

SYSTEMS





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MERSEN ANTICORROSION AND PROCESS EQUIPMENT

Mersen wishes to share its extensive expertise in high-performance equipment with its customers. Mersen designs innovative solutions to address its clients' specific needs to enable them to optimize their manufacturing process in sectors such as energy (nuclear and solar), chemical, fine chemical, water and process industries (metallurgy...).

Mersen's experience and skills in thermal design, process engineering and anticorrosion materials ensure that all the manufactured equipment can cope with your process constraints. All the equipment and systems are compliant with international standard requirements and certifications such as ASME, AS ADM, JIS, CODAP, RCCM, HAF 601.

To serve its worldwide customers, Mersen manufactures its equipment through American, European, Indian and Chinese first-class production plants representing more than 220,000 m².



COMPREHENSIVE OFFER OF EQUIPMENT AND MATERIAL

To learn more about our equipment, consult our brochures dedicated to columns, reactors, heat exchangers, systems, mixers and piping.

	Reactors Pressure vessels	Mixers	Block / Plate	Shell & Tube	Columns	Piping Fittings
	Heat exchangers					
Graphite						
SiC						
Tantalum						
Zirconium						
Titanium						
Carbon Steel Stainless Steel Nickel Alloys						
Fluoropolymer						
			Anticorrosion Systems			



MERSEN YOUR EXPERIENCED PARTNER FOR ENGINEERED SOLUTIONS IN CORROSIVE APPLICATIONS

Mersen has been manufacturing engineered systems for well over 50 years. With over 600 references worldwide, Mersen's wealth of experience contributes to our continued success.

Mersen Anticorrosion and Process Equipment has reinforced the organization of the systems unit to accompany the growing field requests of fully integrated systems.

Packaged systems can include any or all of the following:

- Basic and/or detail engineering, design package
- Major equipment
- Instrumentation and control
- Piping and valves
- Structural steel support frame
- Pre-assembly of the above into a turnkey "skid" package

Mersen's engineered systems experience includes:

- Sintaclor®: HCl and HBr synthesis
- HCl absorption
- HCl desorption
- HCl azeotrope breakers
- Acid dilution (H_2SO_4 , HCl, HF)
- Heating and cooling packages for pickling baths
- Vacuum systems for corrosive applications
- Quench systems
- Other evaporation and concentration systems for a multitude of other corrosives

OUR STRENGTHS

Mersen, your one-stop-shop supplier, guarantees:

- Optimized design
- Efficient project planning
- Quick delivery
- Reliable operation
- Strong team expertise

Our large innovative material portfolio includes:

- Reactive metals: Tantalum, zirconium, titanium
- Metals: nickel alloys, stainless steel, carbon steel
- Graphilor® 3: Mersen exclusive isostatic graphite
- Armylor®: Mersen PTFE range

Our specialized own-made equipment portfolio includes:

- HCl synthesis units
- Columns and reactors
- Heat exchangers (shell & tube: polytube®, plate & frame, block style: Polybloc® and Cubic)
- Vessels

Our worldwide technical presence

- 4 workshops on 3 continents with experience in equipment manufacturing and skid-mounted
 - 10 local repair shops with technical sales & service expertise
- 

GRAPHILOR®, ARMYLOR® AND REACTIVE METALS



Graphilor® bloc

Graphilor® 3

Mersen has developed an exclusive advanced impervious graphite that combines the complimentary of fine grained graphite based materials with proprietary impregnating agents. This advanced material is Graphilor® 3.

Graphilor® 3 is the material of choice for a number of corrosive applications. It has the highest mechanical properties authorized by TÜV and can withstand extreme temperatures.

Armylor®

Armylor® is Mersen trademark material made of PTFE or PFA. It is suitable for almost all corrosive fluids within the temperature range from -50°C to +230°C.

Mersen masters all the manufacturing processes

- The paste extrusion process for pipe liner
- Isostatic molding of PTFE parts
- PFA transfer molding

Mersen Anticorrosion and Process Equipment has been making PTFE/PFA lined piping since 1964. Our long-experience in the PTFE manufacturing process and corrosive process know-how result from our technical leadership.

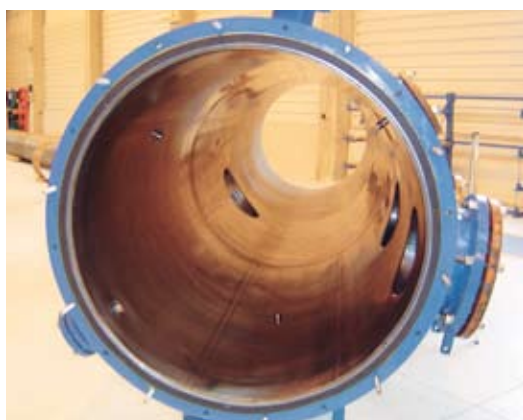


PTFE column

Reactive Metals - CL-Clad® technology

Tantalum CL-Clad® plates as well as Zirconium, are exclusively produced in Mersen France and can be shipped to our American or Chinese plants for final manufacturing.

CL-Clad® is a patented cladding process developed by Mersen (France). With this process, a thin layer of reactive metal (Tantalum, Zirconium) can be cladded onto a carbon steel or stainless steel base plate. CL-Clad® technology is perfectly suitable for big thickness when design pressure is high.



Tantalum CL-Clad® Column



PRODUCTION OF HYDROCHLORIC ACID OR HCL GAS SINTACLOR®, THE SYNTHESIS OF CHLORINE AND HYDROGEN

With over 600 references in operations throughout the world, Sintaclor® - Mersen HCl synthesis unit - is acknowledged as a proven solution.

Sintaclor®: system is composed of

- One compact integrated synthesis unit that performs the combustion, the absorption and the cooling
- One packed tail tower that scrubs the residual gas and releases clean vent gas from the atmosphere (H₂ and inerts)

The synthesis unit and the tail tower are manufactured in Graphilor® 3 while piping is made of Armylor®.

3 flexible modules for a global offer

- Module 1: Graphite equipment and engineering documents
 - Synthesis unit
 - Tail tower
- Module 2: Accessories
 - Flame arrestor
 - Automatic ignition package
- Module 3: Sintaclor® package
 - Combination of modules 1 & 2 equipment in a turn-key skid
 - Piping and hand valves
 - Tanks and pumps (optional)
 - Field instruments and control cabinets
 - Steel structure
 - All of the above items are pre-assembled in the factory.

OUR SINTACLOR® STRENGTHS

Safety

- Outstanding material: Graphilor® 3 withstands extreme conditions of temperature up to 430°C with carbon impregnation
- Top-mounted burner (downward flame) with internal liquid protection that allows a smaller size of furnace
 - Smaller size of furnace (better mechanical resistance and smaller volume of dangerous/explosive gas)
 - No need of condensate drain
 - Combustion chamber is far from the ground
- Bottom-mounted safety disc to have a better control of effluent in case of breakage
- Automated plant
 - Automatic ignitor (pilot burner)
 - Remote controlled start-up

Reliability

- Special burner design: to minimize the hydrogen excess
- Compact system
- Exceptional lifetime of the Graphilor® 3 (more than 15 years)
- Long-term experience (more than 600 references)

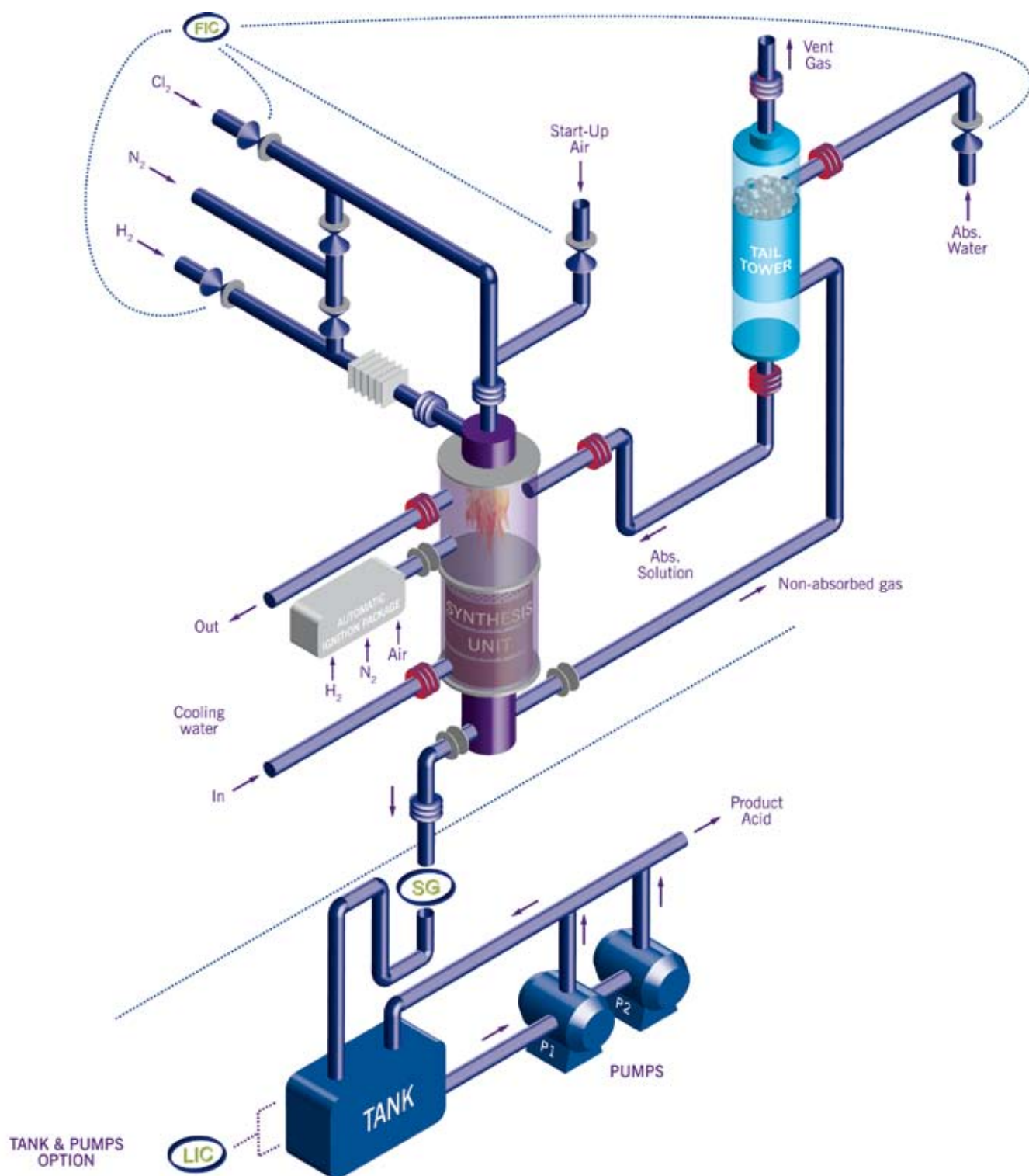
Fast delivery and commissioning

- Record: skid delivered within 5 months after order
- Record: less than 3 days to complete the start-up and acceptance on site
- Experienced technical team in our 4 workshops

Performance

- The Sintaclor® range includes units capable of producing hydrochloric acid quantities varying from 1.4 to 150 t of 100% HCl per day
- HCl concentration (up to 37%) and free chlorine content (1 ppm) in produced acid
- Total combustion of chlorine gas with low hydrogen excess (typically 5%)

Process for Hydrochloric Acid Production



OPTION: SKID-MOUNTED SINTACLOR®

The skid-mounted is a flexible offer that matches all your requirements. It covers all the 3 modules of the synthesis unit offer that are pre-assembled in a workshop

- Module 1: Graphite equipment and engineering document
- Module 2: Accessories
- Module 3: Sintaclor® package

Design

- 3D CAD layout offers views of new skid
- General drawings for equipment
- Installation and maintenance handbooks
- P&ID inc. heat and mass balances at minimum and maximum loads
- Field instruments and valve specifications
- Control and interlock specifications (start-up sequence diagram, narrative description of interlocks and control loops)
- Operator's handbook (including Process description, trouble-shooting guide, operation)
- Isometrics

Pre-assembly in the factory

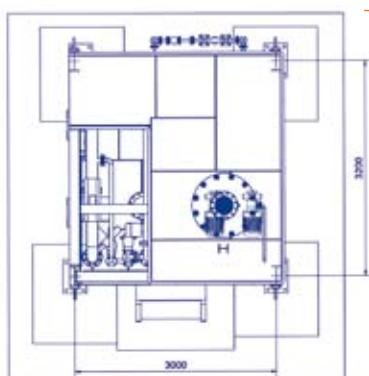
- Sintaclor® skid units are designed to minimize assembly times and errors on site
- The synthesis unit, the tail tower, pipes and all control and safety devices are assembled in a steel frame
- Seal test before shipment on site

Installation

- A Mersen specialist supervises all operations: erection, pre-commissioning, commissioning and start-up

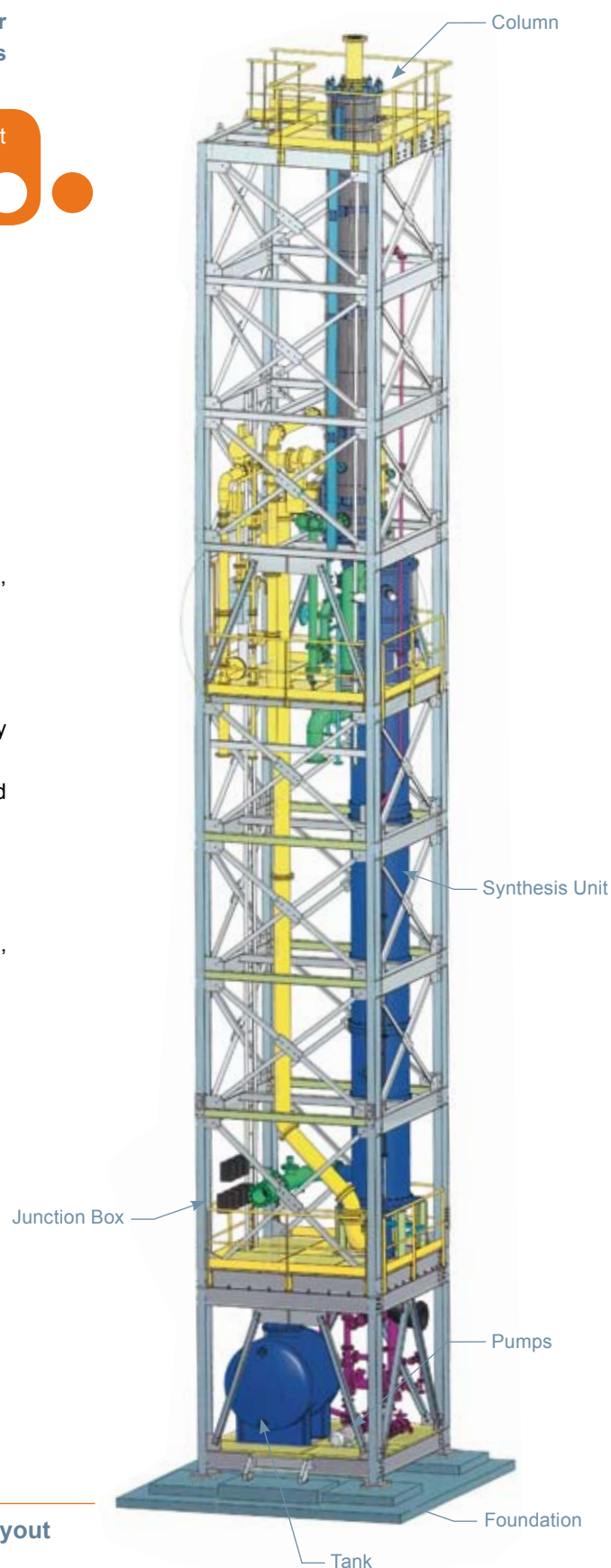
Control and security

- Automatic system on the skid to control the performance
- Put the installations into safe conditions
- Automatic ignition of the flame with a closed furnace
- Automatic remote start-up from the control room
- Control of the production and the main parameters



Top View

3D CAD Layout

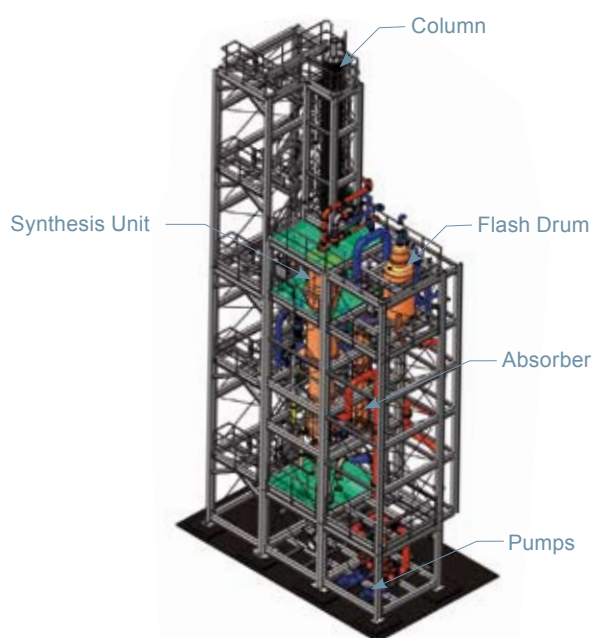


OPTION: STEAM GENERATION

The steam generation option is a development of the synthesis unit to recover the heat generated from the combustion of hydrogen and chlorine. This can be achieved on a new or existing unit.

- One furnace-cooler
- One falling-film absorber

The generated steam can reach up to 8 bara with graphite furnace or over 10 bara with carbon steel furnace. Our technical team can advise you according to your process.



3 FLEXIBLE MODULES FOR THE STEAM GENERATION OPTION

- **Module 1: Graphite equipment**
 - Gas synthesis unit
 - Absorption unit
 - Tail tower
 - Certificates
 - Basic engineering documentation
- **Module 2: Detailed engineering for steam generation package**
 - General drawings for equipment
 - Installation and maintenance handbooks
 - P&ID incl. heat and mass balances at minimum and maximum loads
 - Field instruments and valve specifications
 - Control and interlock specifications (start-up sequence diagram, narrative description of interlocks and control loops)
 - Operator's handbook (incl. Process description, trouble-shooting guide, operation)
 - Isometrics
- **Module 3: Steam generation full package**
 - One flash vessel (carbon steel)
 - One horizontal centrifugal pump for pressurized water
 - Interconnecting piping between flash vessel and graphite equipment
 - Hand valves
 - Necessary field instruments (flow control valves)
 - Steel frame in case of skid



HCl ABSORPTION

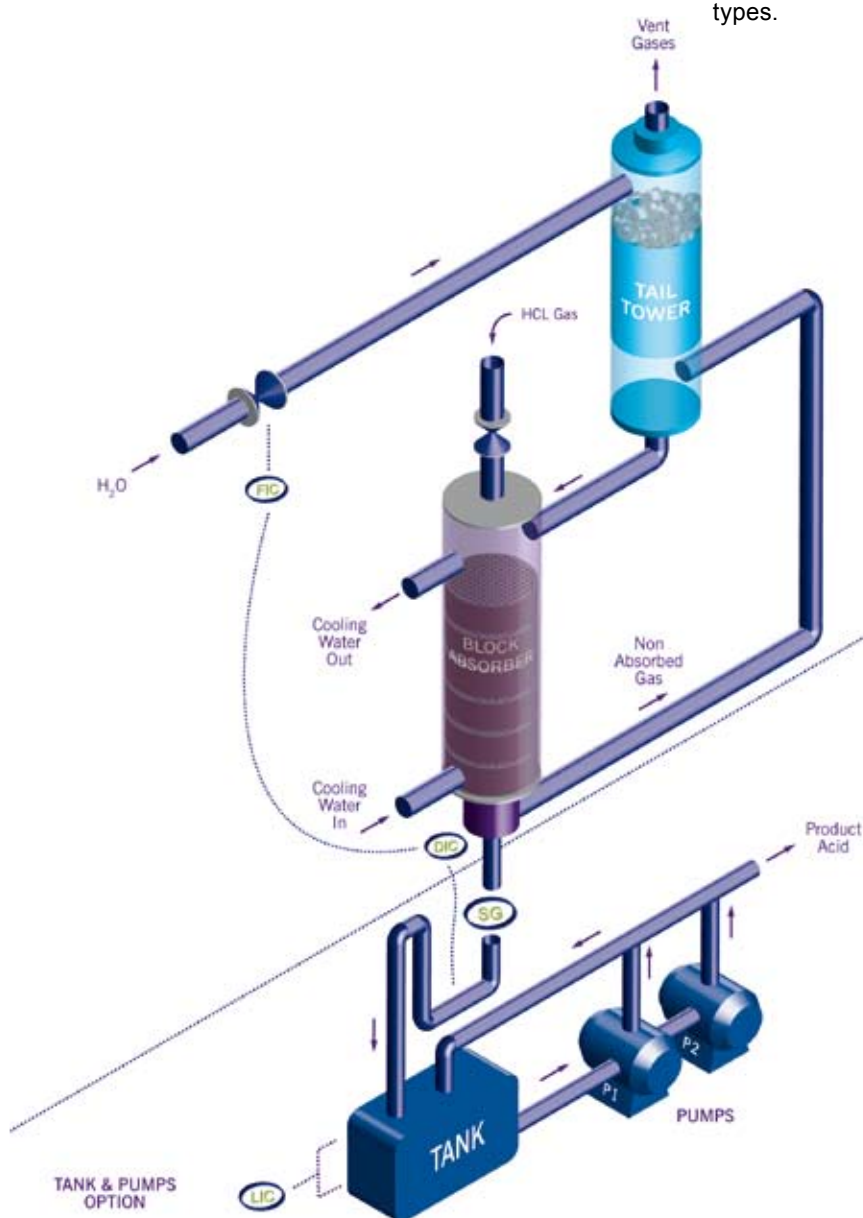
Gases such as HCl gas are dissolved in water in many chemical processes, particularly to store it, purify it or simply to use it in chemical reactions. This operation is called absorption which is an exothermic reaction.

Hydrogen fluoride and hydrogen bromide are also concerned by the absorption process. The absorption is often performed in combining Graphilor®3 heat exchangers and columns. There are 2 HCl absorption processes depending on the HCl concentration in the feed gas.

Process 1 - Falling Film Absorber.

This process is more suitable in case of higher concentrated HCl gases.

The water or absorption solution forms the falling film that runs along the walls of the ducts inside the Graphilor®3 heat exchanger. Water and HCl gas can be counter or co-current. This film is continuously cooled by removal of heat through the walls of the unit to the cooling fluid. A Graphilor® water scrubber can be added to scrub the remaining vent gases. The absorber can be either in blocks or shell and tubes types.



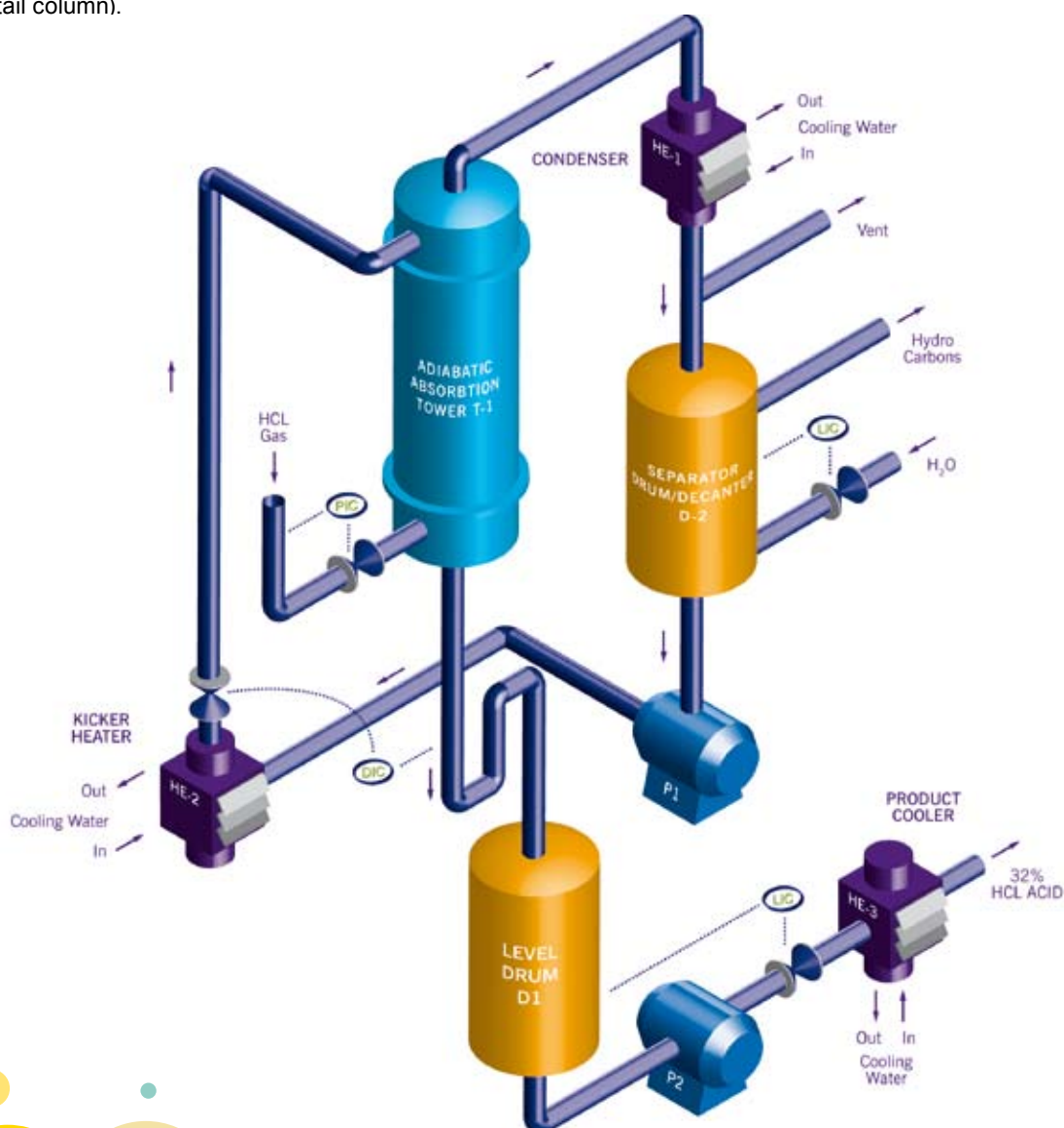
WE OFFER

- Equipment
- Process know-how
- Instrumentation
- Piping and valves
- Full skid-package (with steel structure)

Process 2 - Adiabatic Absorption.

The adiabatic absorption is applied for weak HCl gases. It takes place in **Graphilor®3 or Armylor®** columns when the phenomenon occurs without heat recovery.

A Graphilor®3 column is used, supplied by the gas to be absorbed and the absorption water at the top. Gas and liquid flow are counter-current to ensure maximum absorption. A solution of hydrochloric acid at temperature close to boiling point, and a mix of water vapour and unabsorbed HCl, are recovered at the bottom. Two additional devices are added, namely an acid cooler and a secondary absorption device (usually a tail column).



PRODUCTION OF PURE HCL GAS (AHCl) HCl STRIPPING AND HCl SYNTHESIS UNIT

The typical uses of pure HCl gas are

- High purity silicon for solar cell or electronics applications
- Organic chemistry
- Various metallurgical processes

There are 3 main routes to produce pure HCl, depending on the gas pressure, nature and quality of fed stream.

BY SYNTHESIS UNIT

AHCl is generated by HCl gas synthesis unit.

If H_2 and Cl_2 are available in high quality, the synthesis of H_2 and Cl_2 in Mersen synthesis unit is the most economical and reliable choice to generate AHCl gas at 2 barG max. The HCl synthesis unit is considered as a very safe and proven-in-use system.

BY STRIPPING

System allows to generate AHCl by distillation of fed concentrated acid. This stripping system can be coupled with a Sintaclor® or HCl absorber.

CLASSICAL STRIPPING OPERATING UNDER PRESSURE

In a classic stripping system, we provide all the following equipment, delivered optionally in skid.

- 1-Graphilor®3 Armylor®
and Tantalum CL-CLad® stripping tower
- 2-Graphilor®3 thermosyphon reboiler
- 3-Graphilor®3 condenser
- 4-Graphilor®3 interchanger
- 5-Graphilor®3 bottom cooler
- 6-Armylor® PTFE piping

The feed acid is heating close to boiling point in interchanger by outgoing azeotropic bottoms acid. The stripping tower (T-1) is operating acid under pressure at normally 3 barG. The reboiler (HE-2) is providing the stripping energy while the 2 condensers (HE-3), (HE-4) and demister (D-1) are removing all H_2O .

The outgoing azeotropic acid at bottom is used to heat feed acid through (HE-3) and then is cooled to storage tank.

Mersen can supply reliable system that can generate AHCl gas with reliability at pressures up to 5 barG. Refer to page 15.

HCL AZEOTROPE BREAKER

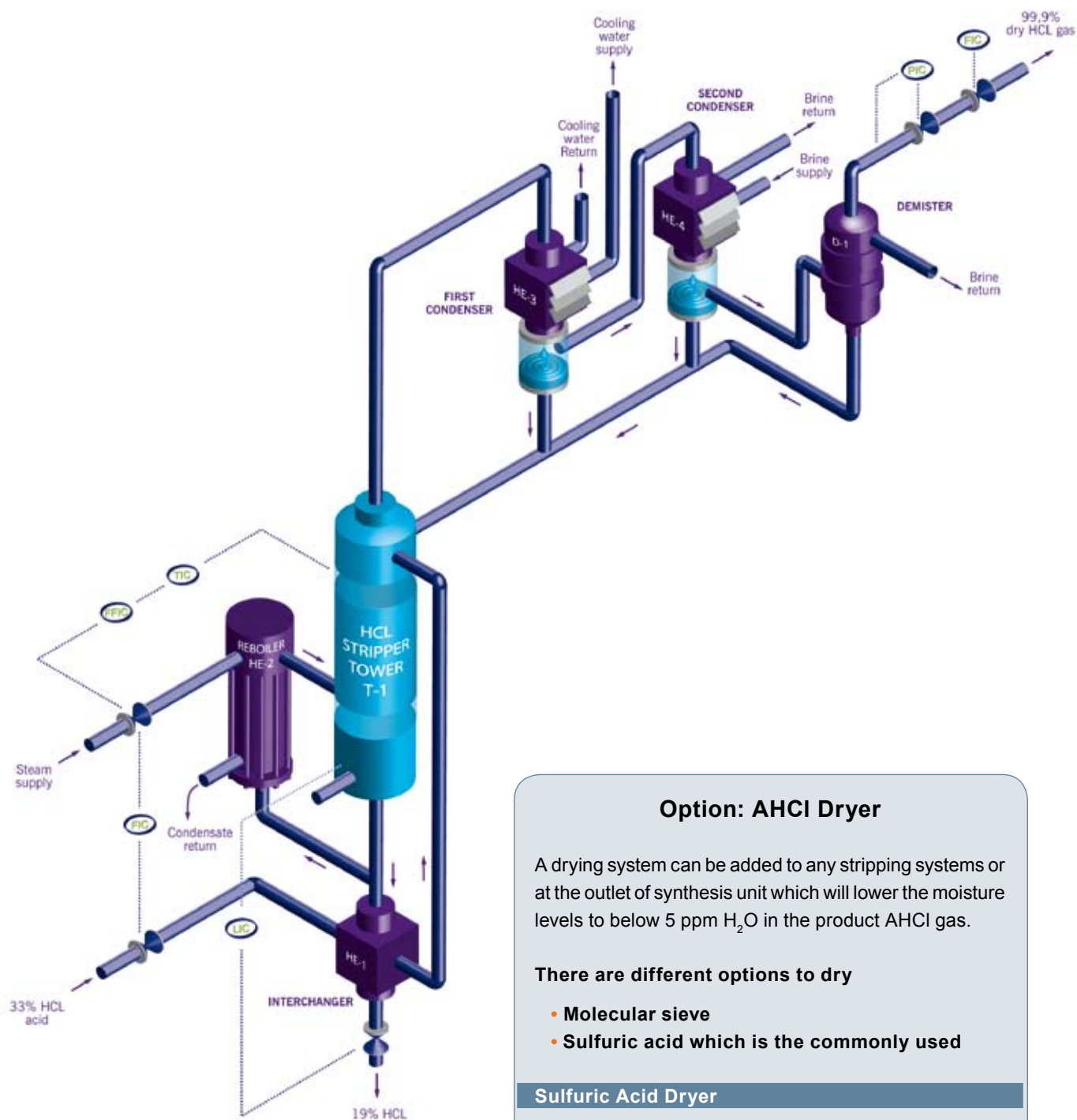
$CaCl_2$ Azeotrope Breaker - Salt effect principle:

At azeotropic concentration, the molar composition of liquid and gas phase are the same.

When you add the $CaCl_2$ salt, the salt dissociation requires water, so water is “trapped” in the liquid phase. The “normal” vapour-liquid equilibrium is broken. Effectively the boiling point of the water is raised so that most of the “liquid” water falls in the column but the boiling point of the HCl remains the same so its vapour rises in the column and goes “overhead”. This system will permit stripping of all HCl content in hydrochloric acid which comes through the stripper.

Other routes are available upon request.

Stripping System Operating under Pressure



Option: AHCI Dryer

A drying system can be added to any stripping systems or at the outlet of synthesis unit which will lower the moisture levels to below 5 ppm H_2O in the product AHCI gas.

There are different options to dry

- Molecular sieve
- Sulfuric acid which is the commonly used

Sulfuric Acid Dryer

Single or double stage systems can be provided. They all use a Brinks style demister as the final demisting element and trace amounts of H_2SO_4 will be carried over into the AHCI stream.

ACID DILUTION SYSTEMS SULFURIC, HYDROFLUORIC, HYDROCHLORIC ACIDS...

Acid dilution process

The concentrated acid and dilution water are mixed under pressure in a static mixer provided by an **Armylor® dilution tee pipe** connected to the concentrated acid and dilution water feeds. This provides turbulent mixing of the two fluids. The dilution of acid in water generates considerable heat. The hot corrosive mixture then flows through a corrosion-resistant **heat exchanger of Graphilor® impregnated graphite**. On the shell side, this heat exchanger is fed with cooling water which removes the heat and cools the diluted acid to the desired temperature.

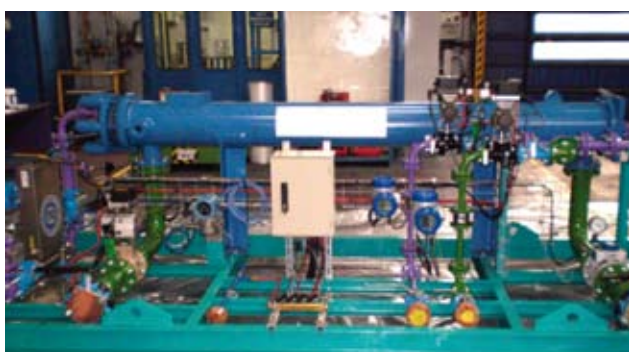
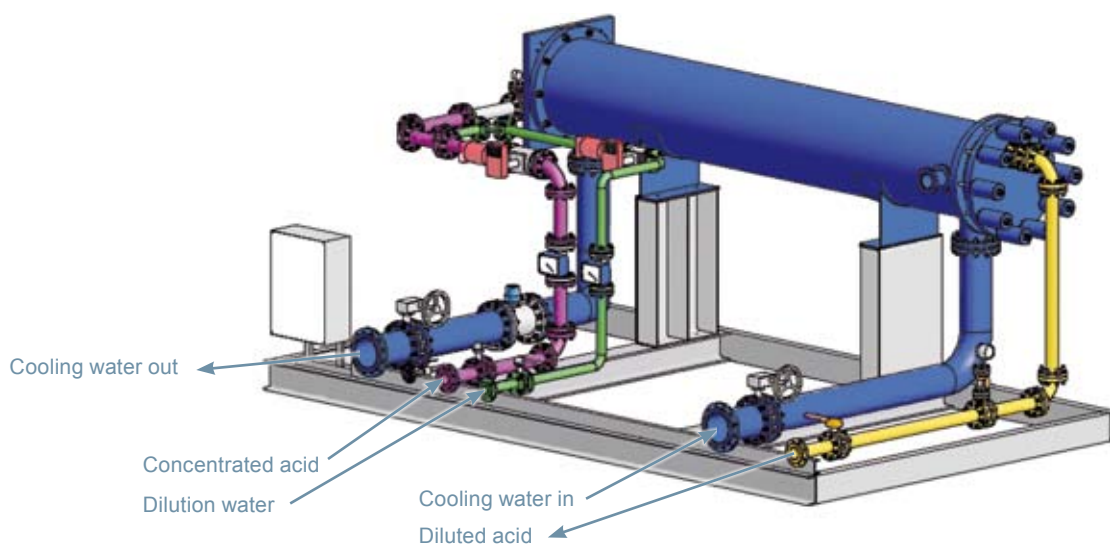
The diluted acid concentration is obtained by adjusting the concentrated acid flow rate with reference to the dilution water flow rate.

OUR STRENGTHS

- Cost-efficient design
- Optimal material selection and reliable operation
- Fast delivery and commissioning

Option: the ready-to-use skid-mounted system

All the items such as heat exchanger, dilutor, mixer, piping, instrumentation and cabinet are mounted on a metal frame wired, connected and tested in our workshop. The unit comes as a single turnkey unit, which considerably reduces assembly time on site



Hydrofluoric Dilution Unit.
5 160 kg/h 33% HF



Sulfuric Dilution Unit.
86 333 kg/h 84% H₂SO₄

UNIT FOR HEATING AND COOLING FOR PICKLING BATHS

The steel pickling industry requires corrosion resistant solutions

- Corrosion and abrasion resistant heat exchangers
- Corrosion and abrasion resistant recirculation pumps
- Corrosion resistant piping and filters

Mersen is the world leader in supplying heat exchangers for the steel and stainless steel pickling market industry.

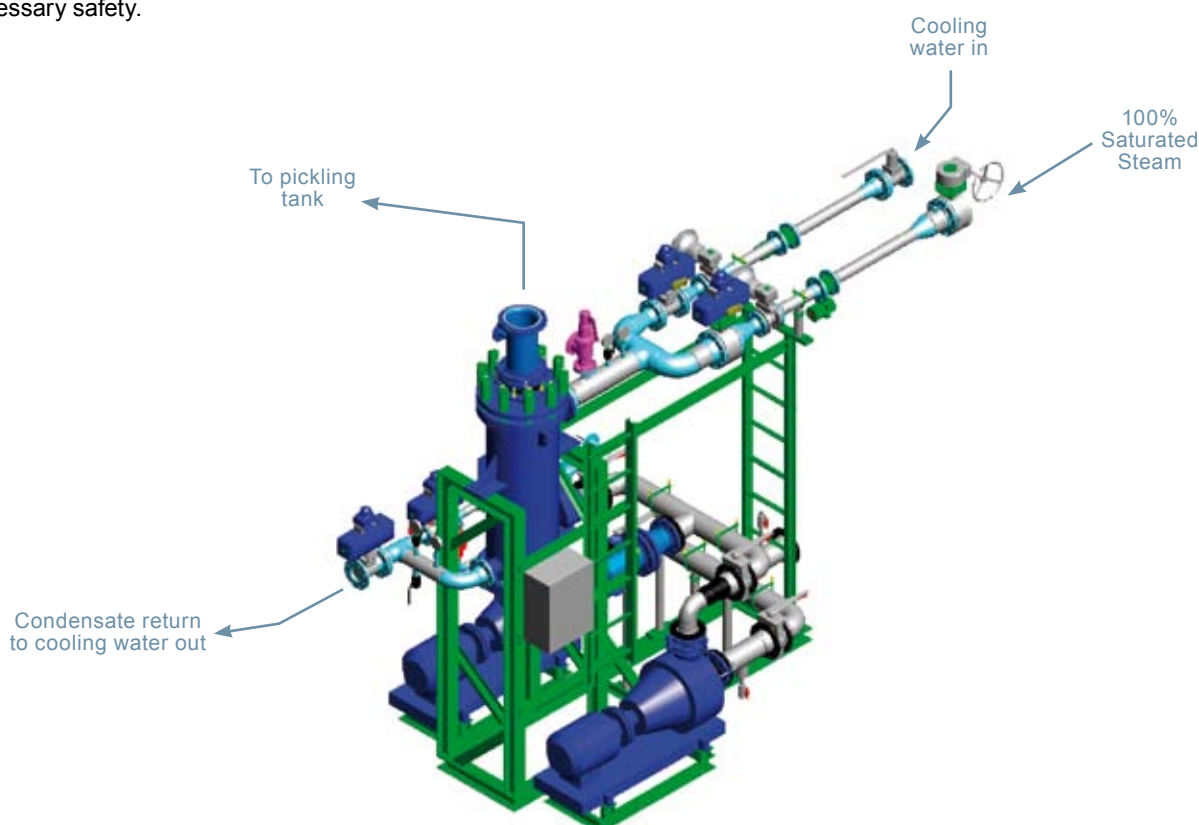
Our heat exchangers can be manufactured in several corrosion-resistant materials such as

- Impregnated graphite
- Reactive metals (tantalum, niobium...)

The heat exchangers can be either Graphilor® or reactive metals, depending on the characteristics of the pickling process. Our pickling packages are comprised of acid heat exchanger with a pump and strainer, all coupled to piping systems for both acid and service streams. The instrumentation package includes instrumentation for a temperature control loop for the acid. The package also supplies devices for necessary safety.

OUR STRENGTHS

- Graphilor® 3 xbs or xth (phenolic or PTFE impregnate for HCl pickling used in the carbon steel plates)
- Graphilor® 3 xth for HF/HNO₃ acid used in the stainless steel plates pickling
- Cost-effective solution for Graphilor® 3 Polybloc®
- Long-lifetime for tantalum or niobium shell and tubes exchangers
- Strong leadership with key producers and engineering
- Worldwide references
- Local repairshops
- Production centers in each continent for graphite and reactive metals.
- Dedicated engineering team to design heat exchangers and systems.



Pickling bath - External Heating Flow Diagram

OUR TECHNICAL ASSISTANCE OFFER FOR DESIGN AND FIELD SERVICE



**Based on our expertise and our presence
in all the continents, we propose a technical assistance**

- Revamping unit
- Technical improvement
- Maintenance follow-up
- Process and recommendation
- ...

PROJECT MANAGEMENT COMMITMENT AND QUALITY

Project management

More than your order, Mersen manages your project.

After the signature of the order, a dedicated project manager is appointed to coordinate all the following steps

- Kick-off meeting
- Engineering and fabrication bar chart
- Basic engineering (P&ID, heat and mass balance, General arrangement drawing, drawing of each equipment, instrument specification package)
- Detail engineering (isometrics drawings, 3D layout, steel structure drawing, foundation drawing)
- Monthly report (clear status of the order)
- Management of our partners (electrical part, instrumentation and steel frame)
- Technical assistance of the team during the project and the commissioning

Quality Commitment

Certifications

- All our systems are CE certified and respect PED and ATEX directive.
- Construction codes ASME, Codap or Ad Merck Blatt
- Third - Parties TÜV, Apave

Worldwide Experts to Serve your Development

Mersen Xianda



Mersen Salem



CUSTOMER



Mersen Chennai



Mersen Pagny



MERSEN
 Expertise, our source of energy

**A worldwide specialist
 in anticorrosion
 and process equipment**

Worldwide presence
 with several manufacturing
 sites and workshops close
 to our customers

Mersen France Pagny-sur-Moselle

- > 36,000 m²
- > Heat exchangers, pressure vessels, columns, piping, bellows and compensators, mixers, systems, bursting discs

Mersen USA Salem

- > 6,690 m²
- > Graphite heat exchangers, systems, welded plate heat exchangers, piping, bellows and compensators, bursting discs

Mersen France Brignais

- > 8,000 m²
- > Welded and gasketed plate heat exchangers, metallic shell and tubes heat exchangers, mixers

Mersen France Grévy

- > 8,000 m²
- > Specialist in equipment for the nuclear industry
- > Pressure vessels, columns, mixers, heat exchangers

Nippon Carbon Mersen

- > Distribution and repair shop

Mersen UK Teesside

- > 5,600 m²
- > Graphite heat exchangers, bursting discs

**Mersen Deutschland
 Linsengericht**

- > 3,000 m²
- > Tantalum equipment : heat exchangers, bayonets, heating coils, columns, accessories

Mersen USA Oxnard

- > 6,600 m²
- > Pressure vessels, columns, heat exchangers (zirconium, titanium)

Mersen India Chennai

- > 2,600 m²
- > Graphite heat exchangers, systems

Mersen Maroc El Jadida

- > 2,500 m²
- > Graphite and metallic heat exchangers
- > After-sales service, assembling

Mersen Xianda Shanghai-Fengxian

- > 150,000 m²
- > Heat exchangers, pressure vessels, columns, piping, mixers, systems

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