and the system therefore must take pressure in one direction only. PTFE gaskets are used for sealing.

Block heat exchangers are often used as condenser, because the condensate can be collected in the bottom part and can be removed easily.

-20°C up to 150°C with phenolic impregnation
-20°C up to 240°C with PFA dispersion
3 bar, (10 bar on request)
5 bis 300 m²/unit
380 x 380 x 380 mm, 380 x 380 x 660 mm
380 x 760 x 660 mm, 380 x 1140 x 660 mm
Drilling:
10, 12, 14, 18, 20 mm
10, 12, 14 mm
Carbon steel, stainless steel, customised

Design Options
1) horizontal installation
2) both sides corrosion resistant
3) optimized condensate removal

Service
- thermodynamic design
- maintenance training
- standard blocks on stock
- customized design
- service teams

Technical Data
operating temperature
-20°C up to 150°C with phenolic impregnation
-20°C up to 240°C with PFA dispersion
3 bar, (10 bar on request)
5 bis 300 m²/unit
380 x 380 x 380 mm, 380 x 380 x 660 mm
380 x 760 x 660 mm, 380 x 1140 x 660 mm
Drilling:
10, 12, 14, 18, 20 mm
10, 12, 14 mm
Carbon steel, stainless steel, customised

The diameter of the pass way is designed according to the process data. Heat exchanger are made according to the European Pressure Code, DIN and ANSI norm.
Shell and Tube Heat Exchanger

Shell and tube or tubular heat exchangers are made of graphite tubes, which are connected to graphite tube sheets. On the shell side baffles support the tubes mechanically and guide the media flow.

The heat exchangers offer a low pressure drop and are ideal for applications where large mass flows require heat transfer areas of up to 1,000 m² per unit.

The diameter of the tubes is selected according to the media. Two standard sizes are available, which cover most applications. In order to achieve higher mechanical strength the tubes can be supported by carbon fibers. The units are successfully used as cooler and condenser.

The units are easy to maintain. If needed single pipes can be plugged.

Fiber supported pipes are available for higher pressure and temperatures.

Applications
- evaporator
- condenser
- cooler
- heater
- falling film

References
- Hydrochloric acid
- Sulphuric acid
- HF
- Phosphoric acid
- Chlorinated FCKW
- Waste acids

Service
- thermodynamic design
- maintenance training
- customized design
- Service teams

Technical Data
- operating temperature: -20°C up to 200°C
- operating pressure: 6 bar on shell side, 8 bar on request
- operating pressure: 6 bar on tube side
- heat transfer areas: 5 to 1,000 m²
- tube dimensions: 32/22 mm or 50/36 mm
- tube length: Carbon steel or customized
- shell options: The diameter of the drilling is designed according to the process data. Heat exchangers are made according to the European Pressure Code, DIN and ANSI norm.
Floating Head or single tube sealing
Due to the difference in thermal elongation of the graphite bundle and the steel shell the bundle can be subject to tensile or compressive strength. In order to compensate this stress the bundle can move independently from the shell by a floating head.

For severe conditions we have developed a single tube sealing, which reduces the stress on the tubes even more.

Falling - Film Absorber

The turbulent graphite falling film absorber offers the benefit of a high absorption rate for a high concentrated medium together with a low outlet temperature and the result of a low concentrated HCL in the tail gas (usually 0.8 - 1.2 t/d per single tube). There is no contamination of the media to be found.

An example for the usage of this unit is the absorption of HCL for the production of hydrochloric acid. It is also successfully used for the falling - film absorption of gases like SO2, NH3, P2O5 or H2S.

Options
Model I: bottom sealer made of graphite
Model II: bottom sealer made of steel lined rubber

Technical Data
- operating temperature: < 170°C
- operating pressure: 1 bar tube side, max 6 bar; 4 bar shell side, max 6 bar
- heat transfer areas: 5 up to 800 m²
Columns and Column Internals

Column internals like support grids, liquid distributors or inlet pipes are used to support the process in a column. Graphite has been chosen many times because of its many design options, which allow individual constructions for many different processes.

Columns and internals are available up 3000 mm diameter.

Columns and column internals are designed individually according to the process data. This service is also available including the related guarantees. Many different forms and designs result from the many different tasks. Therefore we can only show some options here and ask for your individual data.

Support grids
Support grids are used in columns to support packing made of various materials suitable for the given process. The construction follows the maximum allowable flow rate, the required load and the size of the packing. It may either be flanged in between two column section, or seated on a support ring.

Liquid distributor
Distributors for liquids are usually individually designed according to the data of the process. They serve to distribute the liquid of a process on the packing and at the same time allow the gases to pass. Accordingly they can have all kinds of different shapes and designs.

Inlet pipes
At certain points of a column the media involved in the process needs to be fed to the inner parts of the column, which can be sophisticated sprays or a simple inlet.

Customized design
Many different kinds of column designs are available on request. Please send us your process data for an optimized lay out.

Graphite columns
Columns made of graphite up to a diameter of 3000 mm are offered and designed according to customized processes. Please ask for details.
Customized Heat Exchanger

Cooler for high viscosity media
This modified rectangular block heat exchanger has been developed to cool high viscosity acids. The benefits achieved are:

- counter current cooling
- both sides corrosion resistant
- media pass ways of 16 to 24 mm with several drains due to high viscosity of the media
- short media holes for easy cleaning of crystallization
- self flow needs no feed pump
- F4 pickled graphite provides extremely good chemical resistance as an option

Technical Data
- operating temperature: up to 240°C
- operating pressure: 2 bar, product side, 3 bar water
- heat transfer areas: 5 up to 300 m²

Sulphuric Acid Dilution Cooler

For the dilution of sulphuric acid the unit is divided into two parts. In the upper part the acid gets mixed, diluted and distributed. This part consists of PTFE impregnated graphite and a two layer special mixing area for optimized mixing results. The lower part is a standard circular block heat exchanger unit used as a cooler.

This unit is used to reduce the concentration of sulphuric acid from 98% down to 65% or less and cools the acid down to 40°C in one step.

Technical Data
- operating temperature: -20 °C to 180°C
- operating pressure: 1 to 4 bar
- heat transfer areas: 5 up to 500 m²
Waste Sulphuric acid recovery process
In the process of for example the production of Titanium Dioxide one of the byproducts is low concentrated sulphuric acid, which needs to be recovered. The acid must be concentrated from 20% to at least 70% to be used in the process again, which is achieved by various evaporation steps and further treatment to the contaminated acid.

High Purity HCL Gas
Based on 30% or lower concentrated HCL high purity HCL is achieved after purifying columns and following condensation steps. This process has been optimized in cooperation with European partners.

Hydrochloric acid recovery
In between the 3 most commonly used acids Hydrochloric acid is widely used in various applications. As a byproduct it can be recovered and purified in our process, which has continuously been improved and secured by 3 patents. Our major field of application is the hydrochloric acid from chloro acetic acid industry, chlorinated paraffin wax industry and chloride benzyl industry.

Acetic acid concentration
Starting from 15 – 25% diluted acetic acid our process reaches 99% concentrated acid. The process has been developed with European partners and uses the benefits of our PTFE impregnated graphite.

Waste gas treatment
Waste gases coming from the production processes have to be absorbed and recycled. In this absorption column gases are absorbed, recycled in one step, simplifying the process of repeated absorption and cooling. References are available for the treatment of gases like: HCL, CL2, SO2, H2S, HF, P2O5.

The units are standardized with capacities from 9 t/d up to 150 t/d for 35% - HCL. Customized units are available.

Technische Daten
Absorption rate: 99.9%
Absorption/day: 9 bis 150 t/d (35% HCl)
Max. Flow of Absorbant: 140 kg/h
Cooling water flow: 2 t/h
HCL-Synthesis

HCL-Synthese-units
During the process of hydrochloric acid synthesis the chlorine gas reacts with water by adding energy to HCL. This process is often used because of its reliable performance and the relatively small units.

The chemical reaction takes place in a furnace which is cooled by separated cooling water. Further steps may include absorption and the cooling of the HCL in one unit.

More than 100 turnkey units designed by Sunshine are installed with more than 15 years of life time.

Water jacketed HCL Synthesis furnace
This very simple unit allows the synthesis in a very neat, mechanically strong unit, which usually serves for more than ten years. It consists of the inlets for the gas and the water supply as well as the burner. In order to take away the heat, cooling water is lead to the outside of the burning chamber.

Three in one HCL furnace
This unit design allows three steps in one unit. The synthesis, absorption and cooling of the hot HCL down to 40 – 50 °C outlet temperature takes place in only one unit. With more than 100 units installed the technology presents not only the state of the art but includes some important patented features, which allow much higher efficiency than competitive units. The increase in efficiency is achieved by better wall protection in the reaction zone and more efficient heat transfer of the cooling water.

These units may be adopted to given processes or may be included in a complete system that can be offered as a turn key project Three in one furnace

Benefits:
- synthesis, absorption and cooling in one step
- high efficiency
- long lifetime
- turn key system available
- fits into given systems
- more than 100 units installed