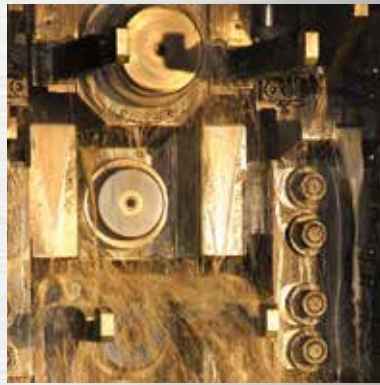




CMI INDUSTRY4
Metals

Innovative technologies for the metals industry



Technologies to translate your strategic needs into performance



As your global partner in the machinery and plant construction in steel and nonferrous metals processing, CMI designs and engineers in compliance with the most stringent safety standards and supplies reliable and effective solutions to a demanding market place.



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In order to assist its customers in their endeavour to adapt to increasingly stringent environmental regulations and standards as well as ever changing market requirements, CMI has extended its core business to high value added services and environmental technologies that will not only reduce its customers' carbon footprint, but also help to reduce operation expenditure.

Toward greater energy efficiency

Building upon its experience, CMI is constantly improving its technologies, amongst others by developing equipment dedicated to reduce energy losses in steel processes for several years now. The purpose of these solutions is to help industrialists reduce their environmental footprint, improve costs by reducing energy costs and improving their processes.

Project financing

As part of its global high value-added servicing offer (see page 10), CMI has supplemented its technical approach with tailored financing solutions and provides guidance and support for its customers in a global manner. Based on a long-lasting relationship with financial institutions and commercial banks, CMI supports its customers in developing and implementing the most adapted financing structures.

Proven technology, new applications

Additionally, CMI Industry Metals developed new applications for several of its tried and tested technologies. Heat treatment and pyrohydrolysis are cases in point, finding outlets in aeronautics and extractive metallurgy respectively.

Compliance with the most stringent safety standards ensuring quality and reliability



Safety is a prime consideration throughout all stages of the life cycle of our products: from design, through manufacturing, transport, installation, operation and adjustment to maintenance. Good health & safety performance is not occurring randomly but is the result of consequent and systematic action. Consequently, CMI Industry Metals has put a dedicated QSEi management in place throughout its 12 worldwide locations.

When it comes to daily plant operations, CMI believes that there are two principles underlying safe operation: machine safety and reliability.

Safety is the ability of a device to keep the risk incurred by persons within acceptable limits. Reliability in operation is the ability of a system or device to function consistently for a specified duration in hostile or unexpected circumstances. An advanced level of automation optimizes processes and guarantees a high level of plant availability and reliability.

Engineering directed towards enhancing industrial competitiveness



Based on decades of experience and in depth-knowledge, CMI has delivered its clients customized engineering solutions. Today all our customers benefit from this experience long before their new or revamped production facilities are commissioned.

Integrated solutions,

more than just the sum of parts

CMI Industry Metals's long experience in managing international projects ensures that the equipment installed will achieve the stated performance. Knowing that a reliable industrial partner must also provide effective coordination, which is a decisive factor in a customer's success in the market, and that integrated engineering is becoming ever more important, CMI provides « simple » yet effective engineering coupled with high performance project management and worldwide coordination. This is the recipe for its sustainable long-term success.

Consistent product quality

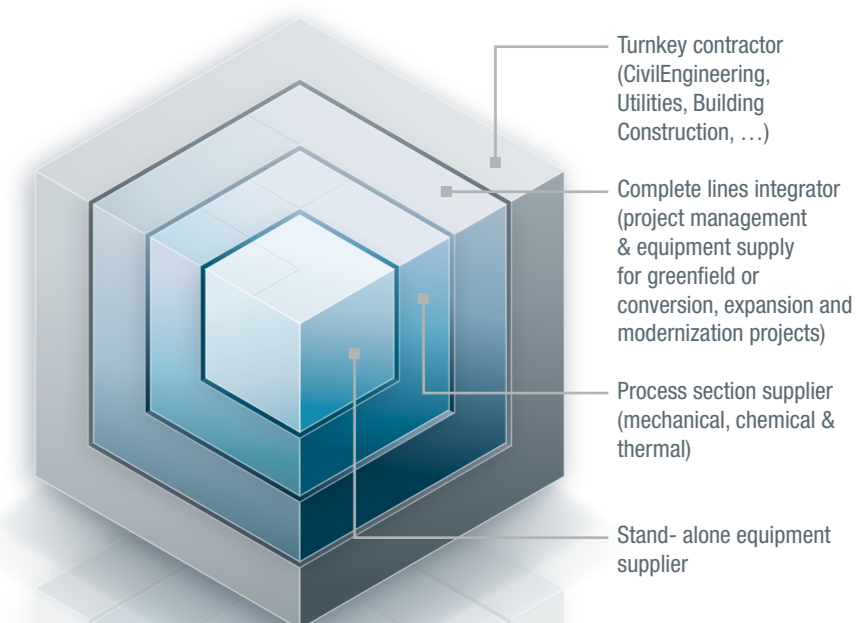
and increased production performance

Production flexibility often translates into complex state-of-the-art plants, yet in practice all production equipment has to be easy to operate, monitor, maintain and modernize, while producing consistent quality and providing profitable, reliable and safe operations. CMI Industry Metals meets these requirements and provides « fit-to-purpose » engineered lines or equipment based on its long term experience and feedback from successfully running lines all over the world, as well as established low cost sourcing and in-house manufacturing.

A single point of contact

complete integration from basic layout to routine operation

Whether global, turnkey solutions for complete industrial complexes, or its process sections (mechanical, chemical or thermal), specific equipment or technical solutions, CMI offers the overall and made-to-measure management of its clients' needs throughout the whole of the lifecycle of their equipment: from design to commissioning of facilities, but also their conversion, expansion and upgrading. CMI also provides guidance and support for its customers to improve the performance of their facilities through training, expertise services and remote assistance.



Global execution and sourcing

Today CMI Industry Metals is a globally operating engineering company



« When it comes to engineering solutions, we are renowned for our vast expertise, outstanding experience and high quality performance. What our customers appreciate just as much is the cooperative approach that shapes our business relations ».

Fabrice Orban,
Vice-President
CMI Industry Metals

CMI Industry Metals has increased its worldwide coverage in response to the globalization of its customer base and the belief that a leading engineering company must offer an efficient global service from a local point of contact. As such CMI Industry Metals is present in all major growth regions in the world.

Through its engineering, its assembly and manufacturing units or regional offices, CMI Industry Metals ensures its customers low cost sourcing, but also an easy access to the entire portfolio of technologies and services, irrespective of the geographic location or the point of contact.



Global manufacturing and assembly

Always close to our customers



GROWTH REGIONS

To serve its customers best, CMI is stepping up its manufacturing expansion in regions that offer a strong long-term economic development and purchasing power that will translate into new and expansion of existing installed production and assembly facilities.

CMI Industry Metals' two workshops in India are equipped with state-of-the-art machining tools and ensure in-house equipment production and assembly activities that conform to the most stringent international quality and safety standards.

Taloja:

- Centre of Excellence for Cold Rolling Mills manufacturing
- Area: 25,000 m²
- Maximum handling capacity of 150 tonnes
- Versatile machine shop with heavy-duty CNC and conventional machines for high precision output
- Assembly shop with 20 assembly stations for Cold Rolling Mills, processing lines and furnaces
- Strong team of skilled workforce
- In-house quality inspection facility
- Integrated design facility



Hedavali:

- Fabrication facility produces close to 150 tonnes/month
- Modern shot blasting and painting facility
- Area: 24 acres with covered facility of 3000 m² with EOT cranes



Shaping our customers future

Research & development, an essential foundation for our and our customers' competitiveness in a global economy



Environmental protection and energy savings are fully compatible with increased return on investment

Spray Pickling – a breakthrough in modern pickling technology

Another is CMI's latest generation of spray pickling technology to drastically increase pickling efficiency, hence increase process speed and reduce line length.

This technology represents a breakthrough when compared with conventional turbulence pickling. The spray pickling technology substantially reduces the pickling time of steel strip by making it possible to process even difficult to pickle steel grades at a much higher speed.

The new process substantially increases the flexibility in the operation of pickling lines, which allows to process a large variety of steel grades on one single line. Additionally, spray pickling requires much less process liquor and pickles at lower temperatures than conventional turbulence pickling, resulting in decreased operational and energy costs. Exploiting the full potential of the process by installing several cascades of spray modules and pickling tanks in series, potentially reduces the pickling time to less than 70%, when compared to conventional turbulence pickling.

Coupled with SILASS™, CMI's innovative technology for Si removal, destined to the pickling of silicon and high-strength steel grades, CMI offers the ideal package solution for modern AHSS and UHSS pickling lines.

Ultra-dry cooling technology to meet the requirements of tomorrow's steel qualities

To meet the growing demand for advanced automotive steel grades, which improve the safety of vehicles while reducing their weight, and in order to help its customers in the development of the latest generations of Advanced- and Ultra High Strength Steel (AHSS +UHSS) grades, CMI has developed its Ultra Dry Cooling (UDC) System that ensures exceptional even strip cooling performance, while guaranteeing superior strip surface quality.

Today, in challenging times, only innovative technologies can translate your strategic needs, related to surface quality, mechanical properties, and new steel grades into performance. Knowing that our growth and success are largely dependent on meeting our customers' needs & expectations, the CMI Industry Metals Teams are focusing on developing "state-of-the art" technological innovation to help our customers to produce new steel grades, and to globally improve their competitiveness.

Tomorrow, today's technology can be yesterday's

CMI advises and supports ArcelorMittal, for instance, in the development of a new type of production line that is unique in the world and dedicated to the zinc coating of steel strip. This line applies the **Jet Vapour Deposition (JVD)** technique to optimise the quantities of zinc used and thus production costs. Its use on continuous annealing lines will also allow the coating of very high resistance steel grades that are difficult to galvanize by hot dipping.

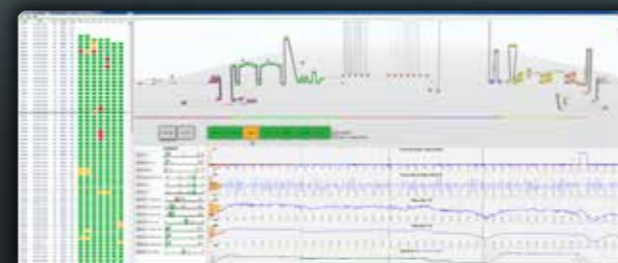
A real technological breakthrough, this innovation is currently being installed on the Kessales site of ArcelorMittal Liège (Belgium) and should make it possible to meet the expectations of customers in the automotive industry and to maintain the position of steel in the race to make vehicles lighter.

The contracts of tomorrow depend on the today innovations

The combination of experience, in-depth knowledge and innovation allowed CMI Industry Metals to book some important orders, such as a Continuous Galvanizing Line (CGL) featuring all major CMI process technologies. The winning comeback to the slab reheating furnace market, where CMI won a major contract to replace the largest furnace in Europe for a major steelmaker is another example. A hot strip mill furnace equipped with the latest generation of **double regenerative burners (DRB)**, an innovation that considerably reduces operating costs through combustion of blast furnace gas.

Furthermore, CMI is devoting resources to developing equipment and technologies dedicated to reducing energy losses in industrial and steel processes. A number of important patent applications have been filed for these solutions, and CMI recently launched several new innovative products and high-value-added services.

▼ CMI's dedicated software, a vital part of the global OPEX™ offer



OPEX™ - Guidance in the heart of our customers production process

One of them being CMI's Operation & Process Expert System (OPEX™) aiming at technical assistance and guidance in the heart of our customers CGL production process. The OPEX™ is including a new integrated software analyzing all process and coil data to determine process and quality conditions and providing operational advice and guidance.



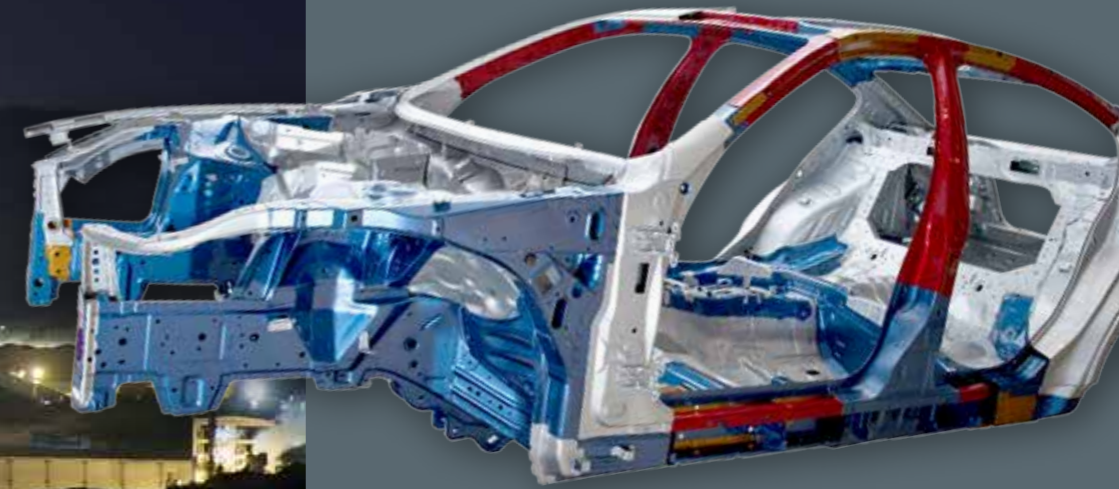
▲ Double regenerative burners for largest European HSM furnace



▲ Close up view of spray ramp

High value added services

A job of experts



Global servicing and spares

Life-cycle maintenance to suit our customers' needs

The relationship with customers continues after the equipment has been successfully commissioned and handed over. CMI Industry Metals offers customized services and spare parts to minimize downtime. CMI's teams are highly experienced and have access to multiple sources to ensure the fast delivery of critical parts at competitive prices. This not only allows CMI's customers to reduce their stock of spares, but enables CMI to offer comprehensive maintenance programs, including preventive and regular maintenance or small revamping jobs designed to maximize productivity, produce a faster rate of return on investment and minimize operating costs year after year.



▲ CMI's global servicing & spares offer provides comprehensive maintenance programs, including preventive and regular maintenance or small revamping jobs



▲ CMI's international training center in Maanshan, China, offers uniquely customized training programmes

Know how transfer

Customized training and process & technology consultancy

CMI's approach combines made-to-measure expertise and services for the account of industrialists, ranging from training for our customers' operating and maintenance personnel on site, or in CMI's dedicated training center in Maanshan, to energy and quality audits, and from technical expertise, to process and technology consultancy, provided by our worldwide network of process experts.

The combination of expertise, extensive experience, and comprehensive know-how that CMI offers customers, not just make production plants but also production employees fit for the future. CMI's International Training Center in Maanshan, China, offers uniquely customized training programmes which provide customers' operators, engineers, as well as operation and maintenance supervisors with thorough knowledge of operations. Customized training modules are focusing on our customers' staffs needs and helps them attain a precisely defined level of knowledge and skills.

Operation and Process Expert System (OPExS™)

Tangible value by bridging the knowing doing gap

CMI has earned a world-renowned process and operation know-how by engineering and commissioning automotive galvanizing lines all over the world. This specialist knowledge coupled with an intelligent software is the heart of CMI's OPExS™. This winning combination allows CMI to give the best possible advice both in terms of the selection of suitable operational parameters and production processes. The new integrated software is analysing all process and coil data to determine process and quality conditions and providing operational advice and guidance.

CMI's Operation & Process Expert System (OPExS™) value offer: audits, certification for the automotive industry, operation expertise and software to reduce cost, increase productivity, improve product quality, and ensure safety.

Automation and Technology Control

Efficient systems control for optimized production



In view of ever more complex process technologies, CMI has developed a flexible and application-oriented automation and technology control. In combination with modern hardware and software systems automation, CMI's has built a multi-platform system, based on its comprehensive process knowledge and return of experience from its numerous, successfully running reference lines and equipment.

Steel production processes are highly energy intensive and comprise many complex operations. Each of these operations has a stake in the quality of steel produced, and needs constant monitoring.

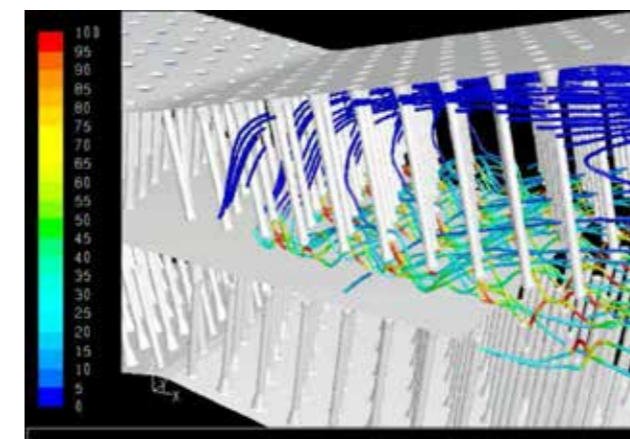
Control solutions that will enable steelmakers to execute real-time control and maintain critical process parameters

In order to help steelmakers in the energy optimization and permanent quality monitoring across the cold route of their steel production and the related production scheduling, CMI has decided to further foster the development of its customized automation systems and models. With our comprehensive know-how and great experience in the steel processing industry, CMI is able to offer the most adequate solutions tailored to its customers requirements.

Process control solutions that will enable its customers to execute real-time control and maintain critical process parameters to produce higher quality products with consistent metallurgical properties.

Multi-Platform PLC (Level 1/ Level 2) and HMI system

Today CMI is offering a wide variety of services as well as tried-and-tested technologies and products related to automation, as well as technology and process control. Its excellent knowledge of industrial processes, and its experience in automation in the domains of rolling mills, processing lines, chemical technologies and industrial furnaces, are major inputs for an optimized CMI design and supply of automation packages, the carrying out of studies, as well as the creation and the putting into service of software systems for Programmable Logic Controllers (PLC), the development and upgrading of man-machine interfaces (HMI – Human-machine interface), as well as level 1 + level 2 systems.



Process models and control systems:

Mathematical Models:

- Thermal Process Optimization
- Production Optimization
- Material Tracking
- Material Scheduling

MultiPlatform PLC (Level 1/ Level 2) and HMI Development and Upgrades:

- Automation hardware migration
- Safety upgrades
- Redundancy upgrades
- HMI upgrades
- Drive systems upgrades

Reheating furnaces



Furnace Designs:

- Optimfl@me® walking beam:** furnaces for slabs, blooms and billets
- Optimfl@me® walking hearth:** furnaces for billets
- Optimfl@me® pusher furnaces:** for slabs, blooms and billets

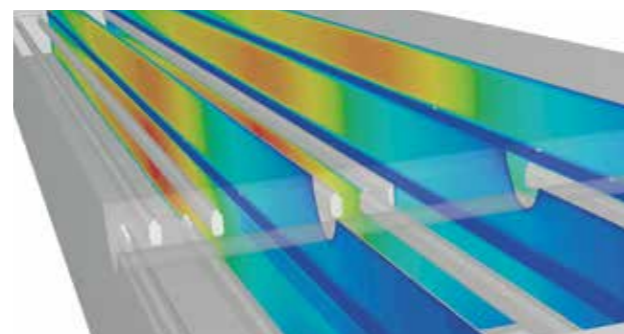
Process Control:

- RTOP®:** Furnace Level 2 Control System based on physical models according to the steel grade
- SMC®:** Skid Marks Calculation model to increase heating quality
- Descalizer®:** Scale Reduction on heated material

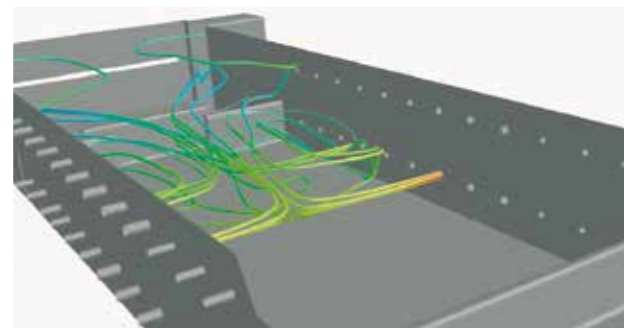
Innovative concepts for reheating furnaces to substantially improve energy efficiency and product quality

For carbon, stainless and silicon steel, CMI has developed its Optimfl@me® reheating furnace. A patented furnace design that considerably improves heating quality, decreases energy consumption, reduces pollutant emissions and increases production flexibility, thanks to an optimized design and exclusive combination of:

- Customized burner sizing, configuration and management, depending on the application, including our patented double regenerative burners (DRB)
- Flat furnace shape with discharging chamber
- Unique quick restart concept based on OnOffSoft® burners firing control
- Scale Management in the furnace hearth, reducing scale formation, while increasing the time interval between stoppages for descaling
- Low NOx emissions
- R-TOP® level 2 expert software



▲ Temperature map in Optimfl@me® furnace



▲ Simulation of flux gas circulation in Optimfl@me® furnace

The CMI reheating furnace is designed to most effectively equalize the temperature gradient within the steel slab, bloom or billet, by optimizing the transfer of generated heat to the surface of the steel stock to be heated to a maximum. This allows for a unique temperature uniformity, while avoiding scale formation and skid marks. Besides these quality driven parameters, the latest generation of CMI's reheating furnaces also addresses environmental and operational concerns and allows for lower fuel consumption by reducing heat losses from the furnace to the minimum, and increase availability and flexibility of operations.

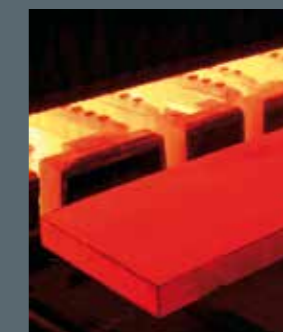
Lower energy consumption and decreased oxidation of steel

The development of new steel grades by our customers have led to a need for increasingly sophisticated process control requirements of our reheating furnaces, and to improving the performance of our equipment as to combustion efficiency and product quality. The associated lower energy consumption and decreased oxidation of steel is achieved through computer simulation of gas flow, temperature calculations of heated stock, studies and evaluation of scale formation and gas analysis. Based on a combination of BAT (Best Available Technologies) and our extensive internal process know-how and experience, CMI developed a new reheating furnace concept under the name of Optimfl@me, addressing all of the above described market needs for efficiency and quality. This new concept has successfully been implemented in several revamping projects, and newly installed reheating furnaces, in many parts of the world.

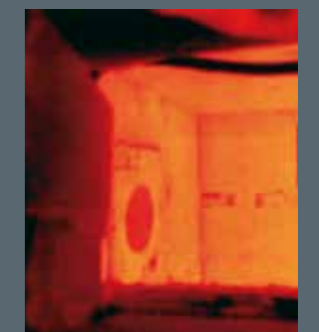
Key Figures

When compared to conventional reheating furnace designs, the Optimfl@me® global concept offers the following competitive advantages:

- A yearly gain of more than 1% of furnace investment cost.
- The Optimfl@me® design results in a discharging temperature decrease of about 10°C, which remarkably improves the homogeneity of the final product.
- Lowest NOx emissions on the market
- Considerable scale reduction of around 10%
- Fuel consumption savings of up to 10%
- A yearly output increase of 0.2% (from 0.5 to 0.7%) with the same furnace capacity

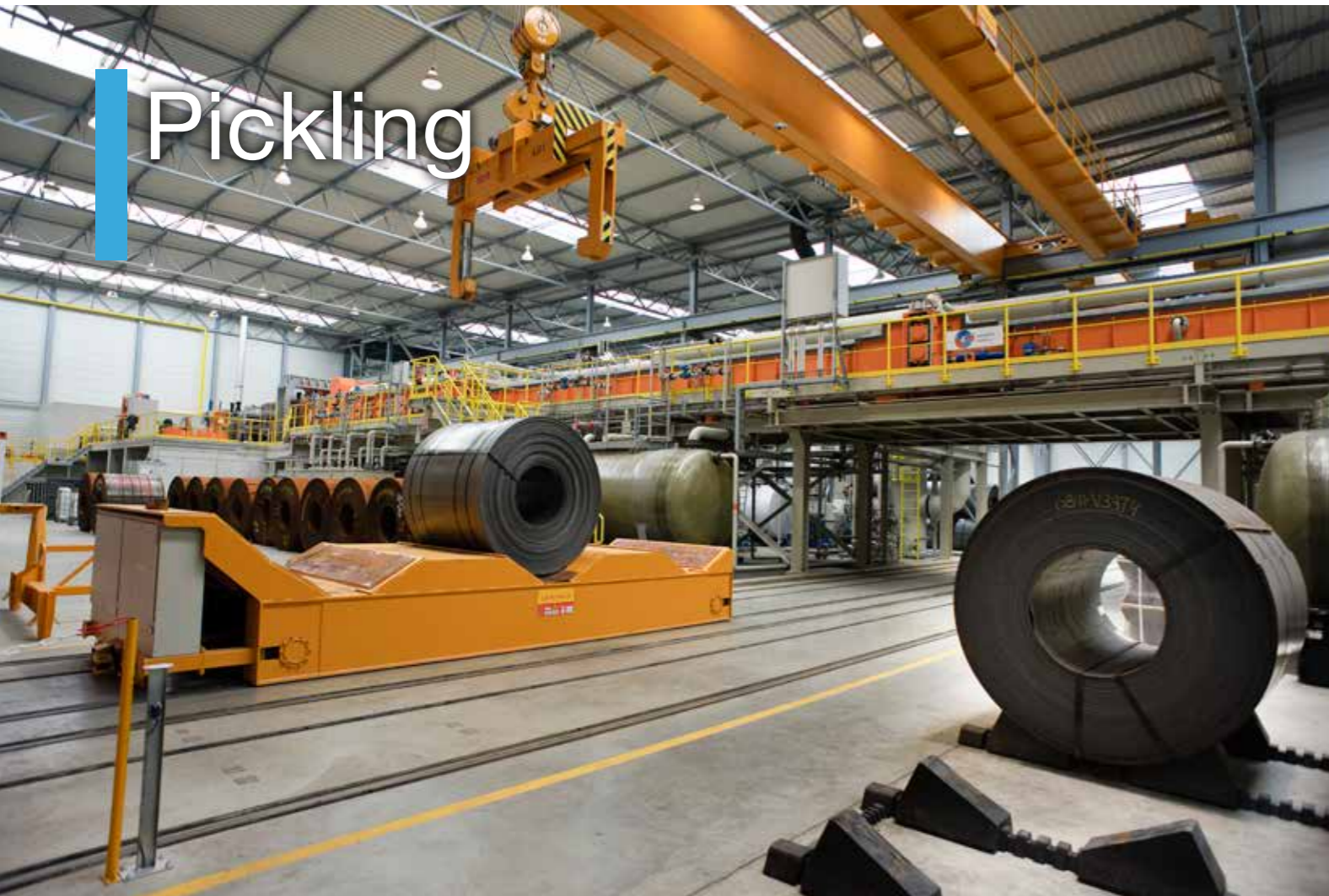


▲ Discharging area of reheating furnace



▲ Flameless burners

Pickling



▼ Fully automated Wire Coil Pickling Line with Salt Bath for Baosteel, China



Pickling lines for long products are a highly specialized group of batch treatment lines, designed according to the product shape, process required and unique parameters defined by the client. CMI's new generation plants feature automated processing using a Level II or Level III control system, multiple fill-drain cycles via an independent transportation function, cascade rinsing using spray and immersion, waste air and waste water treatment aimed at minimizing emissions, and acid control, as well as management through recovery or regeneration processes.

Along with high turbulence pickling that ensures uniform pickling conditions and high heat transfer rates, CMI uses hook vibration for uniform pickling and a high pressure spray rinse arrangement that guarantees a clean surface without residual contamination.

Pickling Line Designs:

- Push Pull or Semi-Continuous Push Pull Pickling Lines
- Continuous Pickling Lines
For carbon steel, including silicon steel Continuous Pickling Lines (CPL) can be part of combined lines:
 - > Tandem Cold Mills (PLTCM)
 - > Annealing Lines for Silicon Steel
 For stainless steel a CPL is incorporated into:
 - > Hot Strip Annealing and Pickling Lines (HAPL)
 - > Cold Strip Annealing and Pickling Lines (CAPL)
 - > Combined Hot/ Cold Strip Annealing Lines (H/CAPL)
 - > Direct Roll Annealing Pickling Lines (DRAP)

Batch pickling plants for ferrous and non-ferrous metals:

- Wire Coil Pickling Lines
- Tube Pickling Lines
- Bar Pickling Lines
- Plate Pickling Lines
- Universal Pickling Lines

The full range of pickling solutions for effective removal of mill scale and other surface impurities

As a market leader, CMI supplies the full range of pickling solutions for both flat and long products, ensuring the effective removal of mill scale and other surface impurities from hot and cold rolled stainless steel, carbon steel or silicon steel, to non-ferrous metal strip such as aluminium, brass, etc. The resulting scale-free quality of the pickled strip improves the quality of the downstream rolling and coating processes.

Used for processing individual coils without strip joining, CMI's **push pull pickling lines** are ensuring excellent operational flexibility in the face of frequently changing strip dimensions and steel grades, and also non-weldable material. Their specific design makes such lines the only practical way of descaling heavy gauge coiled product.

CMI's unique v-shaped tank profile facilitates threading the strip through the pickling tank. The fact that there is no strip accumulator in the line makes this technology easy to operate and the most cost-effective method of hot band finishing. Applications range from the typical service centre to the high production requirements of the largest mini mills.

Semi-Continuous- and Continuous Pickling Lines are used for high capacity production with continuous operation by stitching or welding. The strip accumulators, also called loopers, provided at the entry and exit sections of the line ensure a consistent product flow during joining, coiling and removal of the steel coils.

In continuous pickling, the line runs at constant speed, while in the Semi-Continuous Line the speed of the strip is reduced during changeover or coil joining, due to the lower capacity of the loopers. The installation of Semi-Continuous Lines is highly cost-effective due to the simpler looper design, while Continuous Pickling Lines provide the highest production capacity

CMI's **high turbulence pickling tank technology** for continuous pickling lines is currently among the most efficient and also the most cost effective solutions on the market. In order to most effectively cover all types of applications and product mixes, these pickling tanks come in a range of profiles and acid injection systems, including the latest CMI development, **spray pickling modules** (see page 11). Accurate strip and pickling process control optimizes scale removal without over-pickling. CMI's Pickling Process Management (PPM) system, together

with its fully automated acid control management system, ensures the environmentally safe operation of the plant.

In stainless steel pickling applications, **CMI's Neolyte Purification Systems** not only reduce harmful chromium (+6) to non-toxic chromium (+3), but also regenerate the electrolyte, thus reducing operating costs and the environmental impact of such lines, while fumes loaded with Nox produced during stainless steel pickling, are most efficiently treated in CMI's latest generation of **Selective Catalytic Reactors (SCR-Technology)**.



▲ Stainless Steel CAPL at Outokumpu, Finland

Key Benefits

- Highest product quality through uniformly pickled surface
- Highest achievable production rates
- Optimised pickling parameters through mathematical modelling
- Low operating costs with controlled utility consumption
- Environmentally friendly operation
- Low maintenance costs
- Closed loop systems for acid, water and air treatment



▲ Two high performance wire coil and bar pickling lines, Dalian, China



▲ Replacement of chemical section for CPL at ThyssenKrupp, Germany

Acid regeneration



Leading-edge technology in acid regeneration for all types of acid and all available technologies

As a leader in this market segment, CMI Industry Metals offers a modular design that guarantees its customers the optimal solution for all their individual process requirements and applications, with acid recovery rates of virtually 100%.

Eco-friendly solutions, addressing today's market requirements and increasingly stringent environmental regulations

Today two pyrohydrolysis processes are available, namely fluidised bed and spray roaster technology, both of which have distinct advantages. While both technologies are mature, it is not always easy to make the choice. A number of considerations potentially affect the decision. Being able to offer either of these processes enables CMI to focus fully on its customers' specific site conditions and help them to choose the best option. Simplified processes such as our quick-change spray nozzles, the improved design of our

venturi rendering it completely maintenance free, or the most modern plant control system (PCS), are just a few examples of the features provided by the latest generation of our plants. CMI's Acid Regeneration Plants (ARPs) are equipped with a highly automated control system that minimizes field intervention by the operator and enables safe and reliable daily operation from a single control room.

For the total regeneration of Hydrochloric Acid (HCl), the waste pickle liquor from the pickling line is concentrated by direct heat and mass exchange in the venturi circulation system, before being injected into the spray roaster or fluidised bed reactor, where it reacts with O_2 and H_2O to form solid iron oxide and hydrogen chloride gas.

The HCl contained in the reactor off-gas is then passed through an absorber system, using a counter-current circulation system, in which the rinse water from the pickling line absorbs the HCl in the reactor off-gas. Thus close to 100% of the waste pickle liquor (WPL) is converted back to liquid acid, which is then reused in the pickling line. The remaining offgas passes through several treatment steps, including the exhaust fan which regulates the negative pressure in the whole upstream system preventing gas leaks, before being released via the stack into the atmosphere.



▲ Europe's biggest Spray Roaster ARP - ILVA in Taranto, Italy



▲ Fluidized Bed ARP - Riva Group in Genua, Italy



▲ Burners situated on the reactor bottom - Fluidized Bed ARP



▲ High-density Oxide produced by Fluidized Bed ARP

Highly innovative solution for the regeneration of mixed acid in stainless steel applications

Mixed Acid used for stainless steel pickling consists of Hydrofluoric Acid (HF) and Nitric Acid (HNO_3), both of which are expensive and problematic in waste streams. TOMAREG® recovers not only these expensive acids for reuse in the pickling line, but also the valuable metals contained in the waste stream. With TOMAREG®, CMI offers a system for pickling stainless steel that allows highly flexible operation of the pickling line, due to the adjustable acid concentration of the regenerated acid. TOMAREG® can produce oxide either in the form of a fine powder or coarse particles, as the plant can be delivered optionally with spray roaster or fluidised bed technology. Compared to conventional neutralisation plants, TOMAREG® reduces annual costs by 70% and hazardous waste discharged to the environment by more than 98%.

Acid Regeneration Technologies:

Carbon steel including silicon steel applications:

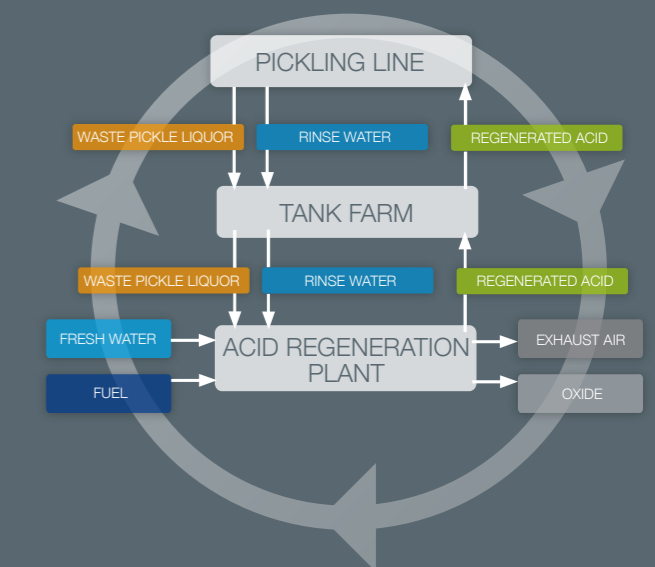
- Fluidised Bed Acid Regeneration Plant
- Spray roaster Acid Regeneration Plant

Stainless steel applications:

- TOMAREG® - Total Mixed Acid Regeneration Plant

Key benefits

- Environmental protection due to recovery of hazardous chemicals
- Virtually emission-free operation
- Recovery of costs by sale of oxide as high quality by-product
- Highest achievable production rates
- Optimised pickling due to constant operating parameters
- Independence from chemical suppliers
- Short payback time
- Present and future legal requirements on emissions are met
- Low maintenance costs
- Proven design
- Adaptable to all types of Pickling Lines



▲ A perfectly matched CMI acid regeneration plant, guarantees the efficient management of consumable process chemicals, thus minimizing the environmental impact and maximizing operating efficiency.

Rolling mills



▲ Modernization of ArcelorMittal Aviles' tinplate tandem mill



▲ Stand-alone temper mill for automotive applications at ArcelorMittal Dofasco

Rolling Mills Technologies:

- Tandem Cold Mills (Batch or Conti-Conti)
- Pickling Lines/ Tandem Cold Mills (PLTCM)
- Reversing Cold Mills (Single or Twin Stand)
- Skin Pass Mills

Modernization and Special Equipment for Cold/Hot Strip Mills

Rolling technology combining field-proven reliability with cutting-edge innovation

CMI Industry Metals has over 30 years experience in designing and producing steel rolling mills and equipment. Its latest generation cold rolling mills, always made to measure for individual customer requirements, offers many advantages, like reliable terminal equipment reducing downtime, accurate tension control and steering, as well as optimum strip thickness and flatness, to mention only the major ones.

A value offer that is enhanced by proven-and-tested equipment like **shear systems, tension leveling, scale breaking, mandrels and coilers**, all of which are important components in the modernization and the installation of new **Pickling Lines/ Tandem Mills (PLTCM)**.

CMI has built a strong technology experts team, over the years and offers the most efficient, yet lean mechanical design and engineering for all of its mill types.

Additionally, the demand for ever higher-capacity production and improved product quality, increasingly results in existing rolling mills and equipment being in need of modernization.

As such, CMI is not only supplying new mills, but is also offering customized rolling solutions aiming to cost-effectively

and efficiently help customers with the modernization and the upgrading of their existing mills to meet today's need for high performance mills.

The latest development of high-end automotive and tinplate applications of its mills, as well as process models and automation packages are enriching CMI's value proposition.

Rolling technology designed for all applications and requirements

CMI Industry Metals designs **4-High and 6-High reversing cold rolling mills** with high output and high flexibility for all metals industry rolling requirements. These type of mills come in single or twin stand configuration.

The wide range of products able to be rolled by these mills includes low, medium and high carbon steels, along with copper, brass and a number of alloys. Additionally, a very wide range of strip widths can be treated, at mill speeds that are sufficient for the highest volume of demand within steelmaking companies. The mill model for an optimized pass schedule is provided along with the mill itself.



▲ Complete in-line skin pass mill and post treatment section for automotive applications at ArcelorMittal Eisenhüttenstadt

CMI also designs and supplies **skin pass mills** with wet and dry skin pass systems. In-line skin pass mills are supplied for continuous annealing lines and continuous galvanizing lines.

Both stand-alone and in-line skin pass mills supplied by CMI treat a very wide range of strip widths, with precise output thicknesses and the highest possible mill speeds, guaranteeing its customers a great level of productivity and cost-effectiveness.

Key benefits

- Suitable for wide range of strip width and output thicknesses
- Suitable for wide range of products (low, medium and high carbon steels, silicon steel, copper, brass and a number of alloys)
- Reliable terminal equipment reducing downtime,
- Accurate tension control and steering,
- Optimum strip thickness and flatness



Strip processing



High performance strip processing lines for every application

In the face of an ever changing business environment, and the resulting challenges for increasingly demanding quality and flexibility, CMI is enabling its customers to process today's latest high strength steels (AHSS/ UHSS) including DP (dual phase), TRIP (TRansformation Induced Plasticity), FB (ferrite-bainite), CP (complex phase) and TWIP (TWIn Induced Plasticity) steels (see fig. 1).

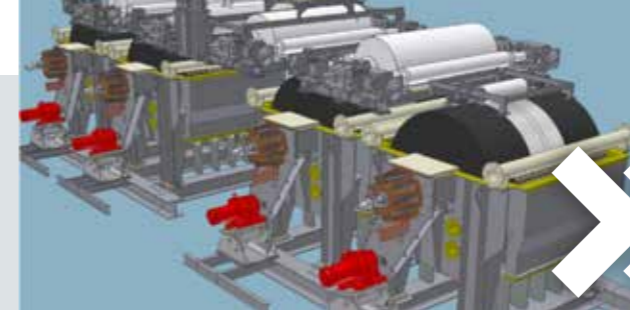
Innovative technologies to address processing challenges related to the latest generations of high strength steels

While Advanced High Strength Steels (AHSS) and Ultra High Strength Steels (UHSS) are considered as the dominant future light-weighting material, the steel industry is moving into the third generation of high strength steels for the automotive industry. CMI is preparing for these even more challenging steel qualities, with a number of **innovative automated and modern cooling technologies** (see page 26) and its latest patented design of a **pre-oxidation chamber** to control the selective oxidation of the steel surface, mainly due to high Si content, during annealing prior to galvanizing, which is resulting in poor wettability and zinc (Zn) adherence.

The combined oxidation and pre-oxidation chamber incorporates a system and a method that perfectly exert the necessary oxidation control on both sides of the steel sheet.

As a global full-liner CMI Industry Metals is providing unique expertise and know-how in steel processing. CMI's lines and equipment are designed and manufactured to offer maximum value, from the delivery of complete new installations, to modernization and productivity and quality improvements of existing lines.

As such CMI is addressing its customers' needs for increased operational flexibility with innovative designs for dual and combi lines. The latest examples of this development are **combi continuous annealing lines/ continuous galvanizing lines (Combi CAL-CGL)** providing superior surface quality, for high-strength automotive structural components, which improves the safety of vehicles while reducing their weight, or **combined continuous galvanizing lines/ color coating lines (CGL/ CCL)** limiting capital and operational expenditure and eco-friendliness as no intermediate storage, no oiling after CGL and no degreasing before the color coating is required.



▲ CMI is providing Electro Galvanizing Lines (EGL) based on its maintenance friendly radial cell design with energy savings of up to 50% and low CAPEX due to the elimination of costly strip guidance systems and tension leveling.



▲ CMI's Chemical and Organic roll coaters come in various configurations (S, L, U, O, or C-type) and a fixed or shuttle type design, thus providing tailor-made solutions no matter what the application need. They are at the heart of CMI's customized color coating lines.

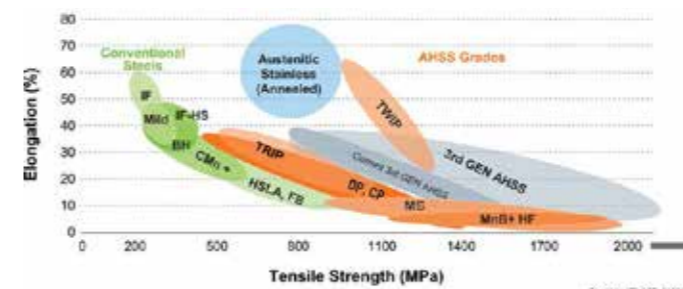


▲ CMI's multi-stage cleaning process is the centre piece of its Electrolytic Cleaning Lines (ECL) and an essential component of number of other processing lines. The modular combination of spray, mechanical, chemical and electrolytic treatment steps is providing tremendous design flexibility and is ensuring excellent cleaning efficiency of all types of steel strip surfaces.

But also continuous galvanizing lines (CGL) designed to apply different coatings including the very latest AluSi coatings.

Today CMI's state-of-the-art strip processing lines, feature the full spectrum of CMI's very latest process technologies: Multi-stage cleaning section, Vertical furnace (incl. CMI's L-Top math model and jet cooling system with energy recovery), Zinc pot section and Air-Knife system, APC Blowstab® cooling system, Inline skin pass mill and Tension leveler, Chemical and Organic roll-coat post treatment, Side trimmer and Exit shear.

fig. 1



▲ Vehicles are expected to be increasingly light and safe, leading to an ever growing demand on materials. CMI convinces with efficient equipment and intelligent solutions for the automotive steel production, laying the foundation for sustainable and future-oriented mobility.

Strip Processing Lines:

- Continuous Annealing Lines
- Continuous Hot Dip Galvanizing Lines
- Dual Product Lines
- Continuous Electro Galvanizing Lines
- Electrolytic Cleaning Lines
- Flux Type Lines
- Color Coating Lines
- Inspection/Correction/Tension Leveling Lines

Process Equipment:

- Multi-stage cleaning section
- Bath equipment (zinc pot + air knife)
- Tension levelers/ skin pass mills
- Chemical or Organic roll coaters
- Shears/ side trimmers

Furnace Designs (see p. 26):

- Continuous Galvanizing Lines (CGL)
- Continuous Annealing Lines (CAL)
- Stainless Steel Lines
- Silicon Steel Lines

Key benefits

- Reliable operation
- High throughput rates
- Optimized process sections (mechanical, thermal and chemical)
- High degree of operational flexibility
- Proven high plant availability
- Consistent top product quality
- Line design adapted to lower maintenance costs (easy service of major equipment increases uptime)



▲ All radiant tubes vertical furnace with convective pre-heating chamber



▲ Double accumulator on Combi CAL-CGL, for automotive quality strip, VAMA, China

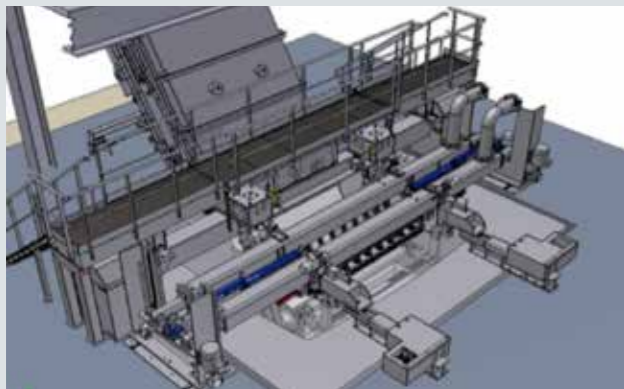


▲ Vertical line furnace on CAL, Shagang, China

CMI is providing the benchmark for many of its robust, yet innovative equipment designs for processing line

Innovative furnace designs to meet the most advanced requirements for production flexibility and strip quality

CMI's zinc pot sections and air-knife systems are designed to meet the latest market requirements and have successfully been implemented in its latest reference CGLs.



Exit shears and Side trimmers - With hundreds of successful operating references around the globe, CMI is a key player for this type of equipment.



▲ Exit Shear



▲ Side trimmer

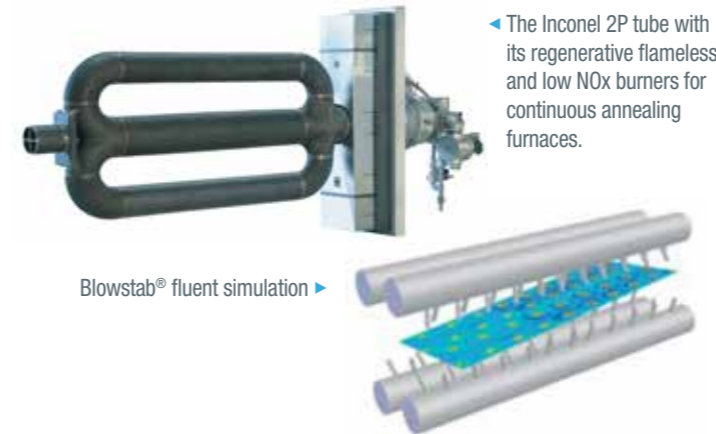
The latest generation of CMI's processing line furnaces and corresponding mathematical models, are designed to process the widest possible range of products from fragile ultra-low carbon to high strength steels, including thin and wide steel strips, while minimizing thermal inertia to allow, next to improved energy consumption also for the quick change of production parameters, thus guaranteeing increased line flexibility.

Based on physical, mechanical and thermal models that help predict the strip behaviour on line, the optimal heating solution is developed.

The use of all ceramic fiber Non Oxidising Furnace (N.O.F.), Inconel P or PP-shaped radiant tubes, the latest generation of patented jet coolers (Blowstab®) without insulation, or the patented furnace control mathematical models L-TOP® (vertical furnaces) and LH-TOP (horizontal furnaces) controlling all process conditions whether steady or transient, are all integral parts of an optimized, state-of-the-art CMI furnace design.

As such, CMI set the benchmark with its patented steel strip stabilization and cooling system (Blowstab® II) guaranteeing the non-fluttering of the steel strip in the jet coolers or after the pot cooling. CMI's furnace design also allows to eliminate heat and cool buckles by means of a dynamic and global control concept for strip tension, roll profiles and strip temperature.

CMI's mathematical models have been successfully implemented on CMI furnaces, as well as those of all major competitors to improve their productivity and the produced strip quality.



◀ The Inconel 2P tube with its regenerative flameless and low NOx burners for continuous annealing furnaces.

Blowstab® fluent simulation ▶

Automated and most modern cooling technologies

CMI has always been focusing on providing its customers top quality based on innovative technologies to meet the most challenging market requirements.

As such, one of the major fields of innovation of the past years has been related to the development of **several, complementary ultra-rapid cooling technologies** to meet the requirements of tomorrow's steel qualities.

To guarantee the required top strip quality and stability, as well as reduce energy consumption, CMI is offering next to its state-of-the-art Blowstab® low vibration cooling system, its patented latest generations of cooling devices: liquid cooling (IWAC®) and ultra dry cooling (UDC®) systems. Both of which allow for extremely high

heating coefficients and cooling rates of up to 1000°C/s and 600°C/s respectively without strip oxidation, needed for the production of ever stronger, yet ductile, cold-rolled steel grades.



◀ The latest reiteration of the patented Blowstab® coolers. Cutting-edge technology available for all line furnaces supplied by CMI, as well as for the revamping of other furnace brands.

Furnace Designs for Continuous Galvanizing Lines (CGL) and Continuous Annealing Lines (CAL) (horizontal or vertical design):

- Non Oxidizing Furnaces (N.O.F.)
- Radiant Tubes Furnaces (R.T.F.)
- Any other specific chambers

Cooling systems:

- > Blowstab®
- > IWAC®
- > Ultra Dry Cooling (UDC®)

L-TOP® & LH-top® mathematical models

Furnace Designs for Stainless Steel Lines:

- Hot rolled only (for annealing and pickling lines)
- Cold rolled only (for annealing and pickling lines)
- Combination HR and CR (for annealing and pickling lines)
- Bright annealing with high purity internals (vertical or horizontal)
- Bright annealing with muffle tubes (vertical or horizontal)

Furnace Designs for Silicon Steel Lines

Key benefits

- Dynamic and global process control
- Latest generation of burners
- Highly efficient combustion modes
- Most efficient thermal treatment of HSS
- Patented, high-performance cooling systems
- Reduction of steel alloying elements to facilitate recycling
- Optimum heating and cooling curves to achieve required strip properties at minimum energy cost

Extractive metallurgy



Recovery and Pyrohydrolysis Plants

The efficient way of extracting metal compounds

CMI Industry Metals offers pyrohydrolysis of metal chlorides along with related up- and downstream processes: solvent extraction, ion exchange, evaporation, crystallization, precipitation, filtration, calcination, and electrolysis.

As such, CMI designs and supplies pyrohydrolysis acid regeneration plants used in mineral leaching processes based on Hydrochloric Acid (HCl) as well as plants dedicated to the beneficiation of ores of various non-ferrous metals.

With decades of experience in pyrohydrolysis, calcination, sintering, and roasting, CMI Industry, including **NESA Solutions®**, offers a full range of innovative solutions from initial feasibility studies and pilot plant trials, to full scale plants.

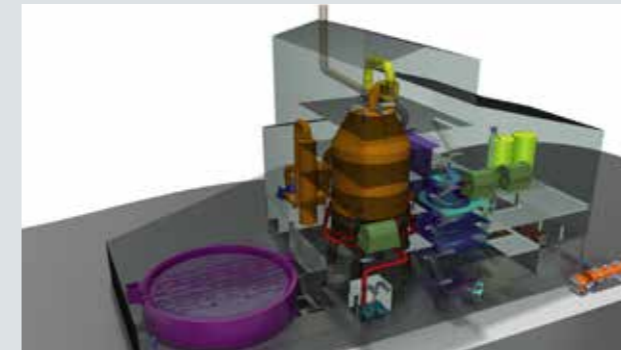
CMI's technologies allow for the extraction of a wide range of metals by chemical and physical methods

CMI 's unique product range in the field of metal extraction suits the production of a wide variety of valuable intermediate and finished compounds (ore concentrates, hydroxides, mixed oxides).

Typical Applications for the extraction of metals with hydrochloric acid are Titania Pigment, Synthetic Rutile, Magnesia, Alumina, Nickel Oxide and Cobalt Oxide, for which different combinations of the CMI technologies are used to achieve the most effective and cost efficient solution, based on the specific feedstock characteristics and customer needs. As such CMI can supply pyrohydrolysis acid regeneration plants based either on fluidized bed (FB) or on spray roaster (SR) technology. The choice between these two processes is made to best suit the customer's specific requirements.



▲ Spray Roaster Pyrohydrolysis for nickel oxide extraction Goro Nickel, New Caledonia



▲ Spray Roaster Pyrohydrolysis, thickener, calcination for high purity magnesia production, Orbite, Canada



▲ Natural gas burner



▲ Fluidized Bed Pyrohydrolysis

Key Benefits

- Pressure / atmospheric leaching based on HCl is a highly effective method for the extraction of metals such as Fe, Ti, Mg, Ni, Co and their compounds
- Total recovery of HCl by Pyrohydrolysis gives independence from chemical suppliers and greatly enhances the environmental performance of the overall processes
- Pyrohydrolysis produces high quality metal oxides

CMI and its partner Ti-Cons combined their competences and offer an Integrated Process for the production of titania pigment from ilmenite or upgraded slag.

The process combines CMI's synthetic rutile process and the Chloride Process (CP) offered by Ti-Cons.

For the synthetic rutile production from various feedstocks, CMI offers next to the total acid recovery using both relevant technologies (FB + SR), the HCl- leaching, along with related up-and downstream processes, while for magnesia production (CCM/Sinter) from various feedstocks only spray roaster pyrohydrolysis (SR) is used along with the up- and downstream processes, specific to this process.

Additionally, CMI offers solutions based on its fluidized bed (FB) and spray-roaster (SR) pyrohydrolysis for the production of nickel and cobalt oxide from nickel chloride and cobalt chloride solutions.

Pyrohydrolysis Technologies:

- **Fluidized Bed (FB)**
- **Spray Roaster (SR)**

Related Up- and Downstream Processes:

Solid / Liquid Separation

- > Filtration
- > Thickening
- > Flotation

Chemical / Physical Separation

- > Solvent Extraction (SX)
- > Ion-Exchange (IEX)
- > Precipitation
- > Ad-/Absorption
- > Membrane Process
- > Calcination
- > Sintering
- > Roasting

Metal Recovery

- > Chemical Reduction
- > Electrolysis
- > Cementation

Typical Applications:

- **Magnesia (DBM, CCM +98 wt%, Sinter +99wt%)** from Magnesite, Serpentine, Dolomite, Brucite, Bischofite, flue dust, end brines from Potash production
- **Synthetic Rutile (+95.5 wt% TiO₂) and Titanium dioxide pigment grade (+99 wt% TiO₂)** from Ilmenite
- **Nickel oxide** and **Cobalt oxide** from Laterites
- **Alumina** from clays
- **Rare Earth Oxides (REO)** from Monazite, Bastnasite, Loparite, Xenotime

Heat treatment



▲ Car Bottom Furnace with Electric Heating Elements



▲ Rotary Hearth Furnace



▲ Atmosphere Bell Furnace



▲ Flexible Heat Treatment Lines

Furnace Designs:

- Box Furnaces
- Tilting Cover Furnaces
- Car Bottom Furnaces
- Atmosphere Bell Furnaces
- Roller Hearth Furnaces
- Flexible Heat Treatment Lines
- Rotary Hearth Furnaces
- Vertical Quench Furnaces
- Aluminum Melting Furnaces
- Continuous or Batch Line with Tray for Aluminum

Leading-edge heat treatment furnaces meeting international safety and quality standards

CMI Industry Metals provides heat treat products (continuous, semi-continuous and batch) to heat treat a wide range of materials (steel, copper, brass, stainless steel, aluminum, zirconium, tungsten, titanium, beryllium, etc.) in a multitude of sizes, shapes and thermal cycles.

CMI Industry Metals's heat treatment furnaces and integrated systems set the standard for product quality and combustion efficiency, and are most effectively addressing environmental and operational concerns, allowing for lower fuel consumption by reducing heat losses from the furnace to the minimum and increase availability and flexibility of operations.

Based on its great historical knowledge and experience, and evidenced by numerous worldwide references, heat treatment products supplied by CMI comply with local, national and international safety and quality standards, including:

- NFPA 86
- NEC (NFPA 70)
- UL508a
- AMS 2750E
- NADCAP

Over the years, CMI Industry Metals has developed a wide range of furnace models. Furnace solutions are simulated numerically in order to ensure the best design and to calculate the final performances of the equipment.

Automation systems allow operators to easily control the system while maintaining environmental and efficiency standards. CMI's control models allow customers to reach the optimum heating curves and optimize production to reach the lowest operating expense. Mathematical models with specialized algorithms guarantee the precision of the heating process and thus improve furnace efficiency.

CMI Industry Metals has built a number of furnaces dedicated to research and testing, and is an active partner in several international research programs.

Additionally, CMI belongs to a worldwide network of technical partners including professional associations, universities and technical centers. Providing the knowledge platform which is necessary to ensure continuous innovation and development for its high end heat treatment solutions.

One of the principal objectives is the analysis of the energy consumption of its different furnace designs and the implementation of the results helping to further reduce fuel consumption while ensuring optimum product quality. With the final goal to continuously lower operating costs and improve customers' return on investment.



▲ Box Furnace



▲ Tilting Cover for Long Products

Key Benefits

- Numerical simulations leading to optimum designs and giving the assurance of respected performance guarantees.
- Consistency and efficiency of equipment, reducing operating costs
- Easy and efficient operator interface and data management.
- Mathematical models to improve furnace efficiency.
- Optimization of energy consumption to increase profit.
- Secure systems management program to reduce risk of human error
- Dedicated onsite training to increase operator knowledge



▲ Roller Hearth Furnace

Next to mechanical and maintenance repairs and maintenance training, CMI also offers the turning, milling, drilling, polishing and straightening of parts, the welding of various metals and parts, as well as their fabrication and assembly out of its machine workshop in Salem, Ohio, USA.



CMI INDUSTRY Metals

CMI designs, installs, upgrades and services equipment for energy, defense, steelmaking, the environment and any other industry in general. CMI numbers 4 500 experienced employees in Africa, Brazil, China, Europe, India, New Caledonia, Russia and the United States, and assists clients throughout the whole of the life-cycle of their equipment in order to improve the economic, technical and environmental performance of this equipment.

Proud of its past and aware of its own capacities to invent the processes of the future, CMI intends to contribute to meeting the challenges of today's society and to generate sustainable industrial progress for the benefit of its customers, employees, the communities in which it is established, and the planet.

As an international specialist in industrial processes and technologies, CMI Industry Metals designs, supplies and modernizes cold rolling mills, processing lines, chemical and thermal treatment installations for the steel and the non-ferrous industry, as well as state-of-the-art heat treatment technologies for the aviation, forging and casting industry.

Based on decades of experience and successfully running references all over the world, CMI Industry Metals not only supplies Green- and Brownfield installations and equipment, but also provides the related services, as well as training and technical assistance.

CMI's reliable and cost-effective, yet innovative solutions are always adapted to the specific needs of each and every customer.

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