



# Aluminium Melting and Recycling

For Sustainability and Optimized Quality





# TENOVA LOI THERMPROCESS

Tenova LOI Thermprocess is one of the leading companies in supplying industrial furnace systems for the heat treatment and melting of metals. Worldwide clients from the steel, aluminium and automotive industries rely on the technical solution competence and thousands of references backed by a history of over 100 years representing the entire know-how in the field of material properties and thermal processing. Tenova LOI Thermprocess is a global partner represented in all major markets throughout the world.

Being a driver in the transformation of the metals industry towards decarbonization and sustainability, we implement proven thermoprocessing solutions and focus on the development and implementation of fossil-free annealing technologies, especially Hydrogen, as well as electrical heating capabilities in new plants and revamps. The wide portfolio of technologies for reheating and heat treatment plants meets the most demanding market requirements.

As digitalization is one of the key drivers in our business, all our processes are enhanced by our smart digital solutions. We provide the full range of solutions for the whole life-cycle of the equipment from a single source: from new plants to modernization, maintenance and service.

Tenova LOI Thermprocess offers reliable and sustainable solutions that minimize the environmental impact and guarantee quality, production efficiency and safety. Tenova LOI Thermprocess is a trademark of Tenova.



# ALUMINIUM – LIGHTWEIGHT, INNOVATIVE AND COMPLETELY RECYCLABLE

Due to its unique properties and the optimal recyclability of used aluminium components, aluminium is a trend-setting material for automobiles, mechanical engineering and aviation industry and outclasses alternative materials with regard to many future-oriented solutions.

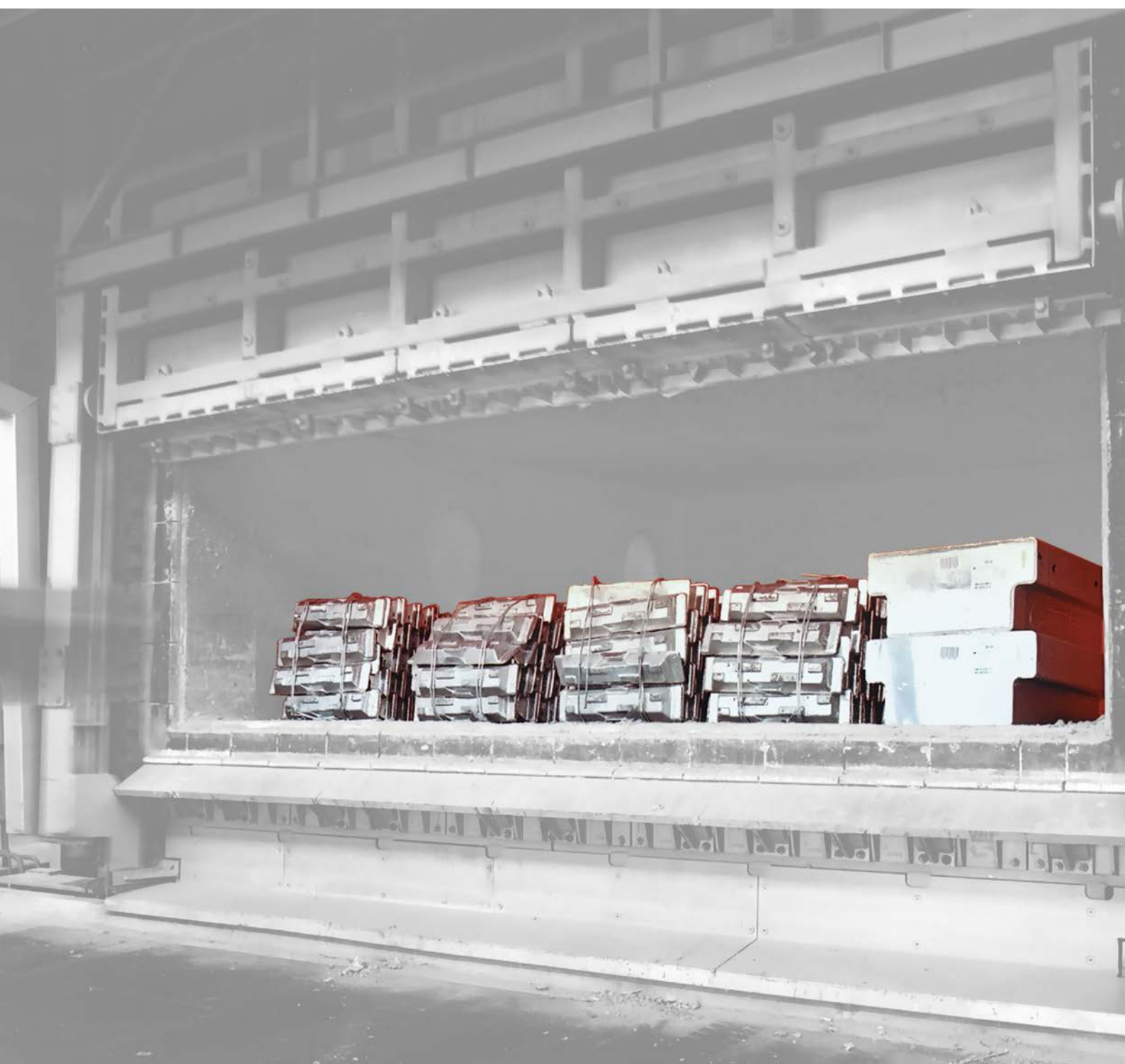
## Aluminium

- low density
- favourable corrosion resistance
- high electrical conductivity
- high thermal conductivity
- high stability
- good formability
- excellent light reflection
- numerous possibilities of surface treatment
- unrestricted recycling without loss of quality



# ALUMINIUM MELTING AND CASTING FURNACE PLANTS

Aluminium melting and casting furnaces are used to melt block metal and clean scrap and to cast the liquid metal in casting machines. The furnaces are either stationary or tiltable; they can be equipped with special charging machines and be adjusted to individual production conditions.





## MELTING AND CASTING PLANTS

The melting and casting furnaces of Tenova LOI Thermprocess can be either tiltable or stationary. They are heated with natural or hydrogen gas. The energy consumption is reduced due to regenerative heat recovery and furnace pressure control. A fully automatic control system ensures the constant quality of the melt; an optimal process control contributes to reduced metal loss. Mathematical modeling supports the process optimization. Dimensioning and design of combustion, metal flow and heating curves are based on numerical models, for optimum conditions.

The plant design is based on the optimized combustion process, melt movements and heating profiles. The today's optimized furnace plants result from the know-how of design and process technology which was gathered in decades of practical experience.

The **al-loi®** melting and casting plants distinguish themselves with

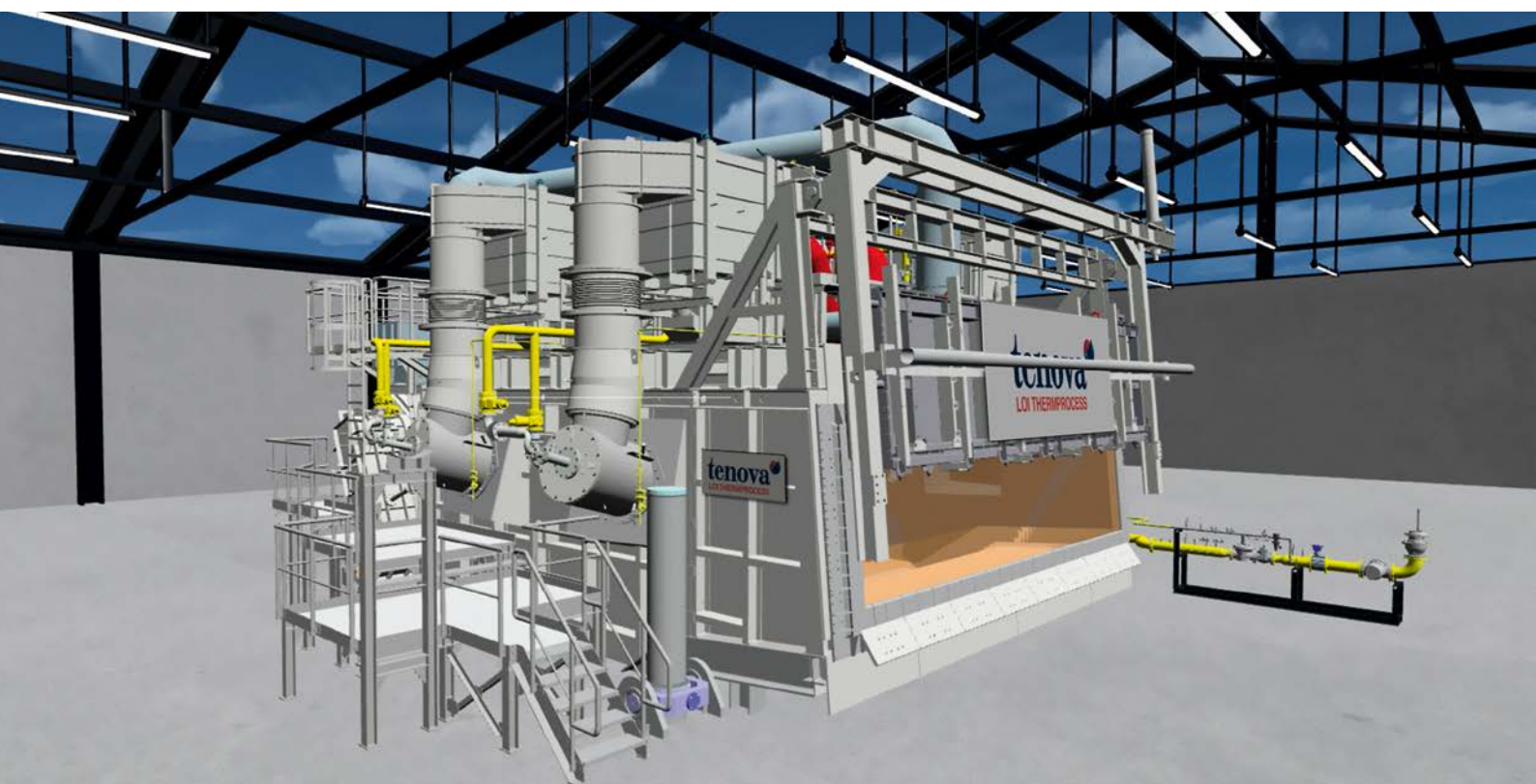
- high energy density
- uniform heating of melting bath
- metal circulation for melt homogenization
- purging gas treatment in the furnace
- reduced hydrogen absorption
- charging machines for optimized production process
- melting aggregates for chips

The furnaces are heated by open burner flames and flameless combustion. The burner arrangement ensures a uniform heating of the furnace chamber and the melt bath. Aiming at reduced energy consumption and metal loss, the individual burner control takes care of uniform and optimal combustion conditions. Burner regenerators (BCR) or a central regenerator (CCR) can be used for the regenerative heat recovery.

The **al-loi®** heating technology offers

- gas heating and hydrogen
- regenerative heat recovery
- central regenerator CCR
- low oxygen furnace atmosphere
- low noxious emission

▼ Design of melting and casting furnace for clean and light contaminated scrap



## MELTING FURNACES

As the melting furnaces are used for melting block metal or clean scrap, they are equipped with a large charging and cleaning door. Special charging machines facilitate the operation and increase the efficiency.

- melting of block metal
- melt treatment in the furnace
- regenerative heating
- metal circulation by use of a stirrer or pump
- charging machines for block metal and scrap
- large furnace doors
- flat inner walls for easy cleaning
- tiltable or stationary
- fully automatic furnace control
- low metal loss

### Lower CO<sub>2</sub> emissions

- high heat recovery
- low energy consumption
- reduced noxious emission

### High availability

- solid and robust design
- reliable components
- know-how gathered in decades of practical experience
- low maintenance required
- easy operation

## PLANT DATA

Final products	rolling ingots extrusion billets pigs
Furnace capacity	35 – 140 t
Heating system	regenerative burners BCR central regenerator CCR
Fuel	natural gas / hydrogen
Metal circulation	pump stirrer
Charging material	electrolysis metal block metal scrap
Melting rate	5 – 25 t/h
Melt treatment	rotary gas injector
Metal temperature	700 – 860 °C

▼ Melting furnaces MCF with a bath capacity of 55 t each



## CASTING & HOLDING FURNACES

The casting furnaces are used to provide the melt for the casting process. The hydraulically tiltable design is typical of these furnaces as it allows to smoothly feed a casting aggregate with the liquid metal

in a controlled manner. The melt is transferred on the same level from the furnace into the casting equipment by means of a hinged launder. The furnaces are equipped with a large cleaning door. The furnaces offer various possibilities of melt refining.

## High metal quality

- uniform temperature during casting
  - low in hydrogen
  - precise level control in the launder
  - closed oxide skin during casting
- smooth metal flow

## PLANT DATA

Final products	rolling ingots extrusion billets pigs
Furnace capacity	30 – 140 t
Heating system	cold-air burners regenerative burners BCR
Fuel	natural gas / hydrogen / electricity
Metal circulation	stirrer
Charging material	liquid metal alloy elements
Melting rate	2 – 5 t/h
Melt treatment	rotary gas injector porous plugs
Metal temperature	680 – 740 °C

## Particularities

- melt treatment
  - with impeller
  - with porous plugs
  - with lances
- cold air or regenerative heating
- large furnace door
- smooth inner walls for easy cleaning
- tiltable
- fully automatic furnace control
- low energy consumption

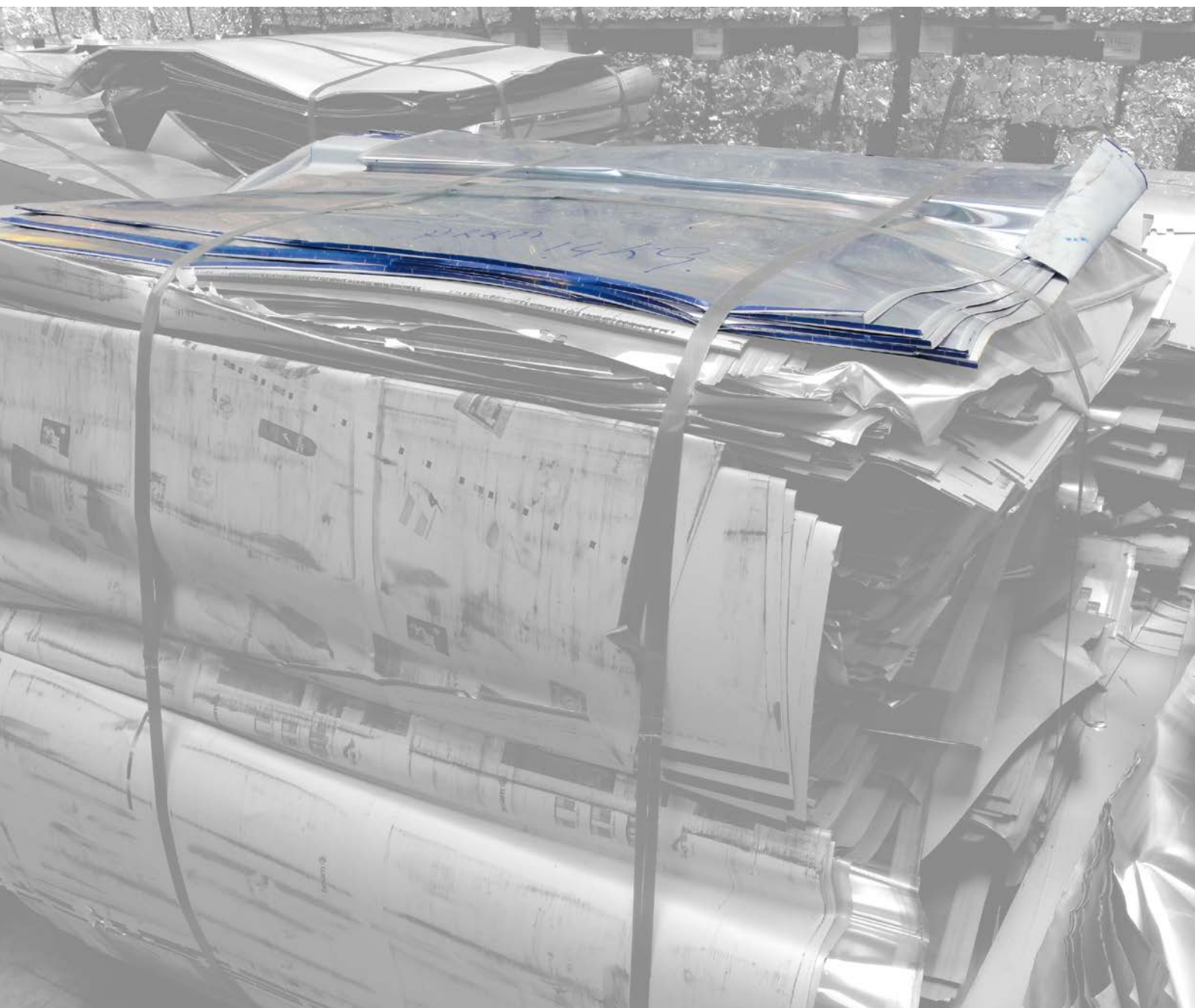


- ◀ Casting furnace CF to be fed with liquid aluminium, used for alloy up and for feeding casting plants. Bath capacity of 35 t, heated by natural gas.



# SECONDARY ALUMINIUM RECYCLING AND REMELTING

The TCF® process, developed by Tenova LOI Thermprocess is subject to continuous optimization. This process is applied for recycling aluminium scrap (post-consumer or production return) and scrap metal with oil and grease adhesion, lacquer, plastic or thermal insulation layers. The combination of a Twin-Chamber Melting Furnace TCF® with a waste gas purification plant is a reasonable solution for aluminium recycling in ecological and economic terms.





### TCF® TECHNOLOGY

- recycling of scrap with contamination
  - chips
  - thin-walled scrap
  - small-sized scrap
- no scrap pre-treatment is required
- scrap pre-heating in reducing furnace atmosphere
- melting in liquid metal bath
- oxygen-controlled scrap chamber prevents metal loss
- recycling without using salt
- optimized oxygen control in the heating chamber
- waste gas quenching for emission reduction
- homogenous bath due to continuous metal circulation
- low metal loss
- lowest energy consumption

### Favourable Environmental Compatibility

- The pyrolysis gas originating from the adhering substances is led into the reaction zone of the heating chamber.
- Emissions and energy consumption are reduced due to the use of the pyrolysis gas.
- Integrated in the furnace with a long dwell time and high temperatures, the pyrolysis gas is safely and environment-friendly burnt.
- A rapid quenching (2,500 K/sec) of the combustion gas avoids the re-combination of dioxins.
- The waste gas is cleaned of dust and harmful gas components (HCl, HF etc.) in the course of the special waste gas purification process.



▲ Recycling Plant TCF®

- Due to the regenerative heating system including CCR the combustion air pre-heating is increased; the energy consumption is reduced simultaneously.
- The automatic charging machine does not only reduce the flue gas penetrating into the hall, but additionally automates the production process.

Twin-Chamber Melting Furnace TCF® ▼  
for salt-free melting of contaminated aluminium scrap



## TWIN-CHAMBER MELTING FURNACE TCF®

The Twin-Chamber Melting Furnace TCF® comprises a furnace casing with two furnace chambers. While their atmospheres are separated, the two chambers dispose of a common melting bath. First, the scrap is placed and pre-heated on the dry hearth of the scrap chamber; the contaminants are pyrolised. In the next step, the scrap is pushed into the melting bath for being melted there. The heating chamber accommodates the furnace burners and provides the heat required for the melting process. The recirculating melt flow transfers the melting heat from the heating chamber into the scrap chamber.

### Twin-Chamber Melting Furnace TCF®

- melting of scrap with contaminants
- melting of chips
- melting of scrap without prior pre-treatment
- separated atmospheres in scrap chamber and heating chamber
- scrap pre-heating on the dry hearth
- melting in liquid metal bath
- oxygen-controlled scrap chamber
- rapid oxygen reduction upon charging process
- oxygen control in the heating chamber
- waste gas quenching by use of the central regenerator CCR
- lowest energy consumption
- fully automatic control system
- safety software for process monitoring
- easy operation
- charging machine with hood
- automatic chip charging

### CHIP CHARGING

The melting aggregate is automatically and continuously fed with chips from a hopper. As the central automatic process control system is responsible for control and monitoring, optimal charging is ensured.

### USE OF BLOCK METAL

Having reached the heating chamber, the block metal is first placed on the dry hearth of the heating chamber for being pre-heated and dried.

## ADVANTAGES OF CENTRAL REGENERATOR CCR

- rapid cooling of combustion gas
- high air pre-heating temperature
- compact design
- uniform heat recovery in a wide performance range
- continuously burning flames
- no switch-over between burners
- optimized burner positioning
- optimal pre-conditions for meeting future emission requirements



Waste gas heat recovery by use of central regenerator CCR ►



### ADDITION OF LIQUID METAL

For the purpose of alloy adjustment liquid metal can be added in the furnace and will be inserted via a liquid metal inlet pocket.

### DISCHARGE OF LIQUID METAL

The melted metal can be discharged from the furnace via tap cones or a pump and will be forwarded to a downstream aggregate (e.g. a casting furnace).

### TYPICAL PLANT DATA

	TCF75	TCF90	TCF120
Final products	rolling ingots – extrusion billets – pigs		
Furnace capacity min.	75 t approx. 40 t	90 t approx. 45 t	120 t approx. 50 t
Production rate	80 t/d	160 t/d	210 t/d
Heating system	CCR/BCR	CCR	CCR
Air pre-heating	950 °C	950 °C	950 °C
Fuel	natural gas / hydrogen	natural gas / hydrogen	natural gas / hydrogen
Metal circulation	electro- magnetic / mechanical	electromagnetic	electromagnetic
Charging material	contaminated scrap – block metal		
Charge per charging process	2.5 – 3 t	3 – 5 t	4 – 5 t
Chip charging	up to 2 t/h	up to 4 t/h	up to 6 t/h
Casting temperature	680 – 760 °C	720 – 760 °C	720 – 780 °C



◀ Twin-Chamber Melting Furnace TCF® with automatic charging device CM

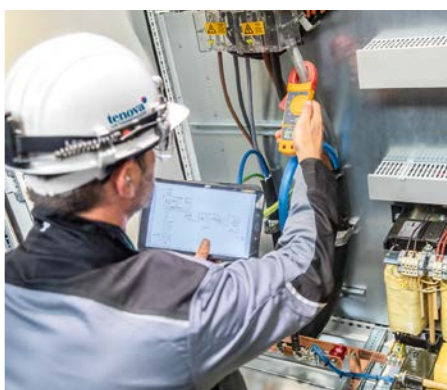
▼ The CW (Charge-Well) aggregate allows the feeding of chips and small-sized scrap into the metal flow of the bath circulation, which reduces the metal loss due to oxidation.



# RETROFITTING AND MODERNIZATION

Being a driver in the transformation of the metals industry towards decarbonization and sustainability, Tenova LOI Thermprocess offers a wide variety of innovative revamping and modernization solutions to help pave the way towards a climate-neutral society.

As each furnace plant is unique, we implement proven process solutions and focus on the development and implementation of fossil-free melting and annealing under usage of electrical heating or Hydrogen combustion.



Especially the relatively short down times and the partial reuse of existing infrastructure combined with performance improvements make modernization an attractive alternative. Irrespective of the original supplier, we can design and implement modernization projects for melting and holding furnaces in accordance with customers' requirements and national regulations. Plants modernized by Tenova LOI Thermprocess offer considerably higher productivity and efficiency. Our retrofit packages are also designed in line with safety and sustainability requirements.

We have the expertise required for the modernization, modification and repair of

- Steel structures
- Refractories
- Electrical systems
- Instrumentation systems
- Automation and control systems
- Heating systems

With our digital products, we offer preventive maintenance, remote support as well as electronic, digitalized spare parts catalogues both for new plants and for the modernization of existing plants.

## MODERNIZATION OF INSTRUMENTATION AND CONTROL SYSTEMS FOR HIGH QUALITY IMPROVEMENT AND UPDATED SAFETY SYSTEMS

Modifications may be needed as a result of more stringent quality, certification and safety requirements of the final customer for the products treated. One example is the modernization of safety systems by our electrical and control experts in accordance with the state of the art.



# Modernization of heating systems

## HIGH DECARBONIZATION POTENTIAL BY RETROFITTING THE HEATING TECHNOLOGY

Melting, casting and twin chamber furnaces have a high potential for reducing CO<sub>2</sub> emissions due to their ease of retrofitting/modernization. In contrast to measures in new plant construction, where the necessary investments are very high, modernizations are an efficient way to reduce the CO<sub>2</sub> footprint in the short term. In addition, modernization can easily be carried out in phases and does not necessarily have to be done in one step, and can be adapted to

the specific circumstances of the customer. Technically optimized and economically viable solutions can only be created after prior analysis of the processes and infrastructure.

## HIGH SECURITY FOR FUTURE OPERABILITY THROUGH MODERNIZATION OF HEATING SYSTEMS

Modern high-performance recuperative and regenerative burner systems in dual fuel technology for natural gas and/or hydrogen guarantee a most efficient heating with variability in the energy source. The possible performance improvements can be illustrated

most effectively by reference to specific projects. Modernized heating systems can be equipped with our own TENOVA burners and regenerators, suitable for natural gas, hydrogen or blends of these gases. Medium velocity flame speed and usage of flameless technology provide the required low emissions in the flue gas.

## SHORT DOWNTIMES

Normally, it is only necessary to shut an existing plant down for between one and two months for the installation of new assemblies.

▼ Installation of modern regenerative heating system with TENOVA burners on a melting & casting furnace



# SERVICE AND SPARE PARTS



Each furnace plant is unique. With know-how developed over many decades and backed by thousands of references worldwide, Tenova LOI Thermprocess supplies targeted and experienced services, consultations, relocations as well as maintenance and spare parts specially aligned for your thermal process plant. The worldwide service network assures high availability and fast delivery.

Being a driver in the transformation of the metals industry towards decarbonization and sustainability, Tenova LOI Thermprocess offers a wide variety of innovative revamping and modernization solutions to help pave the way towards a climate-neutral society.

## MODERNIZATION, RETROFIT & RELOCATION

In cooperation with our qualified personnel, our customers are able to find the ideal optimizations for their equipment. Our specialized service solutions allow customers to operate their equipment at the highest possible productivity and efficiency levels at the same time as focusing on safety and sustainable development.

## SERVICES

We provide our customers with tailor-made maintenance programs, regular technological updates, operation assessment and personnel training with the aim of keeping their equipment running at full capacity in line with best practices, avoiding unforeseen delays and unplanned interventions.

## MAINTENANCE & REPAIR

Our experts are available for maintenance work on systems including:

- Mechanical/Electrical Furnace Systems
- Refractory linings
- Burner systems
- Heating/Cooling systems
- Control systems
- Automation
- Mathematical models





## SPARE PARTS

The technical service personnel of Tenova LOI Thermprocess is well prepared to supply the right spare parts within the shortest time. This includes the installed base for the brands that founded LOI Thermprocess – Ludwig, OFAG and INDUGAS – as well as the companies that have been absorbed into LOI Thermprocess over the decades, such as Nassheuer and Dr. Schmitz & Apelt.

With **LOI-SIS®** (LOI Service-Information System), a web-based catalogue for new and old equipment can be created on demand to facilitate the identification of parts and simplify the procurement process significantly.

## DIGITAL SERVICE

LOI's wide portfolio of different digital services help you to improve product quality, minimize downtimes and enhance your production process.

These are e.g.:

- Remote Services including Remote Assistance to offer live support at your plant and Remote Control for performance monitoring
- Digital Equipment Twins using Virtual Reality that allows you to experience your equipment before it is installed
- Digital Automation Twin to accelerate your plant commissioning

- Video Furnace Inspection to easily analyze various furnace types
- A variety of Intelligent Process Models and Monitoring Systems for performance increase

## CONSULTANCY

Our process engineers and our commissioning and control systems specialists are available to provide innovative and reliable advice and support to our customers in line with their requirements.



# Sustainable solutions for a green transition of metals

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