SIAS® AUTOMATED SURFACE INSPECTION FOR FLAT PRODUCTS
SIMPLE, RELIABLE AND ACCURATE SURFACE QUALITY CONTROL
PUTTING SURFACE QUALITY UNDER CONTROL

YOUR CHALLENGE
The right surface quality in a constantly evolving environment

Flat-rolled steel producers are facing a trend towards zero-defect tolerances regarding surface quality. This trend, initiated by customers in the automotive industry, is now becoming the norm in other industries too: packaging, “white goods” (appliance) and more. Such performance requires a perfect knowledge and control of the production. Yet, the introduction of new processes (e.g., thin-slab and strip casting) and the development of new steel grades (e.g., ultra-high-strength steels) have introduced a lot of changes in the way steel is made, making this more difficult to achieve. In addition, the push towards high throughput rates and yields makes it impossible to rely on time-consuming, traditional quality control practices. From a quality management (ISO) perspective, it is necessary to standardize “surface quality” like any other product characteristic. Today, surface quality can often be evaluated only subjectively, by specialists with years of experience in product inspection. Standardization in this field can therefore only occur if process knowledge and the understanding of defects are emphasized and accurately characterized, and if a repeatable, reliable measurement is performed.

OUR SOLUTION
On-line surface quality control SIAS® detects and automatically classifies all surface defects visible on the strip

- Inclusions such as shells, slivers, seams
- Mechanical damage: pinch marks, cracks, holes, scratches, etc.
- Scale: descaling problem, rolled-in scale, unpickled patch, etc.
- Repeating defects: roll marks, dents, pick-ups, etc.
- Coating defects: dross, arc spots, anode marks, etc.

Results are displayed to the operator, and stored in the form of coil reports mapping the defects on every coil. The implementation of SIAS® is simple and straight-forward, and serves two purposes: to monitor the process and its impact on the strip surface, and to collect accurate, reliable data on the surface quality of the products coming from the line or mill. The SIAS® solution is successfully operated in all flat-product rolling and processing applications:

- Hot mills
- Pickling lines
- Cold mills
- Continuous annealing lines
- Metallic coating lines
  - Continuous galvanizing lines
  - Electrolytic galvanizing lines
  - Electrolytic tinning lines
- Color-coating lines
- Stainless steel lines

ADVANTAGES OF SURFACE INSPECTION SYSTEMS FOR PLANTS SIAS

- Perfect knowledge of everything you deliver - 100% surface-quality control provides the possibility to evaluate in real-time the product with requirements.
- Increased productivity - Inspection is performed without stopping or slowing down the line, and re-inspection is drastically reduced. If a defect occurs, its origin is rapidly identified and eliminated (e.g., scale, roll marks). Harmful defects are detected before they cause any damage downstream.
- Fast, simple and reliable - through a user-friendly interface, SIAS® can be easily and quickly adapted to any application, and customized to user requirements. The powerful classification tool allows repeatable and reliable performance.
- Maintenance friendly - the system requires only minimal maintenance thanks to its lean design and modular architecture. Remote service is available, and local service is guaranteed through the Primetals Technologies network.
SIAS TECHNOLOGY
VISION FOR QUALITY

SIAS®, THE BEST SURFACE QUALITY GAUGE

High-end cameras, optics and lighting provide a sharp, fine-resolution image of the strip surface. The sensor components have been carefully selected for their technical performance, reliability, ease of use and maintainability. The image is processed for defects identification: detection of flaws, automatic classification and severity grading.

The system is PC-based for easy integration into the user’s network, and user-friendly administration. Remote access is possible from any connected PC, to configure the system and monitor its operation.

SIAS® HMI’s have been designed together with world-class steelmakers to match the specifics of every application. SIAS® results are organized into three categories:
- Defects: size, position, type and severity
- Defect images
- Context, or follow-up, information: mill/line speed, product texture, image brightness, camera and sensitivity settings which allow a good understanding of inspection conditions

All results are available to the inspector in real-time, allowing immediate reaction. Results storage is done according to the state of the art, in an open database structure, for later review and studies. The whole system can be fully administered via a user-friendly, fully graphic HMI interface that requires no computing.

EMPOWERING TOOLS TO MAKE THE MOST OUT OF SURFACE QUALITY DATA

The SIAS® system integrates all of the features that allow users to extract desired information from the collected data.

CONSISTENT DATA STORAGE

All SIAS® inspection results are stored together with context information on the product, the process and the environment. This is a key for quality procedures and allows users to make decisions with full knowledge of the conditions of inspection. Through the SIAS® coil-grading software, the quality department can determine instantly whether a coil surface quality matches the requirements of the customer – and what action to take if this is not the case.

OFF-LINE ANALYSIS

The storage of SIAS® results in SQL-compatible database structures paves the way for defect studies, such as trending on groups of coils, e.g., by grades or by dates. The reports that can be edited from the SIAS® provide all the synthetic information for plant managers to monitor the performance of their production units. The fully graphic and intuitive SIAS® interfaces make it a flexible tool that can be easily adapted by the operator to new production conditions or requirements.
**HOT MILLS**

SIAS® for hot mills was optimized to cope with the specifics of surface quality control in the hot mill environment: high production pace, hard visual control, varying product aspects. The SIAS® technology opens outstanding perspectives in terms of quality management at the hot mill. First, it brings major improvements in terms of safety and efficiency of quality control and customer relationship management. In addition to the immediate benefits linked to the control of scale and roll-mark defects, SIAS® allows a perfect adjustment of production constraints to achieve the required level of surface quality. The result is fewer and more adapted production rules, and better quality.

**FEATURES**

- High inspection resolution
- Water-cooled, tight, rugged camera unit housing
- High-power state of the art led lighting
- Auto-adaptive settings for inspection of many different product grades
- Special interface adapted to high rolling speed and production pace
- Simple system administration through fully graphical user interfaces
- Live display with possibility to freeze up to 60 meters of strip image at full resolution and scroll up and down, zoom-in, etc.
- Auto-freeze image display on strip heads and tails

- Near infra-red channel available to focus on critical defects

**MAIN BENEFITS**

- Elimination of unnoticed production of defective material
- Warnings for downstream processes (holes, edge cracks)
- Improvement of surface quality control practices and increased safety
- Yield improvement
- Data available on 100% of the strip surface for surface quality studies and process optimization

**COLD MILLS**

The SIAS® solution for cold mills includes the “SAFE HOUSE” exclusive enclosure, designed to provide mechanical protection for the SIAS® sensors and to make the environment clean and proper for surface inspection. Surface inspection at the cold mill introduces a revolution in terms of quality management and mill operation. With a direct feed-back on surface quality, mill operation can be focused on real issues and precautionary measures can be optimized, increasing output and yield.

**FEATURES**

- Specific camera set-up for maximum performance
- Complete environment and mechanical protection through “SAFE HOUSE” exclusive design
- Fully graphic interface and image-based classification editor for fast and simple configuration and commissioning
- Total visual feed-back through “live display” feature: freeze/zoom in-out functions

**MAIN BENEFITS**

- Weld monitoring
- Real-time reporting
- Increased line/mill productivity
- Immediate detection of “defect crises” such as roll marks or scratches
- Improved quality control efficiency
The SIAS® solution for processing lines is based on a compact, standard, modular design. The optical arrangement system and installation configuration are then adapted to take into account each application’s characteristics (i.e., type of material to be inspected and defects) and the line’s specific mechanical constraints.

**FEATURES**

- High resolution inspection
- Automatic sensitivity adaptation to product changes (brightness/texture)
- Texture analysis module for specific coatings
- Total visual feedback through “Live Display” feature
- Open, SQL database archiving
- Fully graphic interface and image-based classification editor
- Preset detection and classification from past experience
- Real-time reporting: no delay between defect occurrence and reporting
- On-line coil-grading

**METALLIC COATING LINES**

SIAS® is the worldwide leading solution in surface quality control of exposed-quality galvanized products for the automotive industry. For critical applications in the automotive, packaging or appliance markets, SIAS® provides synthetic, highly accurate information on surface quality. The coil-grading module automatically confirms if the coil surface quality matches customer requirements. For specific applications, extra-modules are available to customize results or add performance:

- Specific module for inspection of linemarked products (differential coating)
- Density calculation of micro-defects (e.g., micro-dross, zinc grain) and real-time reporting of density variation
- Edges/holes channel for 100% reliability in hole classification
- Texture analysis to monitor spangle uniformity

**PICKLING LINES**

SIAS® picks up all major surface defects early in pickling lines before the valueadding processes. It provides warnings on pickling issues. A result of SIAS® is that the pickling speed can be optimized. On coupled pickling line-tandem mills, additional benefits can be expected from an early detection of defects right before cold-rolling: the potentially harmful defects are reported to the mill operator who can take action (slow down or open stands), eliminating defects-induced strip breaks.

**CONTINUOUS ANNEALING LINES**

At the continuous annealing line, SIAS® prevents defective materials from being further processed at the electrolytic galvanizing line or in any other downstream process.

**COLOR COATING LINES**

SIAS® ensures high resolution inspection of painted surface at the line exit. Thanks to the system of built-in flexibility, it can be easily tuned to adapt automatically to the widest range of product colors and aspects. Thanks to automatic classification, possible origin of defects (roll coat, oven, dryer or gloss film application) is rapidly identified.

**STAINLESS STEEL LINES**

In the high-added-value stainless steel market, SIAS® is a key component of global equipment, essential to high quality and productivity. SIAS® can be applied to bright annealing lines and annealing and pickling lines as well as integrated stainless steel lines, skin-pass mills and tension levelers. SIAS® will alarm operators about all surface defects (harmful defects for the lines and/or unacceptable defects for required quality).

**MAIN BENEFITS**

- High defects discrimination capability
- Innovative configuration
- 24/7 inspection of 100% of strip top and bottom surfaces at high resolution, independent of line speed
- Early detection of defects before value-adding processes
- Line productivity increases – no speed reduction for quality control
- Huge reduction in manual re-inspection (if applicable)
- Fully traceable measurement of the coil surface quality
- Immediate decision on coil allocation
- Feed-back to upstream processes: steelmaking hot and cold rolling
- Process improvement
- Prevention of downstream defect damages
- Enhanced customer relationship management

Light bar and camera on CGL Bremen, Germany
Main processing cabinet: one server all in one

Lateral lighting on PLTCM to focus on 3D defects
Edge and hole channel: strip inspection with backlight to detect edges, holes and cracks with very high accuracy

Surface inspection on processing lines detects both defects from upstream (incoming material) and defects from the process. It performs final product quality control and allows optimizing process parameters and production practices to reduce defect occurrence.
Surface quality being one of the main components in the value of steel products, the associated control system needs to be constantly operational and reliable. As for other products in the family, users of SIAS® benefit from the worldwide presence of the Primetals Technologies group. Primetals Technologies supports SIAS® along its complete life-cycle, from the installation phase and throughout the system operation, to guarantee a consistent surface quality control.

The following services are available to SIAS® customers:

• Spare parts management and supply, from a set of standard spares, with on-demand replacement and repair
• Preventive maintenance visits, organized periodically to prevent or detect at an early stage any efficiency loss of the equipment, on the basis of thorough diagnostics
• Hotline and remote maintenance services; software updates
• On-demand on-site intervention

LIFE-CYCLE PARTNERSHIP FOR SURFACE QUALITY

PRIMETALS TECHNOLOGIES LIFE-CYCLE SERVICES
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Customer. Rizhao Iron & Steel Co. Ltd, Rizhao, Shandong, China
Line Type. 3 x ESP
Our solution. High-resolution single-camera inspection of top side and couple of cameras on bottom side; live display HMI and multiple-resolution inspection
The result. Detection and classification performance >90%; direct impacts on casting regimes (scale optimization), hot-mill operation (roll changes), flatness supervision
Technical data. 3 x 2.55 Mtpy; min thickness. 0.8 mm; product types: carbon steel, dual phase

Customer. ArcelorMittal, Florange, France
Line Type. Coupled pickling-cold mill
Our solution. Top and bottom side inspection at the exit of the pickling section, before intermediate looper and cold mill with real-time interface
The result. ArcelorMittal Florange has experienced an approximately 1% increase at the No. 1 coupled pickling-cold mill in working ratio (available line time) due to reduced incidences of defect strip breaks and mill stops
Technical data. Max. strip speed (at inspection point): 360 m/min; strip temperature up to 120° C; max. strip width: 1,870 mm

Customer. Salzgitter Flachstahl, Salzgitter, Germany
Line Type. Hot-dip galvanizing line
Our solution. SIAS® with high-resolution inspection and density analysis module
The result.
• Reliably identifies and eliminates serious strip surface defects such as slivers and holes prior to delivery to the client
• Investigates and rates claims due to surface defects even afterwards (a posterior)
• Detects defects systematically, to allocate the same to events or states/conditions and take targeted corrective actions
• Systematically investigates and understands the causes of defects
Technical data. Thickness: 0.3 to 2.0 mm; max. strip speed (at inspection point): 210 m/min; max. strip width: 1500 mm; lateral strip movement: ± 25 mm; lateral strip movement speed: 10 mm/s

Customer. Aperam, Guéugnon, France
Line Type. Continuous Annealing and Pickling Line
Our solution. Top and bottom sides inspection at the exit of the line, before the coiler and after side trimming
The result. New line start-up with a top quality feedback in real-time
Technical data. Hot rolled annealed and pickled coils (serie 300 and 400); max. inspection width: 1,590 mm; max. strip speed: 60 m/min
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