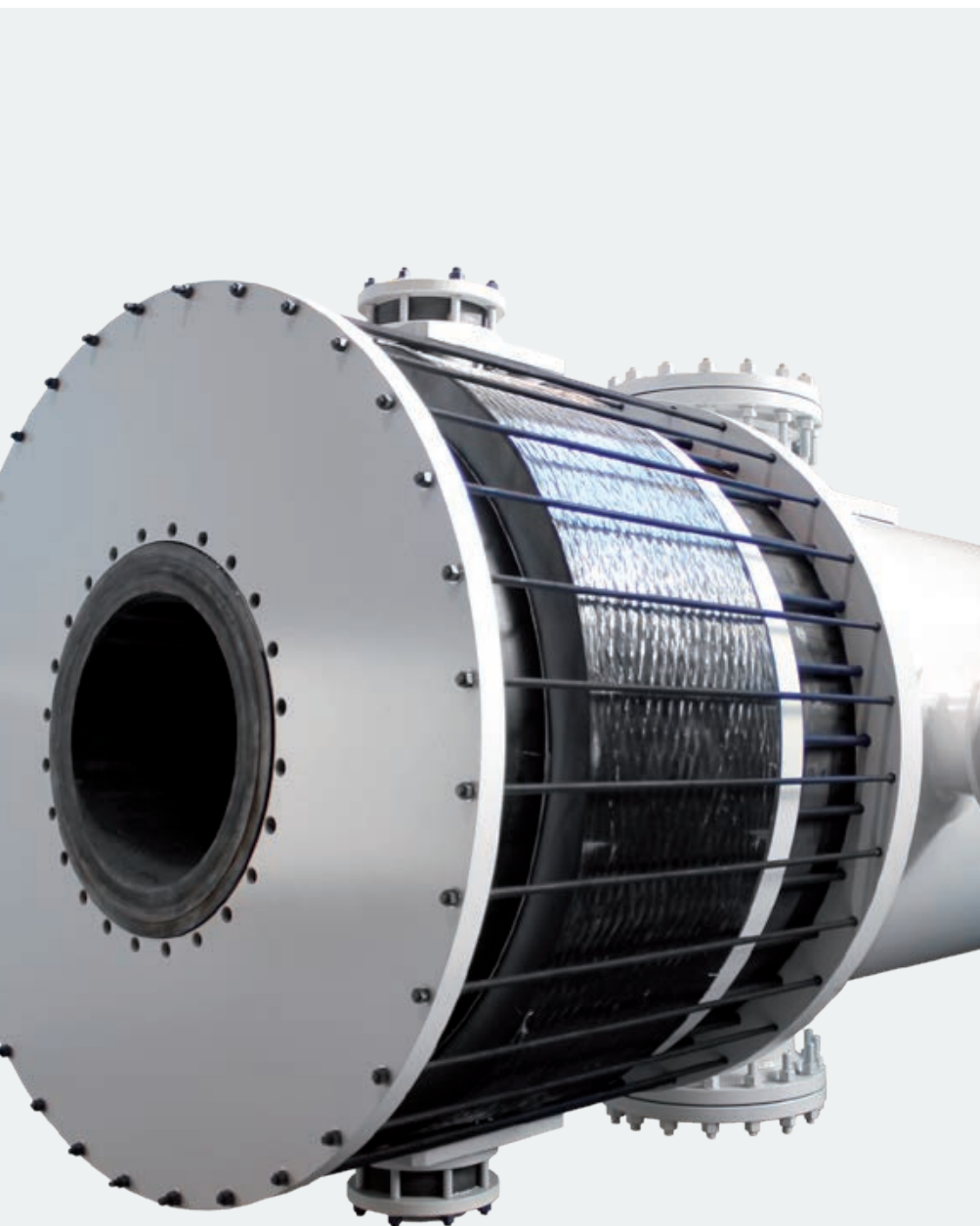




CORROSION RESISTANT

HEAT EXCHANGERS



- Graphite Block and Shell & Tube
- Silicon Carbide Block and Shell & Tube
- Tantalum Shell & Tube
- Niobium Shell & Tube
- Zirconium Shell & Tube
- Titanium Shell & Tube
- Nickel Alloy Shell & Tube
- Stainless Steel Shell & Tube
- Service & Maintenance

WORLDWIDE HEAT EXCHANGER LEADER WITH SOLUTION-ORIENTED APPROACH

The Mersen AntiCorrosion Equipment activity is internationally recognized for its expertise in the design and manufacture of corrosion resistant process equipment (including the materials graphite, silicon carbide, tantalum, zirconium and PTFE). Mersen also has an in-depth knowledge of the process technologies requiring our AntiCorrosion Equipment and can provide the basis equipment only, up to skid-mounted turn-key process packages.

	HEAT EXCHANGERS	REACTORS, VESSELS AND COLUMNS	PIPING BELLOWS ACCESSORIES	PROCESS TECHNOLOGIES
GRAPHITE	 BLOCKS, CUBIC AND TUBES		 RUPTURE DISCS	 FEEDSTOCK H ₂ SO ₄ HCl Cl ₂ HBr Br ₂ P ₂ O ₅ FeCl ₃ Brine Flue Gas
SILICON CARBIDE	 BLOCKS AND TUBES			
TANTALUM	 TUBES AND BAYONETS		 TANTALUM SMALL PARTS	
ZIRCONIUM				
TITANIUM				
NICKEL ALLOYS				
PTFE			 PIPING AND BELLOWS	
AFTER-SALES SERVICE				PROCESS FUNCTIONS Absorption Burner Concentration Dilution Gas Drying Distillation/ Desorption/Stripping Gas cleaning / Vent treatment Inorganic removal Organic removal Production Temp. Control Vaporizer Vacuum system



WHY MERSEN?

- 50-years thermal and mechanical design experience
- Solutions to cope with corrosive and hot applications
- Reliability and quality of all engineered equipment
- Efficiency to design the optimized solutions to provide higher yields, lower maintenance costs and longer product lifetime

SUMMARY

- 1 FEATURES AND APPLICATIONS OF GRAPHILOR® 3 P.4
- 2 GRAPHITE BLOCK HEAT EXCHANGERS P.5, 6
- 3 GRAPHITE SHELL & TUBE HEAT EXCHANGERS P.7, 8
- 4 SILICON CARBIDE SHELL & TUBES HEAT EXCHANGERS P.9
- 5 SILICON CARBIDE BLOCK HEAT EXCHANGERS P.10
- 6 TANTALUM EQUIPMENT P.11
- 7 ZIRCONIUM AND TITANIUM EQUIPMENT P.12
- 8 METALLIC SHELL AND TUBE HEAT EXCHANGERS P.13



THERMAL DESIGN EXPERIENCE TO SERVE YOUR PROJECTS

Mersen has over 50 years of thermal design experience and applications expertise. Our engineers have a long history of designing thermal equipment, based on our customer's applications in order to optimise thermal efficiency, appropriate performance and easy maintenance.

Several design tools are used to provide thermally efficient heat exchangers, which achieve the specified process constraints:

- Thermal design tools (In-house Programs, ASPEN B-JAC, X-Designer...)

Our integrated Engineering and Design Department has the capability to manage all aspects of new projects, as well as the refurbishment and upgrading of existing process equipment. With more than 450 mechanical designs completed each year, our highly experienced Engineering Staff provides drawing and design support using the following software tools:

- Drawing software: 2D/3D CAD
- Mechanical design software such as Autopipe Vessel (formerly Microprotol) to produce the calculations required by the design codes (ASME, EN 13445, CODAP, AD 2000-Merkblatt), or ANSYS for the specific Finite Element Analysis.
- Mechanical design programs for heat exchanger design. These in-house mechanical design tools are continuously improved based on Mersen's long experience.



HIGHLY SKILLED ENGINEERING DEPARTMENT



WORLDWIDE PRODUCTION SITES AND LOCAL SERVICE CENTRES

Mersen is not only an equipment supplier. We can also provide support for all the products we deliver throughout their life cycle and offer a broad range of services. After-sales service can be carried out at our Mersen sites or directly on the customer's site

- Worldwide production sites : USA, Morocco, Germany, France, China, UK, India
- Local repair-shops : South Africa, Korea, Taiwan, Spain, Brazil, Japan, Italy, Turkey and the Netherlands.
- Maintenance and spare parts supply, including repair and refurbishment services
- Fast emergency assistance & Start-up services
- Process lines check-up and diagnosis

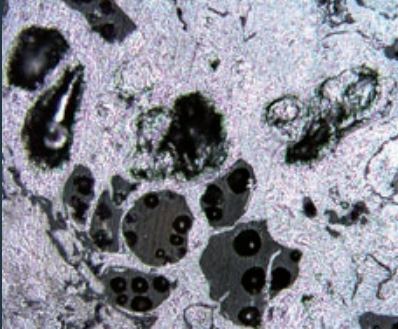
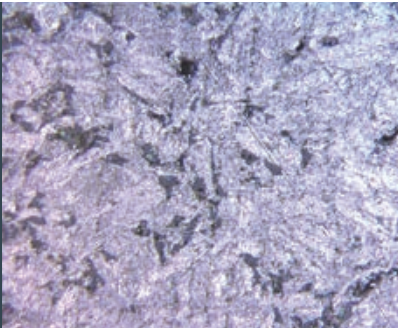
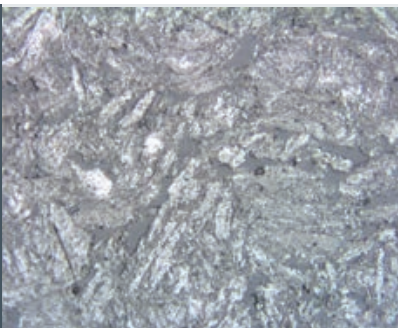
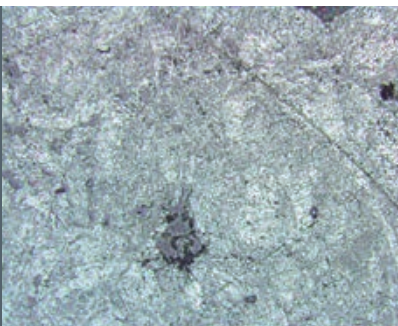
01 FEATURES AND APPLICATIONS OF GRAPHILOR® 3

Graphite is a material with ceramic properties. It is widely used for chemicals applications due to its excellent thermal conductivity, chemical corrosion resistance and mechanical strength.

There are 2 grades of graphite used : extruded and isostatic.

Mersen produce internally Graphilor® based on raw materials manufactured in its American and Chinese plants.

The German Notified Body (TÜV SÜD) has tested and determined the maximum temperature and mechanical resistance for each of Mersen's impregnated graphite grades. **They have the highest homologation for tensile strength (up to 36 Mpa).**

	MICROGRAPH	FEATURES	APPLICATIONS
GRAPHILOR® BS		<p>Extruded graphite with phenolic resin impregnation.</p> <p>Maximum service temperature 200°C</p>	<p>Standard graphite used for the manufacture of heat exchangers and other components.</p>
GRAPHILOR® XBS		<p>Advanced small grain size (20µm) isostatic graphite with phenolic resin impregnation.</p> <p>Maximum service temperature 220°C</p>	<p>Graphilor® XBS is used for the manufacture of heat exchangers especially when process conditions are subject to mechanical stress.</p>
GRAPHILOR® XC		<p>Advanced small grain size (20µm) isostatic graphite material for very high temperature conditions.</p> <p>Exclusive carbon impregnation developed by Mersen.</p> <p>Maximum service temperature 400°C</p>	<p>Graphilor® XC is used mainly for the production of hydrogen chloride synthesis units components, especially when temperature process conditions are very high</p>
GRAPHILOR® XTH		<p>Superior graphite material for very corrosive conditions notably oxidizing and alkaline environment.</p> <p>Exclusive Mersen process : 100% PTFE-impregnated isostatic graphite.</p> <p>Maximum service temperature 250°C</p>	<p>Graphilor® XTH is the best material for the Polybloc heat exchangers used in the stainless steel pickling lines or as condensers in the API industry.</p>

02 GRAPHITE BLOCK HEAT EXCHANGERS



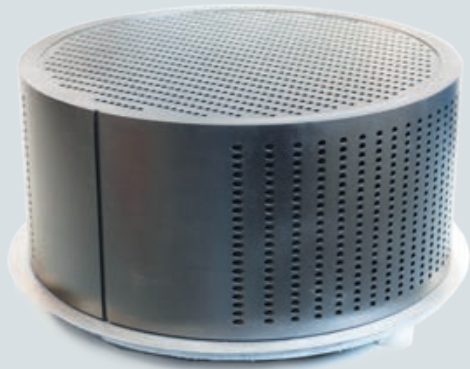
DESIGN AND MANUFACTURE OF BLOCK HEAT EXCHANGERS FOR OVER 50 YEARS

Mersen has designed and manufactured block heat exchangers for over 50 years, with more than 10,000 units in service in almost 50 countries.

WHY MERSEN?

- 10,000 unites in service in almost 50 countries
- 400°C maximum temperature resistance of Graphilor®3
- In-house production of isostatic graphite and impregnation
- High corrosion resistance with exclusive carbon (XC) and PTFE (XTH) impregnation
- Flexible design for multiple applications

GRAPHITE POLYBLOC® HEAT EXCHANGERS



LARGE HEAT TRANSFER AREAS WITH MODULAR DESIGN

- Large exchange surface areas (up to 300 m²) with high heat transfer
- Headers - available in Graphilor®, stainless steel, reactive metals, PTFE or rubber lined steel
- Large range of block sizes from 140 to 1,500 mm diameter
- Design for high pressure up to 16 barG (service) and 12 barG (process)
- PTFE Bellows - fitted to graphite nozzles
- Drilling adapted to process constraints with large diameter holes for fouling process
- Multi-pass arrangements possible for both process and service sides
- Rigilor® treatment to protect the surface of the blocs against erosion in some abrasive processes

EASY MAINTENANCE

- Easily dismantled system (plates with reactive metals, PTFE or rubber), cleaning and validation

EXTENSIVE REFERENCE LIST

- List available upon request for main market applications such as pickling baths, coolers, evaporators, absorbers, condensers, H₂SO₄ dilution.

GRAPHITE CUBIC BLOCK HEAT EXCHANGERS



COMPACTNESS

- slots or double drilling on process side effectively doubling the process side surface area making units ideal for condensing duties

SPECIAL GMP DESIGN FEATURES

- fully draining with no process to service gaskets

DESIGN TO SUIT CUSTOMER NEEDS

- Headers - available in Graphilor®, carbon and stainless steel, PTFE or rubber lined steel
- No hidden gaskets - single piece core blocks (250, 400, 500 & 600mm square and up to 1800mm long)
- Heat exchange areas - from 1m² to 100m²
- Drilling - adapted to process requirements (6.5, 10 & 16mm holes in single or double drilling patterns)
- Design pressure - up to 10 barG on process and service side
- PTFE Bellows - fitted to graphite nozzles to remove pipework stresses
- Interchanger - most optimum solution for corrosive fluids on both process and service side
- Multi pass arrangement - on both process and service side gives the most efficient thermal design using true counter-current flow

EASY MAINTENANCE

- Easily dismantled for overhaul, cleaning and validation

EXTENSIVE REFERENCE LIST

- List available on request for main markets (Fine Chemical & Pharmaceutical, H₂SO₄ Dilution, interchanger for 2 corrosive fluids)

03 GRAPHITE SHELL & TUBE HEAT EXCHANGERS

WORLDWIDE LEADER IN THE MANUFACTURE OF GRAPHITE TUBES FOR OVER 50 YEARS

Mersen has designed and manufactured graphite shell and tube heat exchangers for over 50 years with units in service in the most demanding processes, especially in the phosphoric acid industry.

GRAPHITE POLYTUBE® HEAT EXCHANGERS

LARGE HEAT TRANSFER AREAS AVAILABLE

- High exchange surface (up to 1,000 m²) and high heat transfer
- Designed for high pressure : : 11 barG (service) and 7 barG (process)
- Special shell designs adapted to corrosive service fluids

EXCLUSIVE 6-METER-LONG TUBES IN GRAPHILOR® 3 WITHOUT A JOINT

- The absence of a joint makes the tubes less fragile. Tubes can be optionally reinforced with carbon fiber.

SAFETY OPTIONS

- Rigilor® consists of a layer of carbon fiber which reinforces the graphite and improves the erosion and abrasion protection (Mechanical resistance is better and Erosion resistance is increased six times)
- Carbon sleeves can be cemented in the tube sheet passages to protect against erosion.

EXTENSIVE REFERENCE LIST

- List available on request for market applications (phosphoric acid evaporators, sulfuric acid heaters, hydrochloric acid re-boilers)

WHY MERSEN?

- 50-years of experience
- N°1 worldwide producer of graphite tubes
- Exclusivity 6-meter jointless graphite tubes (option : fiber tubes)
- Highest mechanical resistance for tubes and tubesheet certified by TÜV SUD



HEADERS

- Graphilor® 3 XBS standard header
- Other materials are available: stainless steel, carbon steel, CL-Clad® tantalum or massive metals (tantalum, zirconium, titanium), rubber lined, PTFE lined, glass lined.
- Fast dismantling design option for easy cleaning and re-tubing.
- Special design according to the process (falling film, multi-pass process, kettle, phosphoric or sulfuric acids)

TUBE-SHEET

- Monolithic design
- Alternative ML technology for diameters between 36" and 82"
- Rigilor® option to increase abrasion resistance
- Amorphous carbon sleeves to increase erosion resistance
- Graphilor® 3 XC option for severe application (up to 400°C)

GRAPHILOR® 3 TUBES

- Tubes in Graphilor® 3
- Fiber-reinforced tubes
- Diameters : 25/16, 32/22, 37/25 and 51/38. Special diameter on request.

SHELL

- Diameter 10" – 82"
- Carbon steel shell as a standard
- Other materials are available: stainless steel, carbon steel, CL-Clad® tantalum or massive metals (tantalum, zirconium, titanium), rubber lined, PTFE lined, glass lined.

GASKETS AND BOLTS

- PTFE solution (braid, pure expanded PTFE, modified PTFE with glass or graphite..)
- Elastomer solution
- Graphite solution

04

SILICON CARBIDE (SiC) SHELL & TUBES HEAT EXCHANGERS

SILICON CARBIDE : AN ADVANCED CERAMIC MATERIAL WHICH OFFERS THE FOLLOWING ADVANTAGES

- Chemicals resistance to strong acids, bases, oxidants and chlorinated organics
- Completely impervious without the use of any impregnants
- Non-contaminating for high purity applications
- Excellent thermal conductivity resulting in efficient heat transfer and immunity to thermal shock
- Excellent mechanical properties and thermal shock resistance
- High erosion resistance allowing higher velocity and improved heat transfer

ADVANTAGES

- Flexible design with large number of options
 - Single or double “O” ring design
 - Single fixed tube-sheet design
 - Floating tubesheet design
 - Double tube-sheet design
- Materials of construction for shell and headers
- Multi-pass process flow

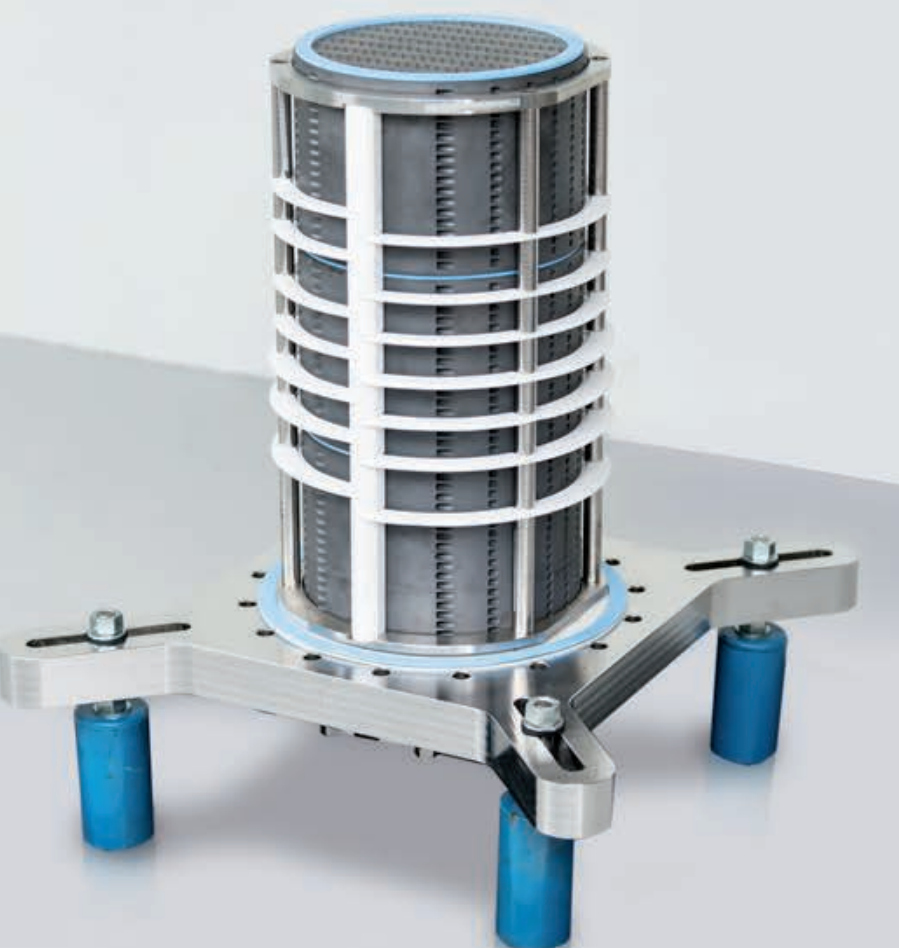
CONSTRUCTIONS

The Sintered silicon carbide tubes are matched with Teflon® tubesheets for a combination of corrosion resistant and thermal performant heat exchanger.



05 SILICON CARBIDE BLOCK HEAT EXCHANGERS

Mersen SiC Polybloc® heat exchangers give optimized performance and are the first choice for applications in the pharmaceutical and fine chemicals industry. They can be installed to replace an existing graphite block heat exchanger, as a technical upgrade with no piping modification. The core blocks are manufactured from Boostec® sintered Silicon Carbide, an ideal material for corrosion-resistant heat exchangers. Boostec is a Mersen company.



KEY MARKETS

✦ Fine Chemicals, Specialty Chemicals, Condensers and Evaporators for API and Chemicals, Acid recovery Units, Organic Solvents, Bromine, Heat Recovery Units – Interchanger, Dechlorination in Cl-Alkali plant, etc.



NO PARTICLE EMISSION

- Highly resistant against abrasion, hardness close to diamond
- No porosity thus no impregnation
- No permeation
- No contamination for high purity applications

THE MOST COMPACT HEAT EXCHANGER

- Higher fluid velocity
- Extremely high thermal conductivity, close to aluminum
- Higher efficiency

SOLUTION SUITABLE FOR EXTREME ENVIRONMENT

- Resistant to temperatures of nearly 1000°C
- Universal anticorrosive solution
- Pressure resistance up to 40 bars
- High thermal shock resistance compared to graphite and glass-lined

EASY MAINTENANCE

- Low fouling
- No preventive maintenance
- Tell Tale system (leak detection between compartments)
- Compatible with many cleaning methods (in-place, pyrolysis, high-pressure water-jet, heavy chemicals detergents)

06

TANTALUM EQUIPMENT

MERSEN PRODUCES TANTALUM HEAT EXCHANGERS IN ITS DEDICATED WORKSHOP IN GERMANY. MERSEN LINSINGERICHT, THE HOME OF TANTALUM, IS DEEMED TO BE THE WORLDWIDE LEADER FOR THE MANUFACTURE OF TANTALUM EQUIPMENT.

The particular properties of Tantalum require know-how, specific equipment and highly trained people. A long experience in design, forming and welding Tantalum equipment, combined with an international material sourcing policy, allows Mersen to provide quality and cost-effective solutions.

Mersen has many references for Tantalum Shell & Tubes Heat Exchangers, Bayonet Heaters, U-tube Heat Exchangers, Heating Coils, Clad Tube-Sheets and bonnets, Interchangers in case of corrosive fluids. We have the possibility to optimize the tubes size design for special application in the pharmaceuticals condensation process.



One of the most important advantage of Tantalum compared to other anticorrosion material is the high mechanical resistance, bringing very reliable solutions, with the minimum cost for maintenance operations compared with other materials (for example retubing, gaskets replacement etc.)



- + WORLDWIDE LEADER FOR THE MANUFACTURE OF TANTALUM EQUIPMENT
- + DEDICATED TANTALUM WORKSHOPS IN GERMANY
- + HIGHLY SKILLED WELDERS
- + MANY REFERENCE LISTS FOR SEVERE APPLICATIONS
- + MANY DESIGNS ACCORDING TO SPECIFIC CUSTOMERS' NEEDS



KEY MARKETS

Key markets : Hydrochloric Acid, Sulfuric Acid, Acid Concentration, Bromine, Pharmaceuticals, Pickling baths, Nitric Acid, Phosphoric Acid, Strong Organic Acids

07

ZIRCONIUM AND TITANIUM EQUIPMENT

MERSEN IS RECOGNIZED AS THE WORLD'S NUMBER ONE SUPPLIER OF ZIRCONIUM COLUMNS, SHELL AND TUBE HEAT EXCHANGERS AND PRESSURE VESSELS.

Titanium is suitable for wet chlorine and chlorinated compounds, sea water and oxidizing acids.

A long experience and expertise in the design and fabrication of reactive metal equipment, combined with an international material sourcing policy, allows Mersen to bring quality and cost-effective solutions.

Mersen produces Zirconium and Titanium Heat Exchangers at its plants, on three continents.



08

METALLIC SHELL AND TUBE HEAT EXCHANGERS

STAINLESS STEEL AND NICKEL ALLOY EQUIPMENT

MERSEN XIANDA : THE ASIAN HUB SPECIALIZED IN METALLIC PRESSURE VESSELS

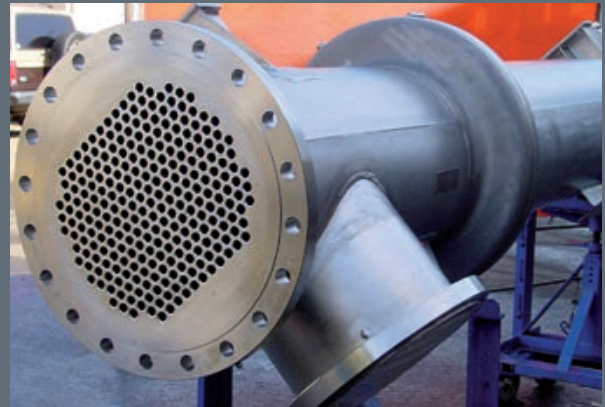
Mersen Xianda, located in the industrial park region of Shanghai, is a brand new production center, equipped with the highest-level of industrial capabilities, including Waterjet Cutting machine for high accuracy, CNC Plasma welding and Automatic TIG welding machines for efficiency together with various inspection apparatus such as Helium Leak Detector, PMI Spectrum Analyzer, and Whole Element Analyzer.

For many years, both international and local customers have acknowledged Mersen Xianda as a leading manufacturer, particularly for the supply and project management of large contracts. The long experience of Xianda with many worldwide Engineering EPC companies, allows Mersen to handle international projects with different design code (ASME, AD MERKBLATT, CODAP, JIS) and according to local regulations such as PED, GOST, AS 1210, KGS, etc...

MERSEN MOROCCO

The 2,500m² production site located 100 Kilometers from Casablanca.

- Machining, mechanical manufacturing
- Welding, metal construction
- Design and manufacture of equipment from reactive metals (nickel alloys, stainless steel...)
- Manufacturing equipment and parts based on customer specifications

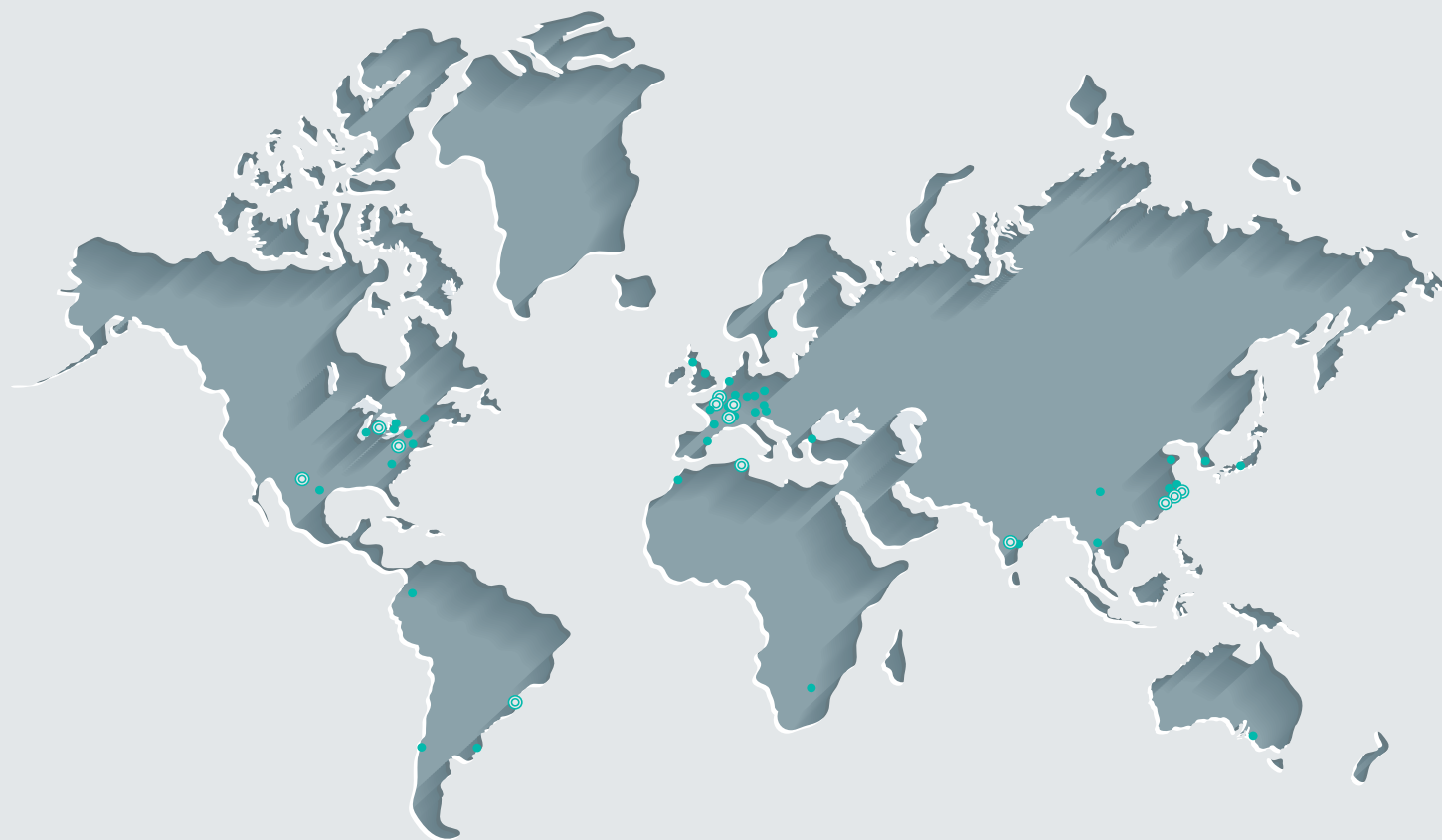


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MERSEN

WORLDWIDE LEADER IN THE
MANUFACTURE OF GRAPHITE
TUBES FOR OVER 50 YEARS



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