

—INTECO—



**WE ARE  
DIGITALIZATION AND  
SMART PRODUCTION**



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# DEAR READER!

Thank you for your interest in INTECO. On the following pages we tried to compile an overview of INTECO's capabilities and know-how in regard to digitalization and smart production. Being a supplier and partner to the steel and general melting industry since 1973, INTECO is proud to be until today the only single source supplier worldwide who offers and has already put into operation all production processes for the treatment of steel, ferroalloys and super alloys such as...

- › Melting & refining
- › Casting
- › Rolling mills
- › Special melting & remelting
- › Automation and production management systems (IMAS)
- › Powder technology
- › Titanium technology

This brochure highlights examples of successful digitalization projects and powerful digital solutions for all of the above-mentioned processes. Automation and SCADA, equipment and machine control, HMI, process automation, process models and optimizations and last but not least digital production management tools are all synonyms for the INTECO digital solution landscape which you can study in detail on the following pages.

.....but in the end it boils down to the one and only name – INTECO – which stands for common values and the one and only mission all of us share: No matter if only a part of the production process or a whole process line – we want to serve you with our know-how and the best tailor-made technology and digital solution possible.

We cordially thank you, our clients and customers, who – with their trust and confidence in the capabilities of INTECO – have helped to pave the way to achieve what you will read in this brochure and more.

  
Patrick Mild  
- Managing Director -

Dr. Harald Holzgruber  
- Managing Director -

  
Ing. Roland Kristl  
- Managing Director -



# ABOUT INTECO

## WHO WE ARE...

Starting out as a consulting company for the specialty steel industry, INTECO has grown to the only single source supplier worldwide that offers all production processes for liquid metal processing. Since more than 90% of our equipment and services are exported, INTECO is a global player represented by local agents and/or subsidiaries who market and service the products worldwide. Together, we form a fully dedicated team of highly skilled employees eager to plan or modernize a steel plant according to our customers' requirements.

## WHAT WE DO...

Over the last decades, INTECO has grown to a reputable provider of customer-specific solutions for the specialty steel industry. The competence in engineering, management services, and technology transfer as well as strong customer dedication was and is the key to success for our customers. This in turn is the driver for INTECO to continue to develop the service and product portfolio in the future. The goal is to further strengthen the leadership in metallurgical process technology and equipment for melting, refining, casting, remelting, solidification, and atomization for high performance steels, super alloys, and titanium.

## WHAT WE AIM FOR...

We continuously aim to improve the quality of the final product and to make metal production safer, easier, and more efficient. Research and development in process technology and plant design is therefore the key to success. In our opinion, success means providing excellent service for our customers. Continuous improvements of processes and operating techniques as well as design of systems and components are the result of our comprehensive R&D activities. Within our R&D process, we make sure that customer requirements as well as innovations triggered by our experienced staff will be pursued in a structured way.

Leadership in metallurgical process technology and equipment for ...

Melting



Refining



Casting



Remelting



Atomization



... high performance steels, superalloys and titanium.



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**Digitalization and Smart Production are today's prevailing and fast-paced industrial driving forces for change and adaptation. On the one hand, demand on industrial production tracking is steadily increasing, which also applies to the steel-making industry. On the other hand, we increasingly see value-added services using the collected production information.**

**With this in mind, INTECO considers itself to be a one-stop technology provider, offering both excellence in plant engineering and digital solutions to deliver unique cyber-physical solutions for high-performance customers.**



# SERVICES & PRODUCT PORTFOLIO



## \_Pre-investment studies

Important aspects of such consultancy assignments may involve new greenfield projects, project expansion or retrofit programs, process route evaluation as well as independent assessments and ratings for financing purposes. This type of consultancy starts with a conceptual study and may be expanded to full range investigations including basic engineering.



## \_Engineering

INTECO provides basic, and detailed design for entire plants including mechanical and electrical engineering as well as automation. All mechanical engineering is carried out by experienced engineers using modern and state-of-the-art 3D CAD systems. All engineering services are executed in-house at INTECO.



## \_Project & construction management

During 50 years of operation, INTECO has executed several EPCM, or process turnkey projects worldwide. INTECO's engineers are specialized in assisting its customers with project management for new plants as well as revamping existing operations.



## \_Technology transfer

INTECO supplies the relevant know-how and technology, from raw material to the finished products with a focus on productivity and efficiency increase as well as quality improvement. During fact finding studies, we identify areas for improvement, evaluate cost reduction potentials, and mutually agree to specific targets. By preparing the know-how documentation, the relevant technology is documented in detail and later implemented on site during technical assistance by INTECO's experts. They also train the operating staff.

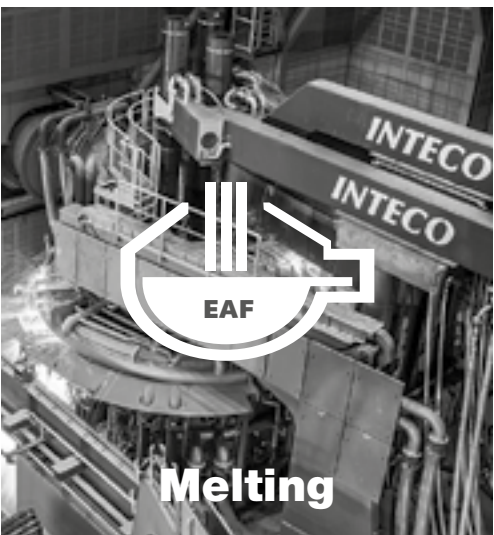


## \_Lifecycle services

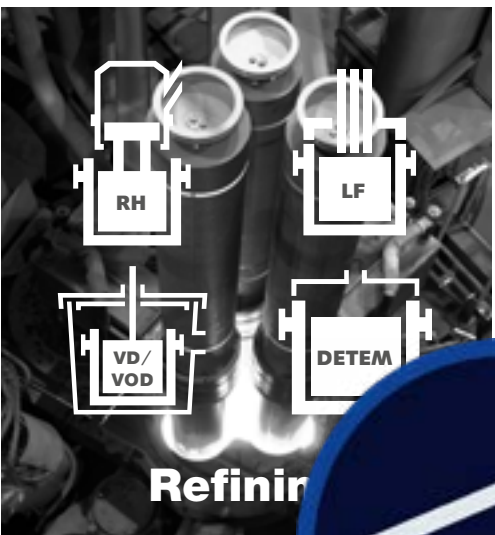
INTECO provides all major lifecycle services for our client's equipment, such as:

- › Remote support and service level agreements
- › Preventive maintenance packages
- › Spare parts supply
- › System upgrades and retrofits

## /MAS DIGITALIZATION AND INDUSTRY 4.0



**Melting**



**Refining**



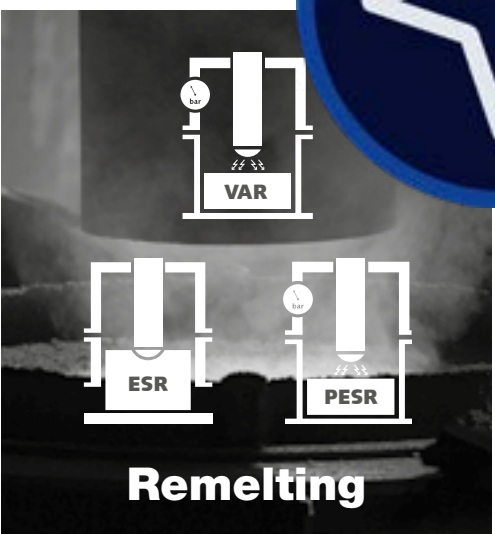
**Casting**



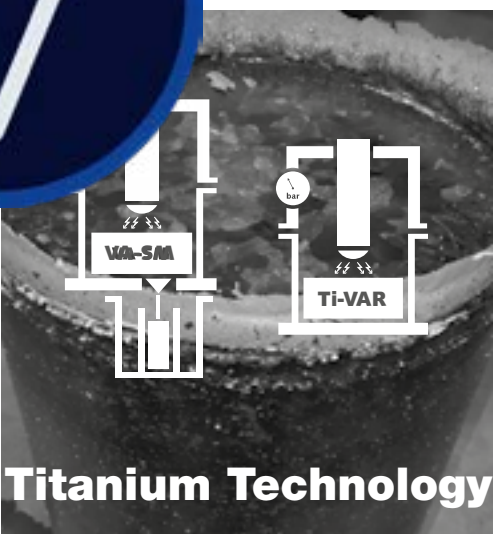
**Rolling Mill**



**Special Melting**



**Remelting**



**Titanium Technology**



**Powder Technology**

 **PROCESS KNOW-HOW & CONSULTING** 



# DIGITAL SOLUTIONS & COMPONENTS

Industrial production of high-performance materials requires precise control and tracking of all relevant data to ensure highest efficiency, reproducibility, and transparency for high-demanding industries such as aviation. Right from the start, first basic (Level 1 and Level 2) control systems with manual operation and data logging in excel sheets or printed melt logs were developed. Since the requirements, complexity, and the amount of data continuously increased over the years, these systems quickly reached their limit.

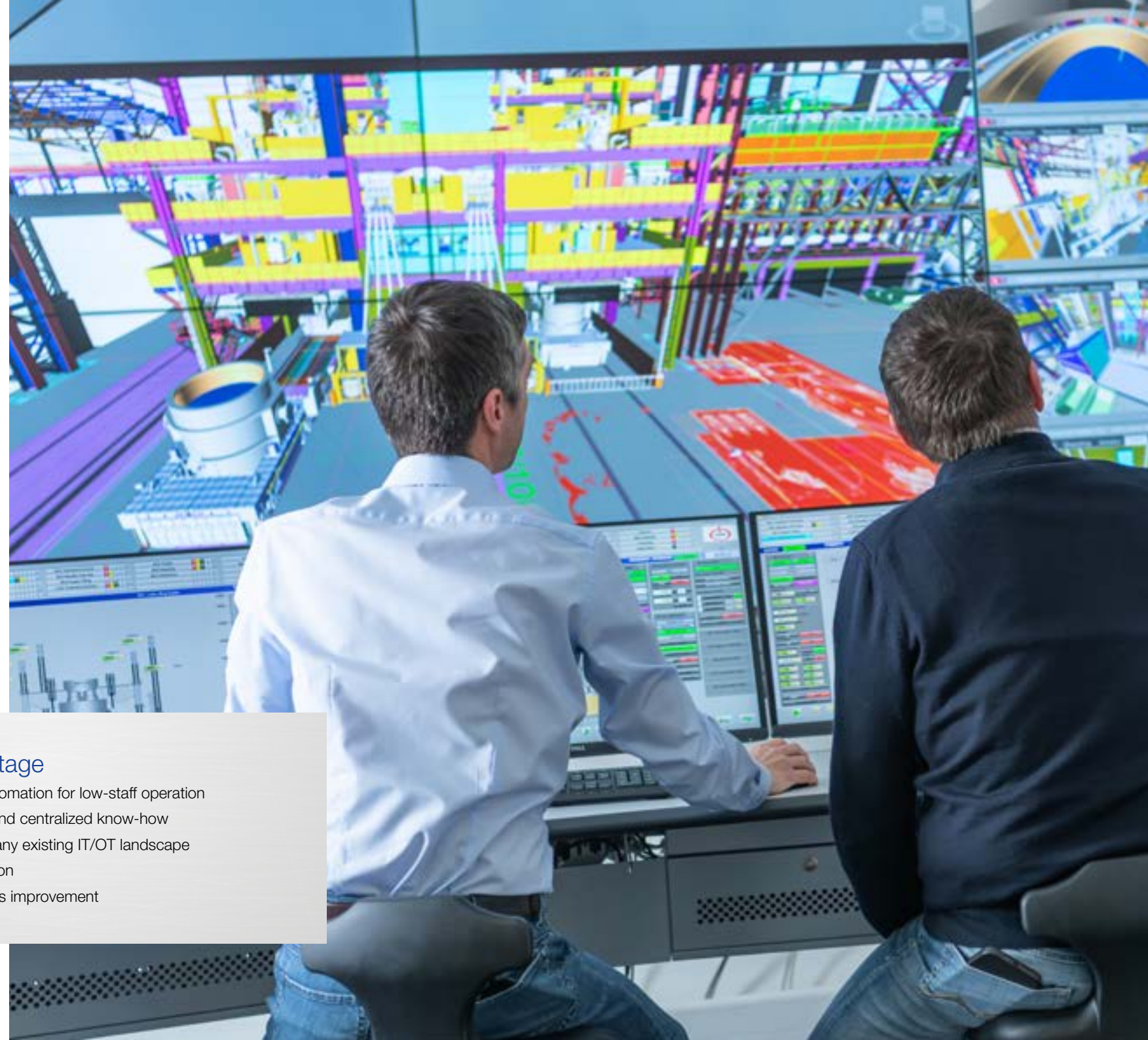
Modern plant automation requires vertical and horizontal integration of all equipment and production processes and must not only cover fully automatic machine operation, process tracking, and reporting, but also planning and optimization for the entire production route. This is especially necessary to meet customer and end-user specific requirements. Furthermore, it must be seamlessly integrated in a smart way into the overall IT/OT architecture, whether existing or new. Finally, it must provide stability and compatibility over the complete lifecycle, which is measured in decades, rather than years, in the steel making sector.

INTECO as a world leading supplier for specialized production technologies offers powerful digital solutions and components for machine and process operation as well as production management called "INTECO Metals Application Suite (IMAS)". IMAS was developed to integrate several levels of automation and is intended to cover all levels between equipment operation (Level 1) and shop floor automation (Level 3). It is also supposed to deliver a clean interface to enterprise IT (Level 4). State-of-the-art software development combined with the process know-how of INTECO are the bedrock of IMAS.



## Our technology – Your advantage

- › Easy-to-use interfaces and high level of automation for low-staff operation
- › Quality improvement due to standardized and centralized know-how
- › Modular design seamlessly integrates into any existing IT/OT landscape
- › Online production monitoring and supervision
- › Data processing and analysis for continuous improvement



## Process and Technology

INTECO Metals Application Suite (IMAS) is a landscape of modular solutions serving all metallurgical processes from EAF melting to casting as well as all special metallurgical processes such as VIM, VAR, ESR, and titanium production. This makes IMAS a holistic set of applications that seamlessly integrates into any IT/OT architecture and precisely delivers the desired functionality. Our integrated automation concept covers the following functionalities:

### Automation and Supervisory Control

Equipment automation and Supervisory Control and Data Acquisition (SCADA) is the solid foundation of any industrial automation architecture. The modules available in IMAS Automation and Supervisory Control (IMAS-AS) range from complete integrated plant automation systems to smart package units, designed for retrofits and enhancements. The modules provide a maximum grade of automation while allowing operators to keep their hands on the machine, if needed. Plant maintenance and productivity is strongly supported through integrated diagnosis features and a smart safety design that features highest operator safety in every possible state of process and machine operation.

### Process Automation and Supervisory Control (shop floor integration)

The modules available in IMAS Process Automation provide dedicated functionality for one metallurgical device each, such as electric arc furnace (IMAS-PA-EAF), ladle furnace (IMAS-PA-LF), vacuum plants (IMAS-PA-VD, IMAS-PA-VOD, IMAS-PA-RH), and casting machines (IMAS-PA-IC, IMAS-PA-SC, IMAS-PA-CC). These modules provide advanced top-down process guidance through dynamic or static formulas and integrated optimization tools. Process supervision is massively improved by the cockpit view and integrated real-time process models. IMAS provides instant information and alerts, based on which the operators can control and steer the process just-in-time. The heat-based data recording stores sensor data, including complex information such as video streams, allowing observation of real-time data.

### Plant Management and Production Lineup

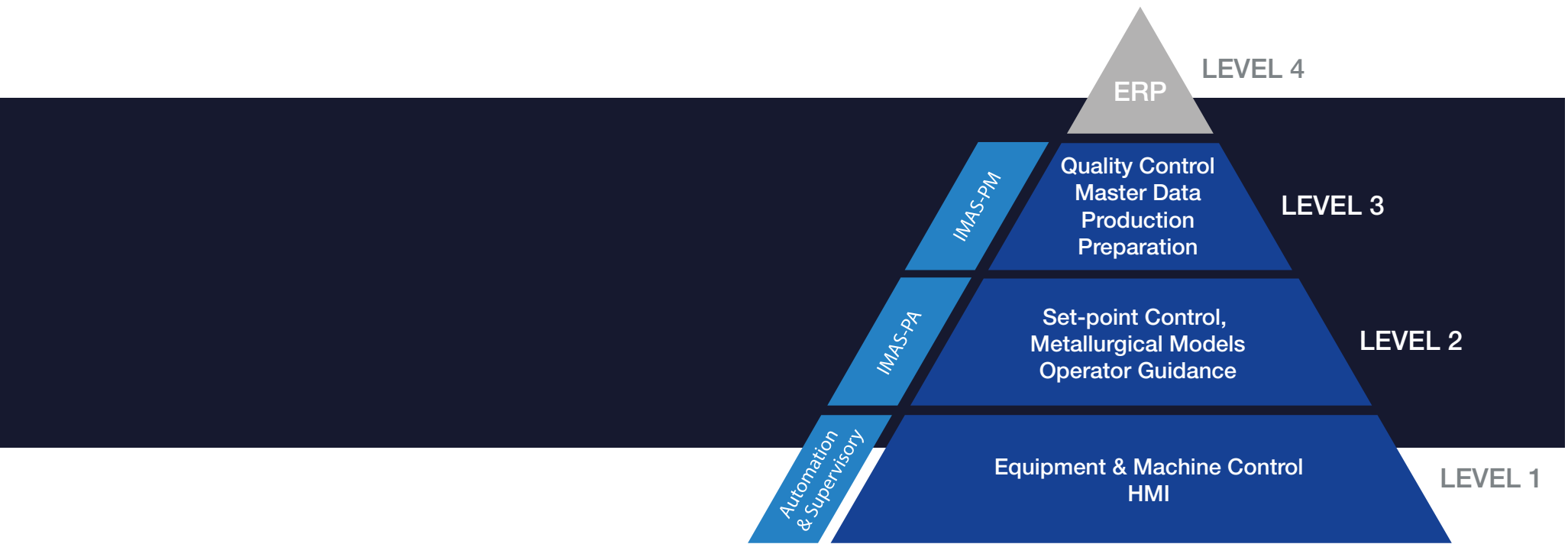
The superior plant management application allows you to stay on top of all processes within the production plant. The plant management unites all the process automation apps under one roof. The major responsibilities include overall quality assurance, production planning, raw material distribution as well as review and analysis to close the cycle at the end of production.



# INTEGRATED PROCESS **AUTOMATION**

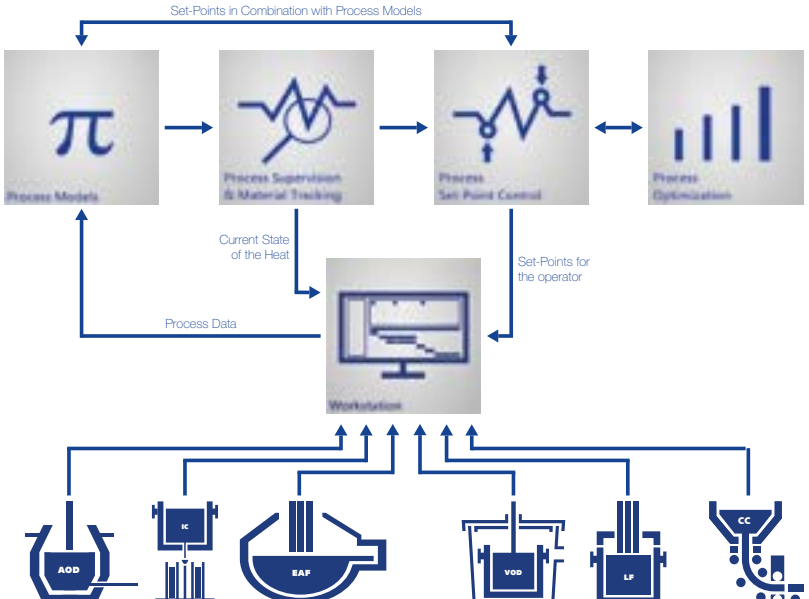
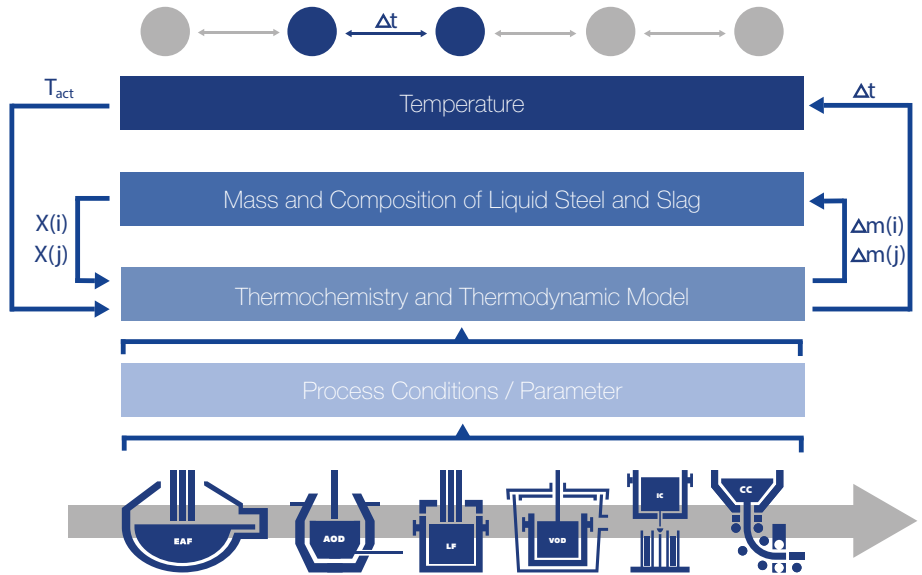
In order to achieve highest flexibility and maximum reliability, IMAS modules are based on the latest technology and developments with respect to its software architecture. Consequently, they fulfil all requirements for Industry 4.0. IMAS breaks with old paradigms like monolithic applications or client/server infrastructure. Instead, the IMAS framework follows a modular concept to ensure scalability in modern steel shops and to support actual trends such as virtualization and EDGE computing.

The distributed architecture of the latest IMAS generation makes it possible to cover all individual customer-specific processes. Additionally, it facilitates extremely flexible bidirectional interaction with any existing IT landscape, such as Laboratory Equipment or ERP systems. IMAS does not only care about real-time operational data, but also provides comprehensive archiving functionality and long-term storage of any process related data. Current research in big data and machine learning will further improve operator guidance and processes with advanced analytics. Research in deep learning technology, also known as artificial intelligence, will improve IMAS' capabilities of recommending or even making decisions.



# **PROCESS** MODELS & OPTIMIZATION

All process-related data is recorded through real-time monitoring and displayed within the specific IMAS applications, either as real-time series or condensed data. Subsequently, the process data serves as input parameters/variables for different metallurgical models. Based on these parameters, models calculate the melting status in melting processes, the current state of the slag and the metal bath in liquid processes as well as the solidification in casting processes. The evaluation is based on mass, chemical composition, and temperature. These calculated results are displayed at the specific IMAS applications. In doing so, process supervision by the operator can be enhanced and metallurgical guidance can be provided online.





# DIGITAL SOLUTIONS LANDSCAPE

## Integrated Automation Philosophy

This is INTECO's understanding of a complete software environment: All customers' needs, from equipment control to production management, are covered within the IMAS ecosystem by providing the best possible solution. At the bottom of the IMAS ecosystem, our Automation and Supervisory Control solutions directly operate the machine itself. The modular SCADA concept allows seamless integration of other digital components such as sensors, controllers, or models located on this layer. The IMAS-PA system expands the machine operation to a process operation, ensuring reproducible production quality and optimum usage of local energy and material by using static or dynamic formulas and dedicated process models. At the top of the IMAS ecosystem, IMAS-PM provides the plantwide operation function with order lineup, coordinated equipment recipes (cook-books), downtime module, quality rules, and service life modules for any kind of equipment.

### IMAS Automation & SCADA

- › Reduced staffing requirements through highly automated machine operation
- › Reduced down-time through extended diagnosis functionality and easy maintenance
- › Maximum safety through tailor-made solutions for each respective work step
- › Maximum operational convenience and production quality through deep integration into process automation
- › Highest quality standard during engineering through virtual commissioning and digital twin for short and safe production ramp-up

### IMAS Process Automation

- › Standardization of your process through grade- and customer-based recipes
- › Reduction of production cost through cost-saving optimization algorithms
- › Reduction of quality defects through deep real-time process supervision granted by our process models
- › Improvement of your process through heat-based data recording and recipe versioning
- › Streamline of your production through valid time and temperature predictions

### IMAS Production Management

- › Efficient production through planning of order sequence
- › Overview through tracking of process and material data
- › Quality through rule-based deviation tracking
- › Improvement through structured downtime reporting and analysis
- › Reduced Cost through service life tracking and management



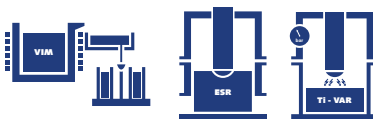
Electric Arc Furnace



Secondary Metallurgy



Casting



Special Metallurgy



Powder Technology

#### Components

- › In-situ offgas analyzer (IPAS)
- › Smart Electrode Controller (ISEC)
- › Spray Cooling Master (ISCM)
- › Burner and injection control package
- › EAF-melt-down model
- › Slag detection system
- › Automatic tapping system (ITAP)

#### Components

- › Offgas analyzer (IPAS)
- › Smart Electrode Controller (ISEC)
- › Temperature and thermochemical model
- › Oxygen-blowing and decarburisation model
- › Degassing model
- › Alloy calculation and material handling
- › Smart process camera

#### Components

- › Mould Level Master (MLM)
- › Tundish Level Master (TLM)
- › Oscillation Master (IOSM)
- › Mould-width-adjustment
- › Breakout prevention system (IBOPS)
- › Heating controller for EPH and ESH
- › Dynamic final stirrer control
- › Soft reduction optimization
- › Ingot casting control (ICAST)

#### Components

- › Remelting Control (IREC)
- › Drip Short Measuring (IDRIP)
- › Charge mix optimization
- › Heating controller for EPH and ESH
- › Temperature and thermochemical model

#### Components

- › Charge mix optimization
- › Heating controller for EPH and ESH
- › Temperature and thermochemical model

#### Applications

- › Scrap yard management (IMAS-PA-SY)
- › Scrap yard loading (IMAS-PA-Crane)
- › EAF operation (IMAS-PA-EAF)

#### Applications

- › LF operation (IMAS-PA-LF)
- › VD operation (IMAS-PA-VD)
- › VOD operation (IMAS-PA-VOD)
- › RH operation (IMAS-PA-RH)

#### Applications

- › CC operation (IMAS-PA-CC)
- › SC operation (IMAS-PA-SC)
- › IC operation (IMAS-PA-IC)

#### Applications

- › IMAS-essentials

#### Solutions

- › IMAS production management for steel making

#### Solutions

- › IMAS production management for remelting and alloys



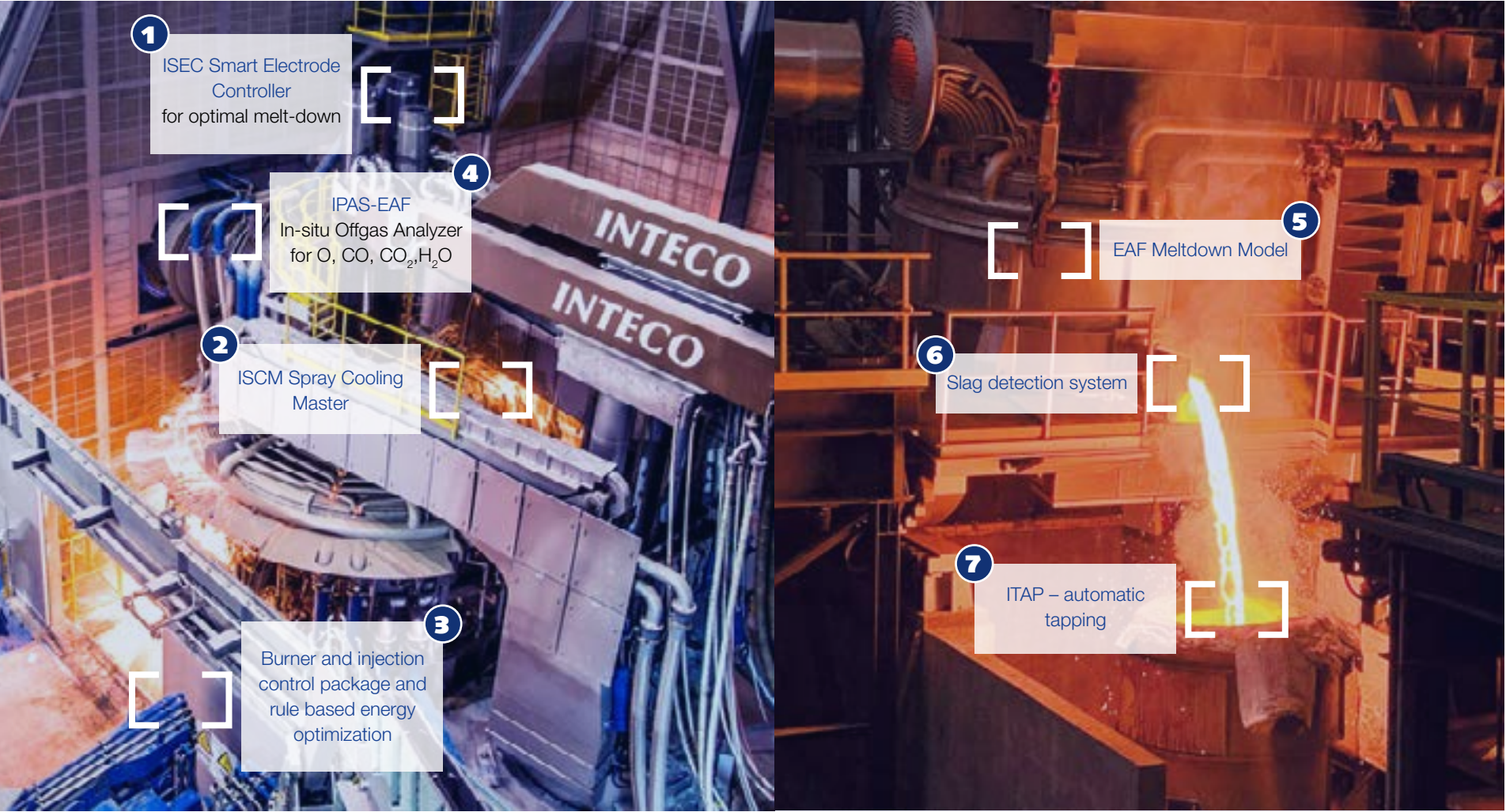
# ELECTRIC ARC FURNACE

**1** The **INTECO Smart electrode controller (ISEC)** was developed to meet the modern furnace operation requirements for electric arc and ladle furnaces in the iron and steel making industry (EAF, LF, VHD/VAD). Additionally, the ISEC can control submerged arc operation, which expands the range of application to all kind of electric furnaces for non-ferrous metals, ferro-alloys, and slag heating. ISEC is based on a state-of-the-art embedded controller that allows sampling and precise computations of all electric values in real time. For flexible operation and fast diagnostics, a modern web-based visualization system is integrated. It offers direct access to advanced information such as working point, control stability, arc lengths, and energy input. The ISEC comes with advanced features such as automatic dip test, automatic valve scaling, adaptive set point control, and a fuzzy logic based foaming slag manager. Standard interfaces such as Profinet, Profibus or Ethernet/IP feature simple integration in new or retrofit projects.

**2** The **INTECO spray cooling master (ISCM)** increases the lifetime of electrodes through automatic state-based cooling optimization. It consists of a filter system with automatic backwash function and an instrumented pipe assembly to check the pressure and temperature.

**3** Our **burner and injection control package** ensures safe and coordinated energy input of electrical and chemical power for a stable and reproduceable melting process. The optional rule-based energy optimization provides an additional control loop enhancing the dynamic power profile with a fuzzy engine to finetune furnace set points for minimum electrode consumption, refractory wear, and energy usage. Different optimization targets allow a direct switchover between production needs such as maximum melt-down performance of minimal operation costs. It integrates perfectly with INTECO's EAF Meltdown Model and the ISEC.

**4** The **IPAS-EAF** provides direct measurement of hot and dusty gases and therefore opens new ways to monitor and control the steel making process. The infrared system helps maintain plant availability, saves energy as well as money, and helps protect the environment. Designed for the ultra-harsh environment of an EAF, it provides real-time, in-situ, simultaneous measurement of temperature, CO, CO<sub>2</sub>, and H<sub>2</sub>O at an agreed-upon location in the water-cooled gas duct near the 4th hole gap. The integrated flow measurement system is a single channel solution, which works according to a patented correlation principle. The system measures the flight time of unique signal patterns created by particles contained in the gas. Because the principle is time-based, it is accurate and drift-free over the entire lifetime. It seamlessly integrates and enhances the function of the EAF Meltdown Model.



**5** The **EAF Meltdown Model** aims to optimize the electric power profile and electric arc furnace operation by monitoring and predicting thermal and metallurgical heat state evolution. The model allows predictive control and operator assistance, offline process optimization, improved understanding of the underlying physical phenomena, and online estimation of parameters that cannot be determined directly through measurements. For that purpose, it uses a detailed modelling of different control volumes in the furnace with liquid, solid, and gaseous phases. The model is non-linear, allowing for the representation of complex interrelated phenomena, including estimation of the visibility of the electric arc and arc efficiency for melting and heating as well as physical modelling principles such as mass and energy balances. The temperatures, total masses, and masses of individual components in the solid and liquid phases of the inner and outer steel control volumes are modelled alongside with temperature, total masses, and individual component masses of the solid and liquid slag phases.

**6** Our **slag detection system** controls the amount of pour-over slag in the ladle. The tapping process is monitored by a thermographic analysis, which measures the radiated electromagnetic energy of the steel flow by means of a non-contact temperature detector. The amount of radiated energy depends on composition, surface properties, and temperature. Even if the temperature of steel and slag are similar, the composition and surface properties are the distinguishing factors that allow for identification of the transition between steel and slag. The temperature detector is based on an industrial thermal imaging sensor, housed in a water-cooled enclosure equipped with purged compressed air, which continuously acquires the tapping area by means of a dedicated recognition software. During every single tapping, the software controls the amount of slag until the pre-determined alert levels are reached. The software is able to record the tapping procedure for further analysis from start till EBT closure.

**7** The **automatic tapping (ITAP)** is triggered by an operator and starts immediately after completion of the EAF melting phase by lifting the electrode columns to the tapping position. Control of EAF inclination is done to maintain a defined tapping speed. Tapping speed is the parameter that drives the function and automatically considers the refractory lifetime for proper EAF inclination. After completion of tapping, the EAF can be automatically returned to horizontal or deslagging position. As an option, it can be equipped with a high-resolution (HD) camera, installed inside water cooled jacket. It allows comfortable monitoring of the tapping situation by providing a video stream to the control room to supervise the tapping process directly.



# 110T **ELECTRIC ARC** FURNACE

Success story from our hero made of steel from China.

## #theChallenge

This customer's aim was to increase operator safety and efficiency. So he wanted to get rid of manual tapping – as it is not only time consuming but also involves a certain exposure to dust and radiation and can bear health risk due to splashing. Additionally, it is challenging for human eyes to distinguish between liquid slag and liquid steel in order to minimize the run-over slag.

## #ourSolution

The implementation of ITAP in the existing furnace PLC and SCADA alongside PTI's automatic sand-filling device for a remotely operated filling of the taphole (no man around) as well as the implementation of the high-resolution thermal imaging system including the slag detection system will hereafter not only increase efficiency in general but will also make the working environment safer.

## #ourDesign

INTECO's automatic tapping solution (ITAP) is designed to be the perfect choice for retrofit applications. It can be easily integrated into the existing furnace PLC and HMI. The thermal imaging camera is detecting the run-over slag and automatically stops the tapping process. Additionally, the camera is designed to provide a live stream to the control room for process supervision.

## Reproducible tapping

- › Control of the tilting angle of the furnace
- › Setpoints for burner mode
- › Setpoints for electrode positions
- › Setpoints for the position of the tapping car
- › Consideration of refractory wear

## BENEFITS



## Quality

- › Reduction of run-over slag by controlling the tapping weight and optional integration of a slag detection system
- › Improved production yield
- › Lower slag content improving steel quality
- › Reduced energy costs

## Operator guidance

- › Simplification of tapping for the operating personnel

## No man around

- › Tapping possible from the control room, monitoring of the process by means of cameras
- › Sand filling manipulator

# 90T **ELECTRIC ARC** FURNACE

Success story from our hero made of steel from China.

## #theChallenge

Mechanical and statical components of an EAF follow a different lifecycle than electrics and controls. While the customer's structural machine of the 90t furnace was still in fairly good condition, its control system was lacking modern components such as digital electrode regulation and combined burner and injection system for state-of-the-art operation.

## #ourSolution

- › INTECO Automation and Supervisory Control for state-of-the-art furnace control
- › INTECO Smart Electrode Controller (ISEC) for optimal energy input
- › INTECO Spray Cooling Master (ISCM) for reduced electrode consumption
- › INTECO PTI Chemical Energy Package in combination with our Burner and Injection Control Package for integrated energy management
- › INTECO PTI SwingDoor™ for sealed furnace operation

## #ourDesign

The INTECO electrode regulation system as well as the burner and injection control package have the potential to return your old furnace to the performance level of a new one at a fraction of costs. The reworked robust mechanical design of the EAF with many small, but essential improvements over other conventional furnaces guarantees a long lifetime and increased maintainability. It works perfectly with our INTECO PTI Chemical Energy Package consisting of burners and injectors for oxygen, carbon, and lime. However, we are also able to upgrade furnaces from other OEM suppliers. In this case, the INTECO PTI SwingDoor™ additionally enables sealed furnace operation, thereby increasing yield as well as burner efficiency. Complicated and dangerous cleaning of the slag door is no longer necessary.

## BENEFITS



## Energy saving

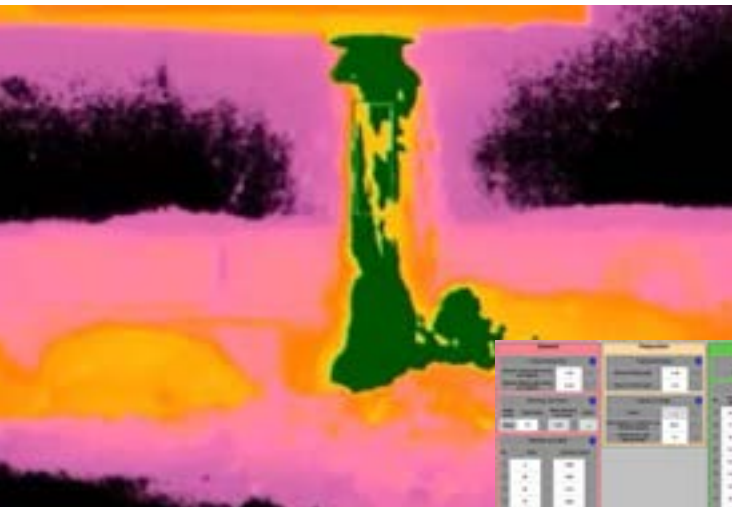
INTECO PTI's chemical energy package in combination with the INTECO Smart Electrode Controller and INTECO's Electrode Spray Cooling System guarantee the lowest possible energy and electrode consumption, which are the main cost drivers besides raw materials.

## Operator guidance

Optimal operator guidance and high automation grade is ensured by a fully integrated SCADA System

## Low staff operation

The fully automatic operation with injection system and swing door enables furnace operation with minimum staff. More importantly, staff becomes redundant in all hazardous areas #noManAround.



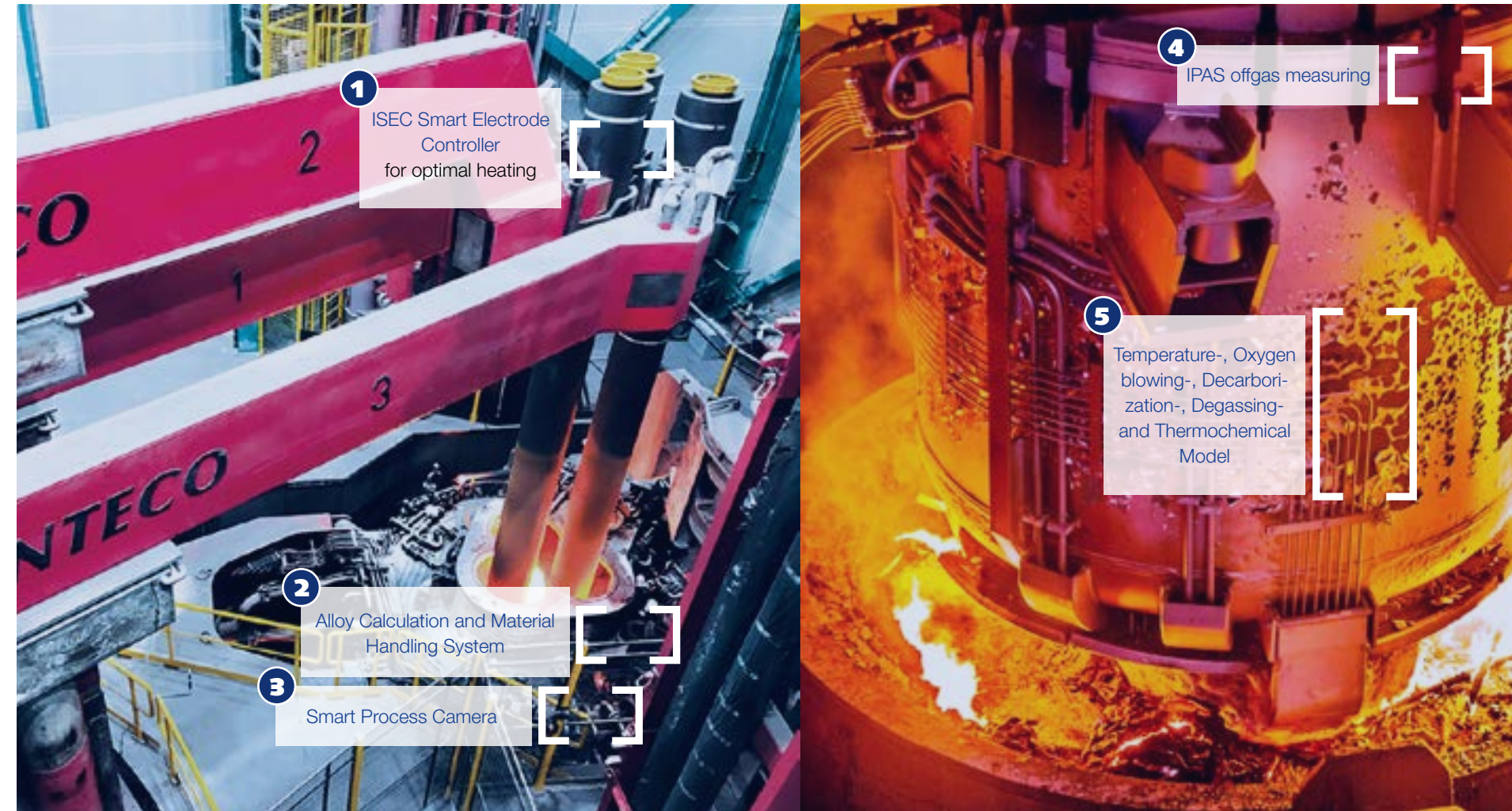


# SECONDARY METALLURGY

**1** The **INTECO Smart Electrode Controller (ISEC)** is not only a perfect choice for the EAF but also for ladle furnaces. The ISEC is based on a state-of-the-art embedded controller that allows sampling and precise computations of real-time electric values. For flexible operation and fast diagnostics, a modern web-based visualization system is integrated. It offers direct access to advanced information such as working point, control stability, arc lengths, and energy input. ISEC comes with advanced features such as automatic dip test, automatic valve scaling, adaptive set point control, and a fuzzy logic based foaming slag manager. Standard interfaces such as Profinet, Profibus, or Ethernet/IP facilitates simple integration in new or retrofit projects.

**2** **INTECO's Material Handling System Automation** is the best solution for exact and time-critical alloying in all secondary metallurgy plants. The recipe based operating philosophy serves all different technologies such as positive and negative weighing, shuttles, weighing bands, or hoppers and integrates micro-dosing systems and wire-feeding machines. Integrated management of materials and related parameters allows usage with or without higher level systems. Besides time optimization and fallback modes in case of redundant feeding lines, it also provides sequential dosing of materials or material groups to ensure alloy to be fed before slag builds. It also integrates perfectly with INTECO's cost optimized alloy calculation that is featured in IMAS. The alloy calculation supports the operator in calculating the exact, cost-optimized alloy quantity to achieve the target analysis for the respective production step. The model can be used during the process whenever it is required and a valid steel sample is available. It also runs perfectly on the results of thermochemical models.

**3** The **smart process camera** for ladle furnaces is a retractable system and therefore well protected from splashes during alloying or heating. The optical system provides a high-resolution direct stream to the control room and ensures safe low-manpower operation. The optional thermal imaging variant provides a clear view through smoke and dust and also serves as input for **automatic stirring adaption**. On tank degasser applications such as **VD and VOD**, a fixed vacuum-tight solution for integration into the upper vessel is provided. The thermal-imaging variant provides an **automatic overboiling detection**. This allows highest production rate with minimized risk and supports highly automated production. Both solutions can be integrated to record their video stream time-synchronized with other measuring values in the central data storage for later analysis.



**4** The **IPAS off-gas measuring** for VOD and RH applications consist of a gas extraction system, the off-gas analyzer, and a flow measurement device. The off-gas analyzer provides online measuring of CO and CO<sub>2</sub> through an infrared photometer, as well as H<sub>2</sub> through thermal conductivity and O<sub>2</sub> through electromagnetic force measurement. The flow meter works based on ultrasound measurements or hot-wire anemometer and is supplied with temperature and pressure data for normalization to standard cubic meters per hour. THE IPAS system is self-calibrating. In combination with the online process models, it also provides a hybrid decarburization and degassing modelling approach.

**5** INTECO's wide range of **online process models** serves all secondary metallurgy processes. The thermochemical model calculates the oxide and element activities based on the prevailing process conditions and events, as well as the current state of the heat and the system temperature. In this context, IMAS modeling includes a thermophysical property library, reaction enthalpies, coefficients for interactions providing the necessary parameters, and coefficients for the determination or calculation of the activities. The temperature model accounts for the temperature losses due to radiation and convection as well as the changes in temperature due to specific events such as purging, material additions, and heating. Temperature changes due to reactions as mentioned above are also taken into account and are therefore coupled with the basic thermochemical model. Both are not only used for calculating the actual state of the heat but also to optimize prediction of take-over time and temperature.

The oxygen model calculates the amount of oxygen required to decarburize the steel to the target content. The initial steel sample as well as the consideration of the current temperature leads to a physically based oxygen quantity. The oxygen model uses the basics of the thermochemical and thermodynamic approach and is available for RH process as well as for VOD. Once the vacuum and/or oxygen blowing has started, the decarburization model tracks the oxidation of the elements involved. Through close interaction with the thermochemical model, the chemical composition is updated. The decarburization model reacts to the oxygen injection rate and oxidizes the steel according to the thermodynamic evaluations. Due to the highly complex system, the decarburization model permanently checks the stoichiometric oxidation against the kinetic approach. The temperature gain due to the reaction enthalpies is back-looped to the temperature model. The degassing model calculates the removal of hydrogen and nitrogen in the VD and RH system. At VOD plants, the reduction model calculates the required reduction mixture based on the oxidized chromium.



# 120-SHORT-TON **VTD**

Success story from our hero made of steel from South Carolina.

## #theChallenge

This customer introduced a new VD plant and process into an existing running melt shop – This requires a change of plant logistics and melt recipes and thus many challenges on the shop floor- Besides a good plant concept, automation and process models were of utmost importance to keep degassing time as long as necessary to achieve the desired metallurgical results but also as short as possible in order to control the temperature to avoid excessive casting temperature fluctuations.

## #ourSolution

- › New INTECO Automation and Supervisory Control
- › New IMAS-PA-VD Level 2 system
- › Temperature and Thermochemical Model
- › Degassing Model
- › Interface to existing L3 system

## #ourDesign

Our degassing model allows an optimized degassing process with shortest possible degassing time while maintaining the grade specification. Additionally, the temperature and thermochemical model helps to always reach the defined take-over temperature for the casting process.

### BENEFITS



#### Energy saving

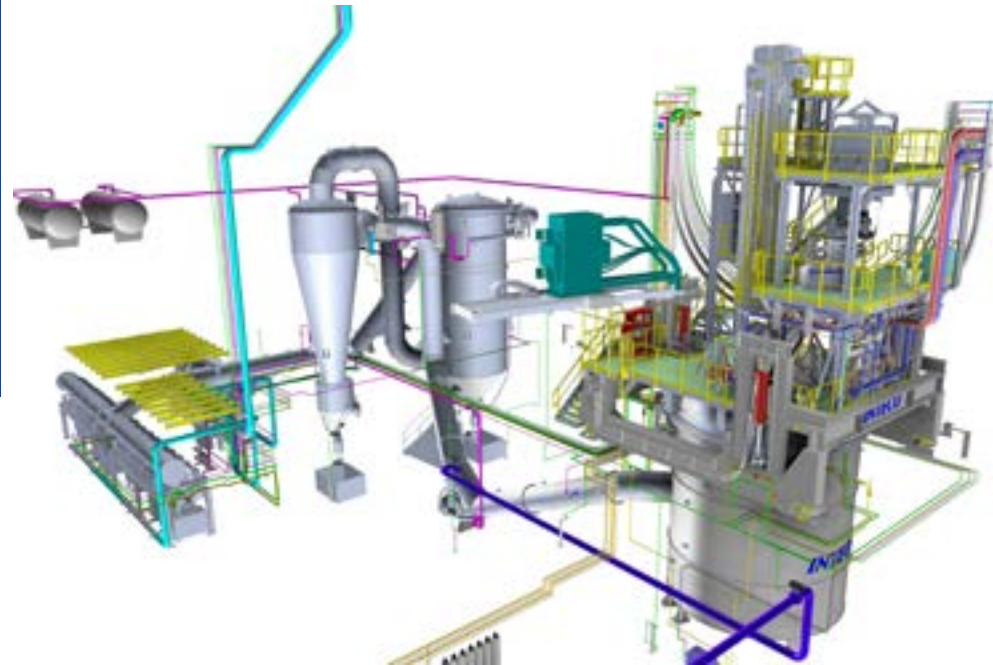
Accurate IMAS-PA-VD process models can help save treatment time and energy

#### Operator guidance

Optimal operator guidance is ensured through INTECO automation and the IMAS-PA-VD during the entire process

#### Low staff operation

- › Process control via camera system
- › INTECO TBR automatic gas coupling



# 110T **LADLE FURNACE**

Success story from our hero made of steel from South Africa.

## #theChallenge

Even though a ladle furnace is a logistical aggregate that helps to ensure exact take-over temperature and time to the continuous caster, this customer requested tools to optimize heating and alloying in order to minimize energy consumption and to avoid additional and unnecessary carbon pick-up.

## #ourSolution

- › New INTECO automation & supervisory control
- › New INTECO Smart Electrode Controller
- › New INTECO IMAS-PA-LF Level 2
- › Temperature and thermochemical model
- › Alloy calculation and material handling

## #ourDesign

Our integrated solution for cost-optimized alloy calculation and material handling saves time and money. The comfortable design offers optimized weighing and transportation and allows prioritization and sequencing of single materials to ensure the correct addition order of alloys and slag formers. Our temperature and thermochemical model reduces the number of temperature measurements. The real-time calculation of steel bath temperature allows to calculate the needed heating time and rate. In combination with our ISEC, heating can be automatically stopped when the target temperature is reached.

### BENEFITS



#### Tailor-made solution

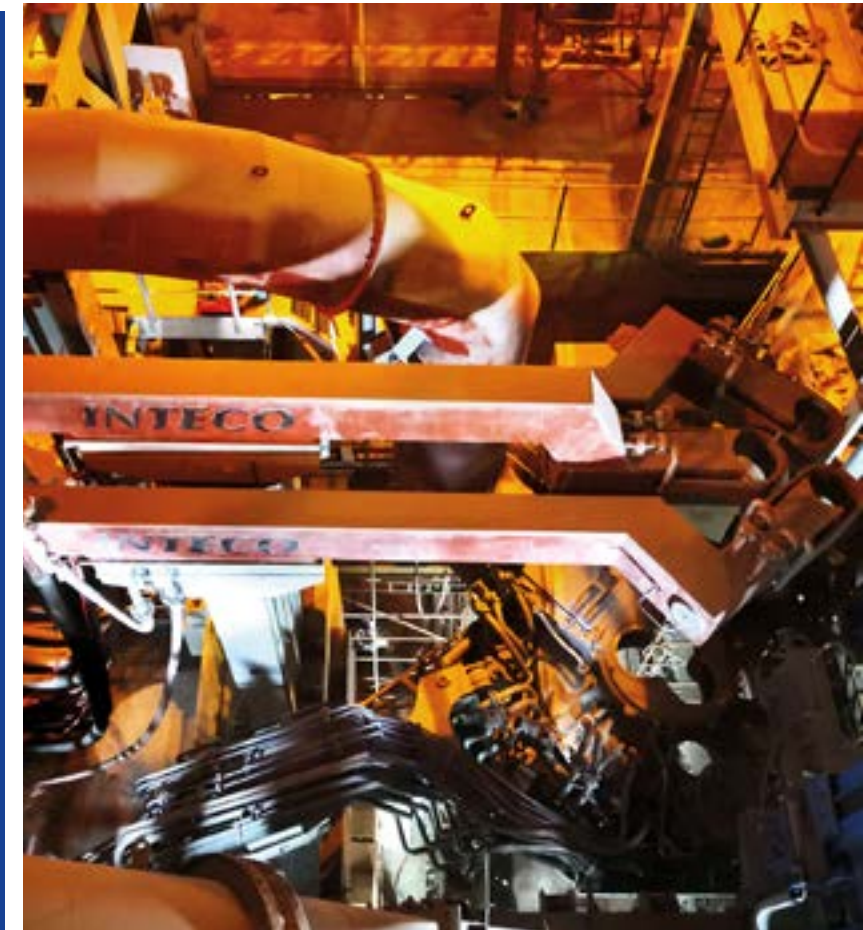
- › The new LF was tailor-made to be integrated between existing plants. The installation and commissioning were largely carried out during ongoing operation of the steel mill.
- › Exact take-over temperature and time for the continuous casting.

#### Operator guidance

Optimal operator guidance is ensured by INTECO automation and the IMAS during the entire process.

#### Energy saving

Efficient energy input through use of Smart Electrode Control und IMAS models.





# CASTING

- 1** The **INTECO Oscillation Master system** uses a universal platform for all section sizes that can be used for hydraulic cylinders and servo drive oscillation systems. The eccentric drive of the servo drive oscillation is driven by a backlash free servo-drive, while the oscillating movement is performed by alternating the rotation direction of the servo-drive. Using the variable rotation angle , the frequency, stroke and shape of the oscillation movement can be altered online. The actuator is exchangeable for flexibility and ease of maintenance. Due to the characteristics of a servo-drive, high accelerations are feasible.
- 2** Our **micro-segregation model** is used to define thermo-physical properties of steel according to the chemical composition such as liquidus/solidus temperature, density and thermal conductivity. The solidification model calculates the temperature profiles along the entire solidifying strand considering the thermal boundary conditions and the relevant process variables like casting speed and water flow. The calculation represents real-time determination of the actual surface temperature, internal gradients, and shell thickness as a function of solid fraction. The soft reduction model can be easily linked to the solidification model providing the optimal reduction amount to be applied depending on the solid fraction. Also, our secondary cooling optimization model interacts with the temperature calculated by our solidification model in order to control each cooling zone based on a defined temperature profile.
- 3** For slab casters, **INTECO's Break Out Prevention System (IBOPS)** features a fully automatic detection and prevention system to reduce costly shutdowns, which are caused by liquid breakouts during the casting process. INTECO uses a sophisticated system to detect these kinds of situations. The system is based on classical algorithms and combines it with an AI-based system to improve the detection rate and to decrease false positives. Additionally, the AI-based system improves its effectiveness over time by utilizing historic trend data. The INTECO mold width adjustment system enables online adjustment of the mould width during casting. The system is designed to work with INTECO mold designs as well as existing molds with electromechanical or hydraulic cylinders. It features non-parallel adjustment in order to reduce the stress on the strand shell and to minimize the transition length.



- 4** A stable mould level is key to cast high-quality steel grades. **INTECO's Mould Level Master (MLM)** increases quality aspects while minimizing risks such as overflow, thus improving casting stability and operational safety. The Mould Level Master includes a special patented detection logic, which detects and initiates counteractions to stabilize periodic mould level fluctuations due to “unsteady bulging” and waving. At the same time, it is designed to avoid synchronism between mould level deviation and stopper position, which would otherwise lead to growing instability of the mould level. The included flushing function is used to remove clogging (alumina build-up). Anti-clogging reduces the clogging behavior by dithering of the stopper around the actual set point. Period and amplitude of the dithering are set in such a way that the motor does not mismatch a synchronization phenomenon because of its mechanical/electrical inertia. Due to the high dithering/vibration speed, the average steel flow variation is zero and therefore does not affect the mould level stability. Due to the dithering movement the vortex effect in the SEN/SES will also be reduced, which additionally prevents the clogging effect. The system works sensor-independent and can be connected with all different types of measuring systems such as radio-metric, ultra-sonic, or eddy-current systems. Additionally, the Tundish Level Master is used for automatic level control of the fill level in the tundish at the defined set point through monitoring of the tundish gross weight (through the related weighing system) and control of the ladle slide gate.
- 5** The **INTECO heating controller for EPH and ESH** is a sophisticated solution for tundish heating applications such as casting or powder production. The basic design offers a cascaded control function for temperature control based on a fixed value or a temperature profile. It features automatic slag melting, immersion depth control, and detection of stirring problems. Optionally, a temperature and prediction model can be applied using tundish condition and history as well as data of successful heat levels for predicting and controlling the temperature and making the system independent from a temperature signal.
- 6** The **solidification model** calculates the temperature profiles alongside the entire solidifying strand, considering the thermal boundary conditions and the relevant process variables like casting speed and water flow. Based on this model, information of the ideal stirring position for the final EMS is evaluated for all steel grades. Accurately and dynamically stirring the ideal position during the solidification process ensures reduced segregation, improved center soundness, and minimized bridging at the final solidification.



# SEGMENT CASTER

Success story from our hero made of steel from Austria.

## #theChallenge

This customer produces a wide range of high-quality steel grades via the ingot casting route with a wide variety of section sizes and was interested in a much more automated concept to optimize the production process so that steel grades can be produced without having to worry about quality and size.

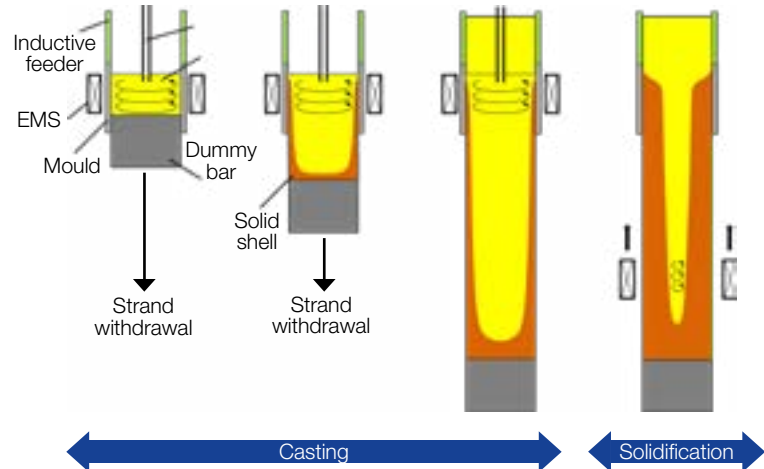
## #ourSolution

INTECO's new Segment Caster as the perfect partner for a fully automatic casting process including the following features:

- › INTECO Automation and supervisory control
- › Electrode plasma heating for constant tundish temperature
- › Mould Level Master to ensure a perfectly stable bath level
- › Tundish and mould EMS
- › Dynamic final EMS to improve center quality using the INTECO solidification model
- › Hot-topping procedure to increase yield

## #ourDesign

INTECO's Segment Caster with its features is designed for a fully automatic casting process from start to end of hot-topping. The dynamic final stirring phase runs fully automatically and ensures a reproduceable high quality of the final product.



## BENEFITS



### Plant specific

- › Our components are standardized for a high grade of reliability and quality, but our solutions are always 100% plant-specific and tailor-made in order to fit to your machine and your process
- › Long established technologies like INTECO MLM ensure top results from the first cast

### High quality engineering

- › Fully simulated plant and operator training prior to commissioning ensures automation quality and operator confidence in all systems and a very rapid production ramp-up.
- › Focus on high safety while maintaining optimal operability guides the complete engineering process
- › Highly flexible design of the complete automation system to enable you to easily adapt to upcoming challenges



# 4 STRAND BLOOM CASTER

Success story from our hero made of steel from Russia.

## #theChallenge

As we live in an everchanging world, every company needs to adapt to the industries needs as well as to constantly optimize product quality. Therefore, with the change of this customer's product mix, so did the demands on the machine over the years. The challenge was to keep investment costs as low as possible while staying competitive. This called for an upgrade for high quality production, while leaving the structural and mechanical parts of the 4-strand bloom caster untouched.

## #ourSolution

- › INTECO Automation and Supervisory Control
- › INTECO oscillation master
- › Micro-segregation model
- › Online and offline solidification model

## #ourDesign

Fully integrated into the customer's existing level 2 system, INTECO's online solidification model calculates the solidification front in all four strands simultaneously based on the input data (steel grade and steel analyses) and controls the independent driver units for each strand for optimal crystallization within the strands. The system ensures continued usage of existing software products and expands those with the supplied process models and products from INTECO. The new withdrawal unit, including control of the new soft reduction and the electromechanical oscillator, makes it almost a new machine.

## BENEFITS

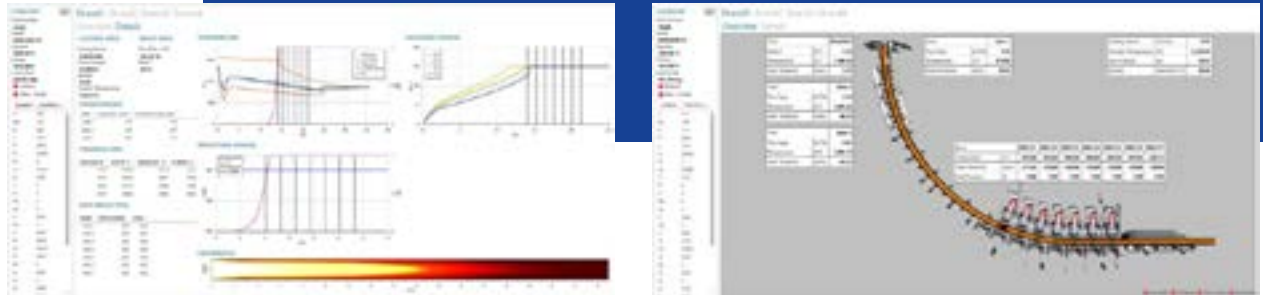


### Cost efficiency

- › Reuse, and/or continue to use, existing and well-established software within the company
- › Reduced commissioning time through standardized IMAS-CON interfaces and operator training on few UI extensions
- › Accurate process models can help you save treatment time and energy
- › Adjustment of oscillation parameters (frequency, amplitude, curve form) during operation enables flexible production
- › Dynamic soft reduction drastically improves the center quality of the final products

### Operator guidance

- › Operator guidance is ensured by INTECO Automation and Supervisory Control
- › Visual representation of all production-related key figures, including a heat map of the strand temperatures, strand solidification front diagrams, and current driver set points
- › Operator guidance through automatic calculation of steel grade parameters based on our micro-segregation model





# SPECIAL MELTING AND TITANIUM

- 1** The **INTECO Drip Short Measuring (IDRIP)** device is based on an embedded controller and can be easily integrated into existing automation systems such as PROFIBUS or PROFINET. It features a web-based interface for diagnosis and configuration. A parallel voltage measuring device provides a sampling rate of 200kHz. If the input voltage falls below a defined trigger level, a single drip will be triggered. The drips will be categorized by the duration of the drip to provide a statistical analysis. The small footprint makes installation on existing plants a simple task.
- 2** The **INTECO Remelting Controller (IREC)** is the ideal solution for retrofit projects in ESR, VAR or Ti-VAR and makes it easy to upgrade any compatible furnace with INTECO's world leading melting control algorithms. It features control of voltage, current, melt rate and immersion depth control by our advanced non-linear controllers. The flexible design supports all different types of power supplies such as transformers, saturable reactors, and different kinds of power supply units. Integration into the complete automation system can be accomplished via commercially available all common fieldbus technologies. The sophisticated deviation tracking warns in case there is any probability of defects during the remelting. It perfectly integrates our IDRIP for VAR applications and can be easily expanded with our IMAS essentials.
- 3** The **IMAS essentials** are the perfect add-ons for single remelting units. The user-friendly web-based interface, available in different languages, provides master data management for mould and electrode formats. The template-based melting formula system facilitates standardization and constant quality improvement. A detailed production report for each melting operation is generated, including production key performance indicators and documentation of quality-related incidents calculating the ingot position where it occurred. The high-resolution trend tool can be used for in-depth analysis. All relevant data points are recorded in PLC cycle time and stored in a head-based structure. Available video streams such as furnace cameras in VAR or ESR are recorded time-synced to facilitate perfect matching between visual inspection and process values.

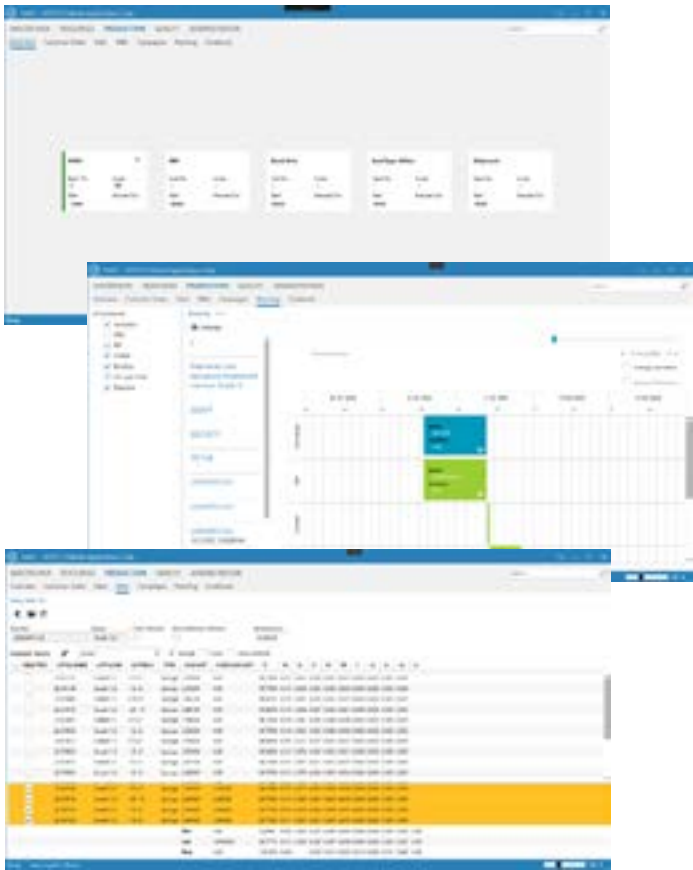


- 4** The **cost-optimized charge mix calculation and optimization** is a powerful tool for calculating exact and cost-optimized material mix and quantity to achieve the target analysis. Therefore, it is not only the perfect solution for electric steelmaking, but also for vacuum induction furnaces and titanium production in compacting routes as well as electrode beam melting. The calculation can be based on previously prepared materials, on strategic material storage, or a combination of both. The latter option also optimizes the material handling through preferred usage of broken lots. Micro-dosing units can be implemented as well as segregation optimization for heavy elements. Compacting routes are perfectly supported by the possibility to consider fractional sizes as an additional selection rule in order to ensure physically perfect compacting. Both, ingot and slab based, as well as batch-based optimization are possible.
- 5** The **IMAS-PM Production Management** for remelting and alloy production has been successfully implemented at remelting shops, powder producers, and producers of titanium ingots and slabs for highest qualities at producers for the aerospace industry. In addition to conventional functions of a production management system such as formula management, order scheduling, downtime recording as well as equipment and consumables consumption, the main focus is on quality assurance. The integrated check-list module provides an aviation industry compliant solution for tracking every production step, not only in a generic way, but with dedicated procedures for the actual grade and customer. You have the choice between a traditional, paper driven concept, an electronic, tablet-based application, or a combination of both. The production-based review system provides summary reports and detailed ingot or batch analysis for all relevant product categories such as ingots, slabs, powder, or flakes. Finally, a rule-based deviation control module and a sample formula integration of the final product are integrated in the shipment module, ensuring that only products with perfect quality are released and delivered to the customer. From a technical perspective, the system can be implemented vendor-independently into any existing production setup by installing a PLC-friendly standard interface such as OPC-UA in the machines and standardized REST interface in higher-level applications such as ERP systems.
- 6** For special use-cases, INTECO is also offering process modelling know-how to provide real-time insight into your process through **thermo-chemical or thermo-physical models** such as meltdown or temperature models. Just contact us for a detailed discussion and a tailor-made offer.



# TITANIUM EB-SHOP

Success story from our hero made of titanium from Kazakhstan.



## #theChallenge

This customer is a supplier of to the aviation industry producing titanium ingots and slabs. In order to pass intensive and complex audits the customer has to produce reliable products at a constant quality.

## #ourSolution

In order to meet these requirements, INTECO equipped this titanium workshop (EB Route) with the latest version of IMAS-PM-RA for titanium slab production after the supply of a similar system for ingot production for a sister company several years ago. The new system supports the customer in planning and tracking titanium slabs from the selection of source materials via all production steps to the final inspection. The cost-optimized alloy calculation module is used to select the right quantity and quality of source materials in preproduction to minimize alloying costs. The operator guidance in the shop floor then starts at the weighing and blending unit, where base briquettes are formed, which in turn are melted within the electron beam furnace into a 20t slab. At the machining area our tracking application traces the entire production operation of the slab to fulfill highest customer standards regarding reporting and quality assurance. The interface to the ERP system allows automatic takeover of customer orders and the customer related cook-books ensure 100% compliance with the contract. Our Production Dashboard provides an immediate overview on current production stages. The extended reporting features are integrated according to the needs and routines of the quality department, making sure that all shipped slabs are completely compliant with quality requirements.

## #ourDesign

IMAS Production Management for Remelting and Alloy shops (IMAS-PM-RA) is specially designed to support production of highest-grade materials. Its advanced integration of checklists, sophisticated reporting and quality assurance tools makes it the perfect choice for demanding production tracking and an appreciated solution for auditors. Our flexible design integrates all different types of machines or stations via standardized interfaces and has been successfully implemented for different production routes such as titanium production (compacting route as well as EB route) and powder production.



## BENEFITS



### Single source of truth

The IMAS-RA Application Suite provides a single source of truth for all production-related data. The system links live plant data with all manual process input data (e.g. checklists) and stores it unalterably for the lifetime of the final product.

### Cost efficiency

The IMAS Alloy and Charge Mix Calculation Model makes it possible to minimize costs of raw material usage while still meeting the needed chemical requirements for each customer.

### Customized solution

While providing standard software modules, INTECO's software design is very flexible regarding customizations. They can be provided by INTECO or can be developed in joint programming sessions to fit the needs of the operators. For example, the customer can create new reports in the system and modify existing ones to meet changing demands in the business world.



# INGOT TRACKING

Success story from our hero made of steel from Germany.

## #theChallenge


Besides all automatic data recording, some information is easier to record manually. Especially in titanium and remelting shops, quality related information that needs to be evaluated on the solid ingot after stripping or data such as return scrap or chips can be easily qualified and roughly quantified. So the customer's request was to unite these manual records with all automatic recorded data and to avoid clutter or only being able to query information that has been recorded automatically by an integrated system.

## #ourSolution

- › New IMAS-PM-RA
- › New IMAS-RA-Ingot Tracking
- › Interfaces to ERP and PPS system
- › Digital signature by each QA gate keeper

## #ourDesign

Our IMAS-PM offers paper-based and paperless tailor-made solutions for enforcing check lists and enabling manual data recording. Our ingot tracking app runs on standard tablets and offers checklist functionality with digital signature as well as data recording for values or pictures taken with the integrated camera. It fits seamlessly into the data context of the IMAS ecosystem and provides all available information.

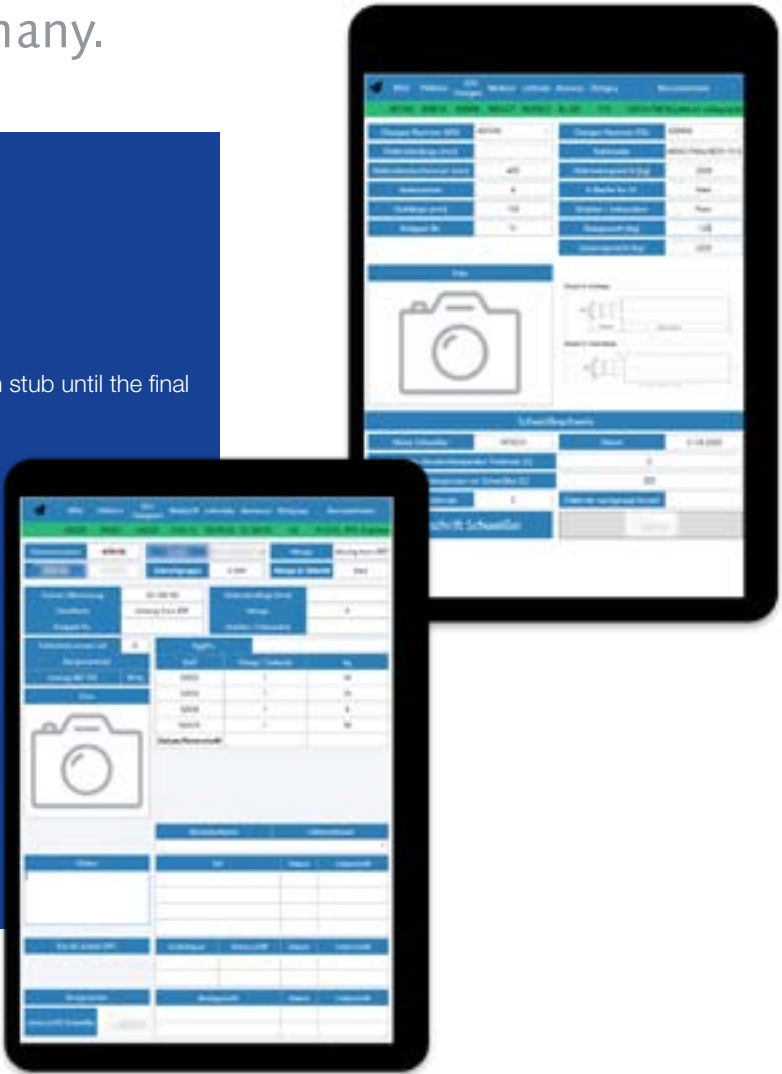
**BENEFITS**

**Cost efficiency**

- › Traceability for each ingot from electrode with stub until the final product.
- › Paperless workshop by handling digital signatures by all relevant process participants to ensure continuous high quality.
- › Tracking Application on standard mobile devices.

**Operator guidance**

- › is ensured by IMAS-RA-PM and IMAS-RA-Ingot Tracking during the entire process.
- › by visual representation of all production relevant key figures on the mobile devices.



# WHAT IS YOUR SUCCESS STORY?





# LIFECYCLE SERVICES



The successful production ramp-up and the final acceptance is an important milestone for INTECO. This milestone marks the end of the project but is simultaneously the beginning of lifecycle services. The basis is already delivered at this point. Based on our spare parts list, TECTRADE is your ideal partner when it comes to spare parts delivery. Our service conditions, issued automatically at the end of your warranty period, provide a clear and easy framework for easy continuation of support. INTECO's clear commitment is: We will never leave you alone if you are in trouble! But the offered services provide more: They help ensure a healthy and working machine and software throughout the whole lifetime that typically exceeds 30 years.



At a fixed price INTECO is offering what we call "system health check" in two different variations. The remote check consists of an analysis of your automation and software to ensure proper operation of both. In cyber-physical systems small things can sometimes accumulate and turn into major issues if they are not detected or if they are ignored. Besides software and hardware diagnosis, we also check machine and alarm logs in order to identify potential risks. With our structured analysis of alarm messages

and machine data, we can anticipate and thus prevent downtimes. The full on-site evaluation additionally includes a visual inspection of all electrical and mechanical components, a checkup of safety functions and emergency features, and necessary metering like grounding or short circuit testing. This holistic evaluation of the machine allows INTECO to identify issues that cannot be detected through automation. The result of both is a detailed action plan for keeping your plant healthy and up-to date.

Lifecycle services to  
secure your  
investment and  
provide safe and  
reliable production



For our software solutions, we are offering service level agreements up to next business day support. This type of contract does not only cover incidents. It also covers minor modifications that are related to normal software lifetime, for example, additional information at a certain place in the software. By request it can also include an update agreement, making sure that your software stays compliant with external technological evolution such as new operating systems. Ultimately, selected solutions are also available as software as a service.



Highly sophisticated technological components also rely on periodic maintenance. Our products, such as the smart electrode controller ISEC, offer all the features to adjust or auto-adjust all the parameters related to furnace wear, instrument change, or a changed production mix. But if you are busy with other work, we will offer you such service at a fixed price. This includes a performance evaluation of our furnace operation, readjustment of valve scaling, and electrical parameters. Optionally we can also offer optimization of power profiles by one of our process experts or finetuning of the rule-based optimization.



For any other enquiry: We are always happy to help and support you realize larger retrofit projects, such as version upgrades of the automation system or increasing the machines capacity by using our smart components or our powerful engineering services.



# MILESTONES





# CONTACT ADDRESSES

## EUROPE



**INTECO melting and casting technologies GmbH**  
Wiener Straße 25  
8600 Bruck/Mur, AUSTRIA  
Phone: +43 3862 53 110-0  
inteco.austria@inteco.at



**ART advanced refractory technologies GmbH**  
Wiener Straße 25  
8600 Bruck/Mur, AUSTRIA  
Phone: +43 3862 53 110-165  
office@ART-reftech.at



**INTECO TBR casting technologies GmbH**  
Wiener Straße 25  
8600 Bruck/Mur, AUSTRIA  
Phone: +43 3862 53 110-0  
inteco.austria@inteco.at



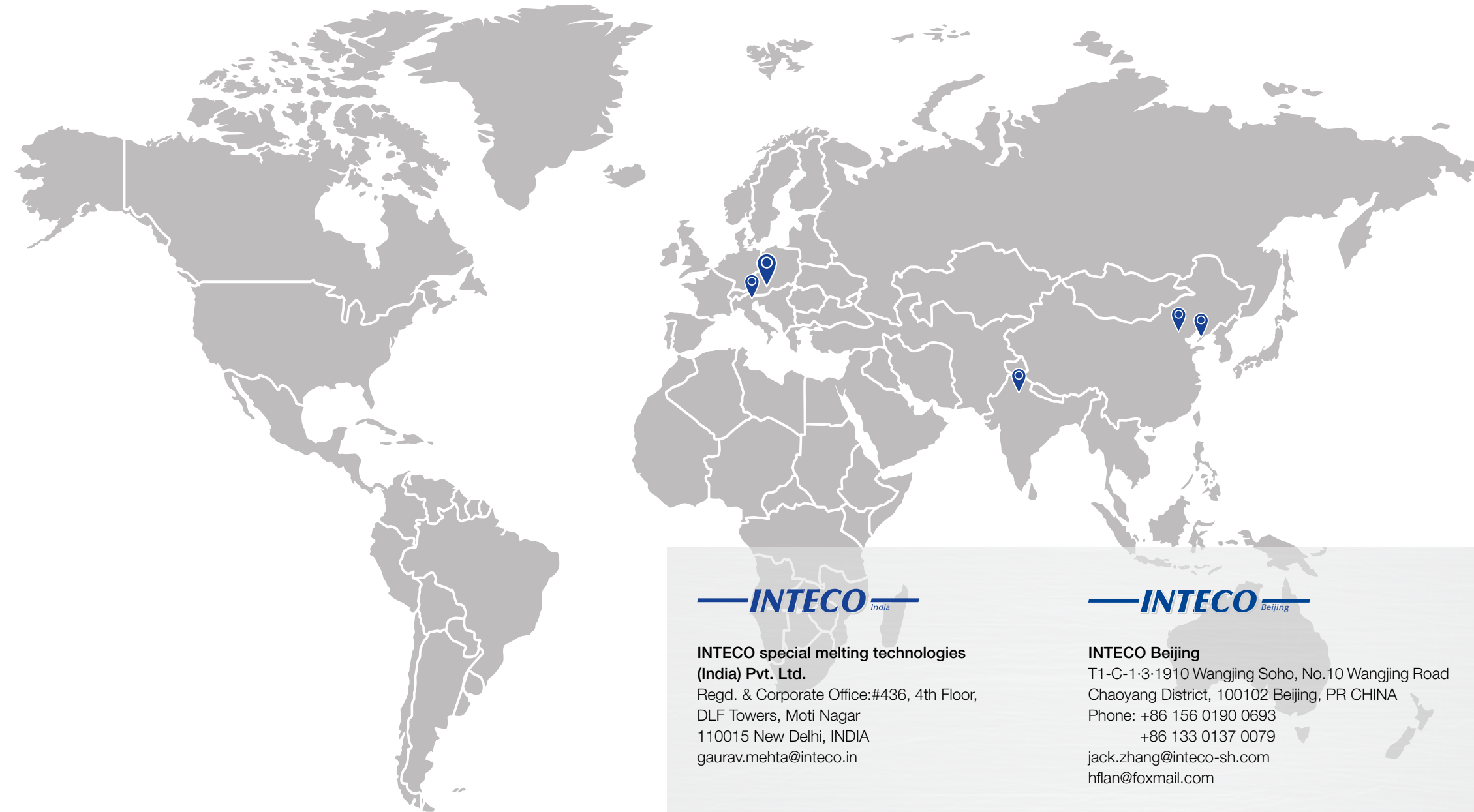
**INTECO melting and casting technologies GmbH**  
Dr. Auner Straße 20/5.OG  
8074 Raaba, AUSTRIA  
Phone: +43 316 49 1000-0  
inteco.austria@inteco.at



**TECTRADE Handelsgesellschaft mbH**  
Wiener Straße 25  
8600 Bruck/Mur, AUSTRIA  
Phone: +43 3862 53 110-0  
tectrade@inteco.at



**INTECO**  
Via Nazionale 42  
33010 Tavagnacco, ITALY  
Phone: +39 432 1901183  
inteco.austria@inteco.at



## NORTH AMERICA



**INTECO PTI process technology int., LLC.**  
4950 S Royal Atlanta Drive, Suite A  
Tucker, Georgia 30084, USA  
Phone: +1 770 934 9502  
sales@intecopti.com

## ASIA



**INTECO special melting technologies (India) Pvt. Ltd.**  
Regd. & Corporate Office: #436, 4th Floor,  
DLF Towers, Moti Nagar  
110015 New Delhi, INDIA  
gaurav.mehta@inteco.in



**INTECO Beijing**  
T1-C-1·3·1910 Wangjing Soho, No.10 Wangjing Road  
Chaoyang District, 100102 Beijing, PR CHINA  
Phone: +86 156 0190 0693  
+86 133 0137 0079  
jack.zhang@inteco-sh.com  
hflan@foxmail.com



**INTECO Dalian**  
Room A401-A411 , Building A  
JinPu International Building, ChiFeng Street  
DDA, 116600 Dalian, LiaoNing Province, PR CHINA  
Phone: +86 411 3924 7266 201  
inteco.china@inteco.com.cn



**IMPRESSUM**

**Party responsible for content, layout and printing**

INTECO melting and casting technologies GmbH  
Wiener Straße 25  
A-8600 Bruck an der Mur  
Austria - Europe

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## INTECO MELTING AND CASTING TECHNOLOGIES GMBH

Wiener Strasse 25  
A-8600 Bruck an der Mur  
Austria - Europe

T: +43 3862 53 110 - 0 | F: +43 3862 53 844  
E: [inteco.austria@inteco.at](mailto:inteco.austria@inteco.at)  
[www.inteco.at](http://www.inteco.at)

[www.inteco.at](http://www.inteco.at)

