



CONVERTER STEELMAKING AUTOMATION

AUTOMATION AND PROCESS
OPTIMIZATION FOR EXCELLENT
STEELMAKING

FOR YOUR MAXIMIZED BENEFITS

TAILORED ELECTRICS & AUTOMATION CONCEPTS FOR YOUR COMPETITIVE ADVANTAGE

STEELMAKING AUTOMATION

Primetals Technologies steelmaking automation supplies advanced solutions for maximum performance and product quality throughout the entire steel plant. The unique advantage of this integrated approach is the fast return on invest, it comprises the aspects of process stability, product quality and operation flexibility, while safeguarding efficiency and profitability throughout the entire plant lifecycle.

A BACKGROUND OF EXPERIENCE

With the experience acquired from more than 1,000 automation and electrical projects worldwide, Primetals Technologies is the leading software house dedicated to the metallurgical industry. On the basis of our in-depth technological and metallurgical expertise, a full range of solutions is available from a single source for all of your electrical, instrumentation and automation (hardware and software) requirements.

These can be implemented into integrated plants, as stand-alone solutions or on a turnkey basis, from the planning, engineering and procurement up to installation, integration, start-up and commissioning.

ON ALL AUTOMATION LEVELS

Modern and powerful process control systems ensure a reliable and user-friendly plant operation.

Stable process optimization systems comprise advanced process models, artificial intelligence, graphical user interfaces and operational expertise. The process models optimize the different production processes with regard to reduced energy consumption and emissions.

ENVIRONMENTAL CARE

Converting raw materials into finished steel products is very intensive in terms of energy consumption.

The continuous efforts of the metal industry are driven by costs and quality while complying the environmental regulations. However, despite the steel producers' success in reducing energy input, it is still one of the leading cost factors.

International agreements and national laws require a reduction of pollution, energy consumption and CO₂ emissions. This has to be achieved in the most cost-efficient way. Rising environmental standards require intelligent approaches in electrics and automation.

Fully optimized automation and electric systems are the basis for reliable production processes, maximum plant performance, and quality products that meet all market demands.



YOUR BENEFITS ...

- Comprehensive, consistent operator guidance and process information throughout the complete steel production route
 - Standardized production operations yielding homogenous steel quality that fulfils certification requirements
 - Increased productivity through optimized steel melting and refining processes for shorter treatment durations
 - Minimized production costs using process models for optimized material usage and energy consumption
 - Environmental care due to minimized emissions
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CONVERTER PROCESS CONTROL AND TECHNOLOGICAL PACKAGES

THE FUNDAMENTAL BASIS OF HIGH QUALITY PROCESS OPERATIONS

Our automation systems comprise the complete range of carbon steelmaking converters (LD, BOF, K-OBM) as well as stainless steelmaking technologies (AOD, CLU and K-OBM-S).

The basic automation systems (level 1) for converters, BOF Control and AOD Control provide the platform for sequential and closed loop control and include all relevant technological control functions, such as:

- Converter tilting drive
- Bottom stirring – single line control
- Oxygen lance control system
- Substance measuring system
- Horizontal measuring manipulator
- Automatic tapping system
- Pneumatic Slag Stopper
- Material handling
- Additive and alloy weighing and control
- Waste gas cooling and cleaning
- Gas recovery and analyzing
- Interlocking and alarm system

Technological packages and solutions shorten tap-to-tap times, ensure that quality targets are met, assist the operational personnel and substantially reduce overall costs. They must be executed quickly, with minimum interference to ongoing operation and need to be compatible with the existing automation environment. The combination of technological packages with other portfolio packages creates additional benefits.

Safety for personnel and plant during the entire production is an important aspect which requires special solutions.

Fluid Guard is a safety certified leakage detection system for all water cooled equipment exposed to high temperatures in steel plants.

Alternative measurement methods enable additional data capturing for optimized process control beyond wired networks.

Wiplant provides wireless data capturing of weight, temperature and acceleration in inaccessible areas, e.g. at scrap yard or directly on transfer cars.

For exact localization and tracking of equipment within the steelplant and its surrounding, Advanced Tracking System opens a large field of applications.

With Acoustic Expert the automation system gets ears. An industrial microphone monitors continuously plant conditions and simplifies advanced planning of maintenance works.

State-of-the-art automation solutions are an essential factor for maximum performance and product quality in the converter steel plant



Converter tilting drive

CONVERTER TILTING DRIVE CONTROL

The converter tilting drive control system features excellent reliability and precision. Depending on the converter size, up to four motors with dedicated frequency converters are used to enable closed loop position control. Load sharing between the individual tilting motors is provided. The control system ensures full functionality even in emergency situations.

AutoTap provides an automatic converter tapping procedure including control of ladle car movements and positioning of the alloy chute. At the end of the converter treatment the operator initiates AutoTap by pressing the tapping button.

MAIN BENEFITS

- Totally integrated automation combining functional and failsafe part in one common PLC
- Safety certified solution considering the requirements in accordance to the latest standards (EN ISO 13849)
- Smooth operation and automatic positioning
- Highest availability of drives
- Pre-tested automation and drives
- Proven design and solution
- Automatic tapping for reproducible, smooth and optimized steel tapping procedure



Bottom stirring overview display

BOTTOM STIRRING

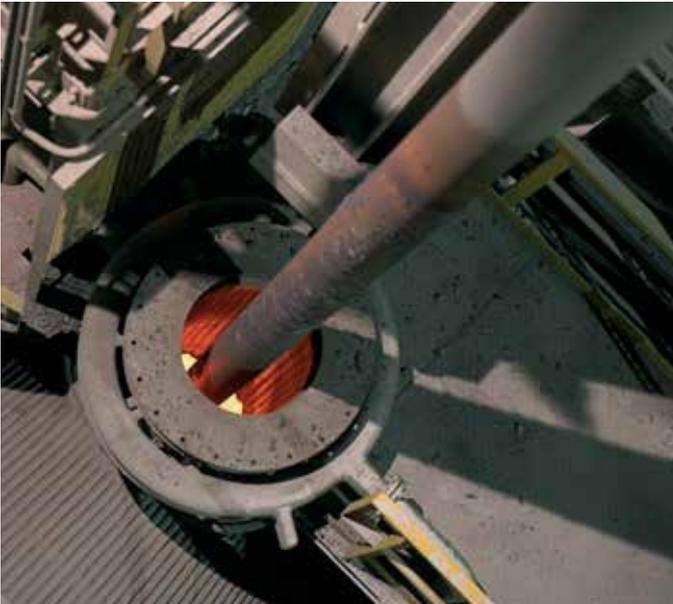
Bottom stirring using inert gas offers advantages in metallurgical and operational aspects. In particular, the process kinetics are significantly improved and the decarburization reaction at low carbon content is forced.

Individual gas flow control offers an optimum of working safety and operational convenience:

- Uniform distribution of the gas flow among each stirring element ensures an even cooling effect and thus prevents a different wear behavior of individual stirring elements.
- Failure of a stirring element is compensated by those stirring elements still in operation, so that a constant efficiency of the bottom stirring process is maintained.
- Measurement of gas flow and gas pressure as well as indication of valve positions allows a permanent control of each stirring element.

MAIN BENEFITS

- Modular container solution with precabled remote I/O units
- Fast and accurate adjustment of tapping temperature
- Reducing the carbon content to 0.02 % without the need of vacuum treatment
- Lower phosphorous and oxygen levels
- Reduced flux quantities (more than 10 %)



Sub lance



Slag stopper

SUBLANCE CONTROL

The sub lance system is used for measuring temperature, carbon content and oxygen activity of the steel bath, as well as for taking steel samples without the need to interrupt the oxygen blow.

Instrumentation and drives ensure excellent position accuracy and operational safety. Closed-loop process control of the sub lance allows fully automatic in-blow or end-of-blow measurements.

The process optimization model dynamically supervises and controls the oxygen blowing process based on the in-blow measurement. By determining the ideal blow-end-point, significant operational savings and improvement of productivity are obtained.

MAIN BENEFITS

- Reduced charge to tap time
- Improved hitting rate
- Increased iron yield
- Reduced oxygen consumption
- Shortened process times
- Reduced rate of overblows and reblows
- Avoidance of converter tilting
- Automated measuring and sampling with maximum safety

PNEUMATIC SLAG STOPPER

In order to avoid carry-over slag from the converter getting into the ladle at the end of tapping, a cast iron nozzle is slewed into the tap hole from the outside through which retaining gas is blown. Sealing is performed pneumatically and thus not influenced by irregular tap hole wear and slag consistency.

For automatic slag detection the SlagMon system evaluates the infrared radiation differences of steel and slag, respectively, which are recorded by an infrared camera.

MAIN BENEFITS:

- Lower cost of deoxidation agent
- Higher ferro alloy yield
- Lower refractory consumption
- Lower rephosphorization rate
- Less inclusions
- Reliable sealing with any type of slag
- Automatic slag detection and actuation of slag stopper



Fluid Guard

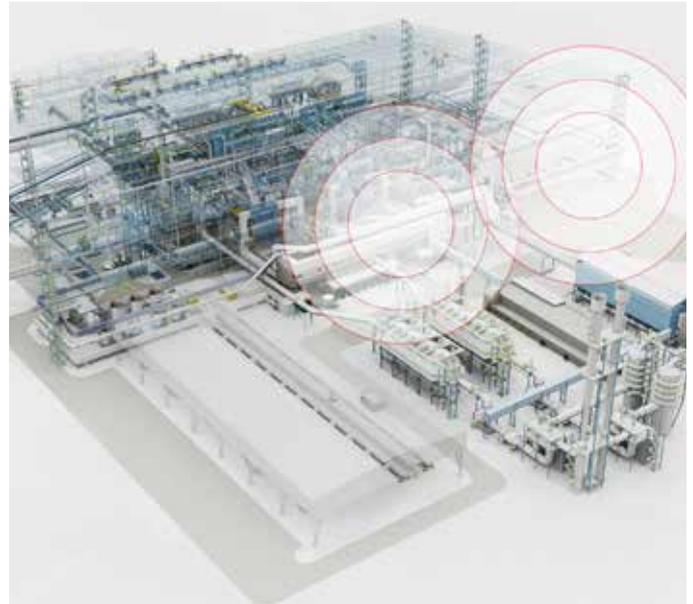
FLUID GUARD

Fluid Guard provides fully automatic monitoring and controlling of the water cooling circuits at highest safety level. The system detects water leakages, pipe / hose break detection and excess accumulation and debris in pipes. Easy integration into existing plants is granted.

An additional feature of Fluid Guard is the extension for eco-solution. The system is dynamically calculating the required cooling power for the equipment under consideration of the actual process phase. With this value a setpoint for the water supply pump is provided and thus electrical energy consumption is reduced.

MAIN BENEFITS

- More reliable production by safety oriented detection of water leakages in cooling circuits
- Fulfills requirements of latest safety standard. (EN ISO 13849)
- Easy system integration into existing cooling circuit ensures short commissioning time
- Rapid detection of leakages in cooling circuits
- Permanent, automatic diagnostic of system function
- Permanent monitoring of cooling supply lines
- Detection of excess accumulation and debris in pipes
- Energy savings by intelligent control of cooling water supply



Process data capturing beyond wired networks

WIPLANT

Wiplant is a wireless, self-organizing network which enables wide ranging data transmission in previously inaccessible areas and opens up a wide range of new opportunities. The modular system allows reliable measuring of values, conditions etc. all over the plant using a combination of sensors with a safe data transmission system - even in harsh environments. An interface to automation solutions enables an advanced process control.

MAIN BENEFITS

- Extended possibilities of acquiring and transmitting reliable measurement data
- Enhanced plant performance
- Improved planning and control of processes and logistics
- Easy installation and implementation
- Exact tracking of scrap input and raw material
- Based on established industrial wireless data transmission technology
- High network coverage throughout the whole plant area due to a dynamic network concept
- Customer-specific modernization solutions
- Access to crucial process data to plan, control, coordinate and monitor the steel plant without time delays



Advanced Tracking System



Acoustic Expert

ADVANCED TRACKING SYSTEM

Advanced Tracking System represents a reliable position tracking system of metallurgical vessels such as ladles, slag pots, tundish and scrap chutes throughout an industrial plant.

It is based on long range UHF-RFID-technology which is a well-established industrial standard. To track the location of a vessel a tag is installed directly on the equipment. The tag is a passive, heat resistant unit which is detected by the antennas. The antennas are placed on each location where the vessel should be tracked.

MAIN BENEFITS

- Self-diagnosis and damage detection of RFID-tag
- Teach-In of new RFID-tags with hand held device
- Wireless data transmission to control system
- Quick exchange of RFID-tags
- For new and upgrade of existing systems
- Protective housing of RFID-tag, thus resistant against heat, slag and steel splashes

ACOUSTIC EXPERT

In industrial plants a broad range of different equipment is used which has to be monitored and checked with high effort and different sensor strategies to guarantee it's proper function during the entire lifetime. The new Acoustic Expert system is based on measuring sound, an important property emitted by almost every device or process. With this acoustic diagnostic system, monitoring a plant gets a new dimension. Independent from all other sensor strategies now the automation systems get ears.

Typical fields of application are monitoring of bag filter plants, wear of gas tuyers, gas leakage detection in valve stations and all other applications emitting a specific sound.

MAIN BENEFITS

- Support for maintenance staff
- Preventive maintenance through trend evolution
- Easy integration in existing automation, thus no plant-shutdown for setup is needed
- Minimal hardware costs
- Immediate feedback to control system
- Reduction of unplanned plant shutdowns

CONVERTER OPTIMIZATION

MAXIMIZED PERFORMANCE THROUGH DYNAMIC MODELING

OPTIMIZATION SYSTEMS

The optimization system (level 2) is the next level in intelligent converter automation. The systems include process visualization, operator guidance, heat tracking and dynamic production control with optimization models. AOD and BOF Optimization cover all available carbon and stainless steel converter technologies.

STEEL EXPERT

Steel Expert is the comprehensive group of process models that perfectly images and optimizes the process of steelmaking in different production units.

Steel Expert Supervision, a set of online models, is monitoring the metallurgical and thermal process and cyclically calculates the actual condition of steel bath and slag. This provides the analysis and temperature of steel bath and slag at any time and setpoint model calculations are always based on the actual situation.

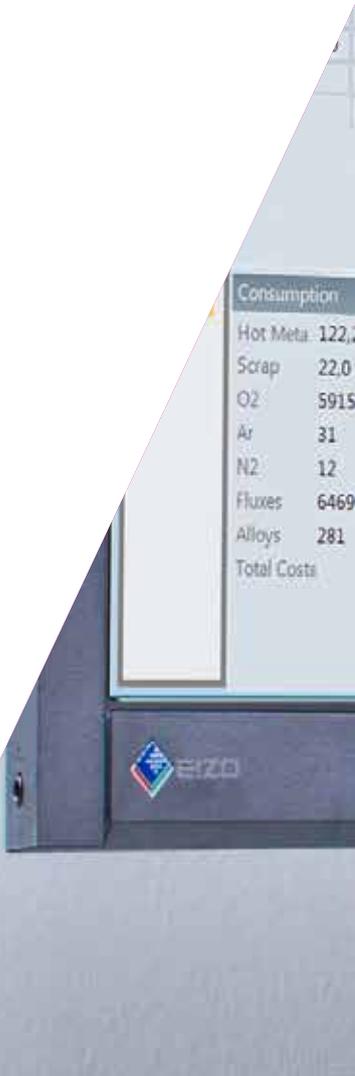
SETPOINT MODELS

The extensive group of setpoint models, Steel Expert Setpoint, is responsible for determining the required supplies of raw materials, gas volumes and/or energy for different treatment steps.

Steel Expert Prediction performs a simulation of the complete production process – using the results of supervision and setpoint models. It provides a forecast of the progress and the final condition of the heat. It also predicts all required additions and actions and serves to optimize the production process.

Whereas the models are adjusted specifically to the special requirements at different production units, the principle of Steel Expert - combining the features of prediction, supervision and setpoint models for perfect quality - is applied throughout the entire steelmaking automation.

Full control of steel production, offline simulations of the entire converter process and calculation for necessary additions and gas consumptions for excellent operational results in steelmaking process.



Consumption	
Hot Meta.	122,
Scrap	22,0
O2	5915
Air	31
N2	12
Fluxes	6469
Alloys	281
Total Costs	



BOF operator training at Primetals Technologies

BOF PROCESS MODELS

Primetals Technologies automation for BOF steelmaking not only considers the vessel-specific process functions, but also takes into account the relevant parameters of the charging materials, including hot metal preparation, scrap yard management and scheduling logistics. Process optimization (level 2) solutions are based on advanced algorithmic equations, which accurately represent the complex thermodynamic-metallurgical reactions. The solutions are particularly suitable for a wide range of operating conditions, e.g. variable scrap to hot metal ratios, minimum slag practice and varying phosphorus content.

PROCESS MODELS OVERVIEW

- Steel Expert HM Desulph for optimum desulphurization results
- Simulation of the complete BOF process before the heat is started with Steel Expert Prediction
- Steel Expert FCC (first charge calculation) for determination of required quantities of scrap types and amount of hot metal to be charged
- Steel Expert SCC (second charge calculation) for automatic determination of the required oxygen volume and vessel additions to achieve the desired steel quality
- Improving hitting rates with Steel Expert Inblow, calculation of heating/cooling agents and remaining oxygen volume
- Steel Expert Reblow determines the required oxygen volume and vessel additions for various reblowing reasons

- Cost optimization for alloying materials during tapping with Steel Expert Alloy
- Steel Expert Supervision cyclically calculates the actual condition of steel bath and slag from charging end to tapping start

MAIN BENEFITS

- Reduction of production costs
- Reduction of reblows
- Improved hitting rate for steel bath temperature and carbon content
- Standardized production operations
- Heat tracking
- Comprehensive reporting tool



BOF control room



Lomas probe

DYNACON

If a continuous off-gas measurement (analysis and flow) is available, Dynacon is applied as a supplement for Steel Expert Supervision. It dynamically calculates the optimum moment for blow end to achieve the target carbon content of the steel from the off-gas information. Thus Dynacon is saving valuable time due to the uninterrupted blowing process and therefore unimpaired decarburization rate.

The combination of the supervision model and Dynacon is a convincing approach for increasing carbon and temperature hitting rates.

MAIN BENEFITS

- Increasing carbon and temperature hitting rates
- Advanced process control and optimization system for BOF converters equipped with a continuous off-gas measurement
- Automatic blow-end control
- Avoidance of overblowing
- Fewer number of reblows
- Reduced Fe content in slag
- Reduced Al consumption for deoxidation

LOMAS

Lomas is a highly sophisticated extractive gas analyzing system and is therefore suitable for plants with very hot and dust-laden process gases in the iron and steelmaking industry.

Lomas uses either a high performance mass spectrometer or analyzers together with intelligent gas treatment technology to measure the relevant process gas composition. Lomas ensures high operational safety, a long service life, high availability and high precision.

MAIN BENEFITS

- Patented probe design for high availability
- Optimized combustion process and reduced energy costs
- Low maintenance operation
- Alternating two probe operation
- Automated three steps probe cleaning circle ensures high reliability
- High accuracy in measurement of CO, CO₂, H₂, O₂ and CH₄
- Short response time
- Enables blowing-end determination



Stainless steel converter



Dynamic process

STAINLESS STEELMAKING PROCESS OPTIMIZATION

Primetals Technologies solutions for stainless steel converters cover the complete range of available refining technologies, such as AOD and K-OBM-S. Intelligent control of the converter processes is performed by the application of a number of dynamic process models.

The automation solutions focus on ensuring an optimum metallurgical and process technological performance with respect to steel quality and operational costs.

MAIN BENEFITS

- Improved and assured steel quality
- Considerable reduction of process gases and reduction agents
- Decreased refractory costs
- Increased productivity up to 1 heat per day
- Full simulation of AOD process
- Dynamic online control of process steps
- Full dynamic online calculation of temperature, weight and chemical analysis of steel and slag throughout the AOD process.

DYNAMIC PROCESS MODELS

PROCESS MODELS OVERVIEW

- Steel Expert Prediction simulates the complete AOD process before the heat is actually started using various setpoint models.
- Steel Expert Charging calculates a cost- optimized mixture of pre-melt portions.
- Steel Expert Slag calculates a mixture of slag forming additions to reach optimal slag basicity for the AOD process.
- Steel Expert Decarb determines the necessary blowing volumes and flows for various decarburization steps.
- Steel Expert Reduction finally calculates the amount of reduction agents and the necessary process time for complete reduction of the slag.
- Steel Expert Supervision cyclically calculates and optimizes the duration of the decarburization steps.
- For desulphurization in two-slag practice, Steel Expert Desulph determines the required material weights for the intermediately deslagged steel bath.
- Steel Expert Reblow corrects the steel temperature and/ or analysis.
- With Steel Expert Adjust the steel weight, temperature and analysis can be accurately adapted to the planned steel quality during final adjustment.



Converter automation

PURE.HMI

Primetals Technologies has designed a new human-machine interface - pure.hmi - dedicated to the requirements of the metals industry. A global customer survey revealed the top 3 features in process control HMIs: integrated design, individual views, and context-sensitive operator guidance. pure.hmi satisfies the business goals of our customers and the expectations of the operator at the same time.

A uniform control interface assists production with higher profitability by reducing the training costs, minimizing downtimes, and reducing support and maintenance costs. A consistent look and feel over the entire production chain supports the application of advanced cost-effective interventions such as job rotation.

Smart tiles serve as glazed doors to automatically display live information from the favorite apps, even though the application may not be running. In case of a significant deviation from normal process parameters, related production data come alive on the home screen, enabling to make an informed decision in order to resolve a particular situation.

pure.hmi customized workspace is a collection of settings that make the HMI look and work the way a user wants it to, ensuring that personal preferences for a workspace are automatically used next time a user logs onto the system with the same account.

The industry's information technology is shifting and mobile access is expected to outpace desktop-based access. pure.hmi is designed to be responsive and flexible, whether it's a desktop or a novel multi-touch interface. It allows operators to work more efficiently and effectively as they focus on the task at hand.

Instant access to online and up-to-date information at your fingertips allows urgent and fact-based decisions to be made from anywhere in the world with access to the web.

To keep plants at the maximum performance level and to ensure the latest technology is available for the implemented automation systems we offer economic upgrading and optimization packages reflecting state-of-the-art solutions. Thanks to pure.hmi, automation systems are equipped with greater intelligence, aiding plant operation and optimizing production.

MAIN BENEFITS

- Higher efficiency over the entire production
- Consistent look and feel
- Simple and fast access to data
- Individual and customized workspace
- Multi-touch and cross-device accessibility
- Individual and customized workspace
- Easy and fast integration



DEDUSTING CONTROL

SOLUTIONS FOR CLEAN AND ENERGY EFFICIENT STEELMAKING

PRIMARY DEDUSTING CONTROL

Primetals Technologies dry-type waste gas cleaning system is the most efficient environmental solution available for emission control, energy recovery and dust recycling in BOF converter plants.

Our long technological experience in combination with reliable automation systems and latest technologies enable energy efficient operation with highest off-gas dedusting results for all individual converter operation modes. Modular drive solutions and up-to-date measurement equipment in combination with optimized algorithm under consideration of the entire process provide best dedusting results and efficient converter off-gas recovery.

The electrostatic precipitator (ESP) is one of the main components in dry-type dedusting plants, at the same time it is also one of the main electrical consumer. Therefore Primetals Technologies supply efficient high-voltage units for ESP operation for best cleaning results. To reduce the energy consumption of new or existing ESPs Primetals Technologies provide a product for energy saving in combination with highest efficiency:

PRECON

Based on the converter phase and actual process conditions, Precon controls the level of possible energy reduction without affecting overall dedusting performance. All relevant process data are analyzed during operation, and the power reduction calculation is sent to the individual high-voltage units of the ESP. Precon can be used for all primary dry-type dedusting systems with electrostatic precipitators in steel plants.

MAIN BENEFITS

- Energy savings up to 60%
- Short payback time
- Optimized dedusting control of the electrostatic precipitator
- No dust concentration increase in the clean gas
- Short implementation and commissioning time
- Easy to use system
- Fast implementation into existing systems

SECONDARY DEDUSTING CONTROL

Secondary dedusting systems collect dust emissions from converter charging, hot metal and steel treatment at various emission points inside the steelmaking shop.

Modular designs of drive solutions for ID-Fan control and latest instrumentation technologies are provided to meet the requirements on secondary dedusting plants.

Many bag filters operate without any energy optimization, based on fixed cleaning cycles where the cleaning valves purge compressed air into the filter bags. A malfunction of a cleaning valve can only be detected manually through maintenance personal.

The next generation of dedusting control is a flexible control of the whole system, from the damper to the stack, considering different operating points and combining the know-how of Primetals Technologies and the experience of operational personal:

BAG FILTER CONTROL

Thanks to intelligent control system with electronic modules the Bag Filter Control optimizes bag filter operation, featuring significantly reduced cleaning air consumption as well as the detection of defect cleaning valves. A fast and reliable system with self-monitoring functions controls the cleaning valves, therefore increasing the life-time of valves and filter bags.

MAIN BENEFITS

- Automatic control of the entire bag filter system
- High efficiency of the bag filter cleaning process
- Pre-tested technological package including HMI, software and hardware
- Powerful electronics replace conventional relays
- Short implementation and commissioning time in new or existing bag filter
- Energy savings due to reduced cleaning air consumption
- Reduction of maintenance costs

LATEST AUTOMATION REFERENCES

CONVERTER STEELMAKING

REFERENCES ALL OVER THE WORLD

REFERENCES FOR NEW, MODERNIZATION AND REVAMPING PROJECTS, SINCE THE YEAR 2000:

- > 50 level 1 automation systems and
- > 80 level 2 automation systems in carbon steelmaking
- > 45 installations of Lomas Dynacon
- > 25 level 1 and level 2 automation systems in stainless steelmaking





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MORE**

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