FEATURING 7

MECHATRONICS, AUTOMATION AND PLANT-WIDE SOLUTIONS

Example of a continuous casting control pulpit supplied by Primetals Technologies

papers from Primetals Technologies at the ESTAD Conference 2017 in Vienna, covering the topics of inline measurements, condition monitoring, maintenance services, production planning, plant optimization and quality control.

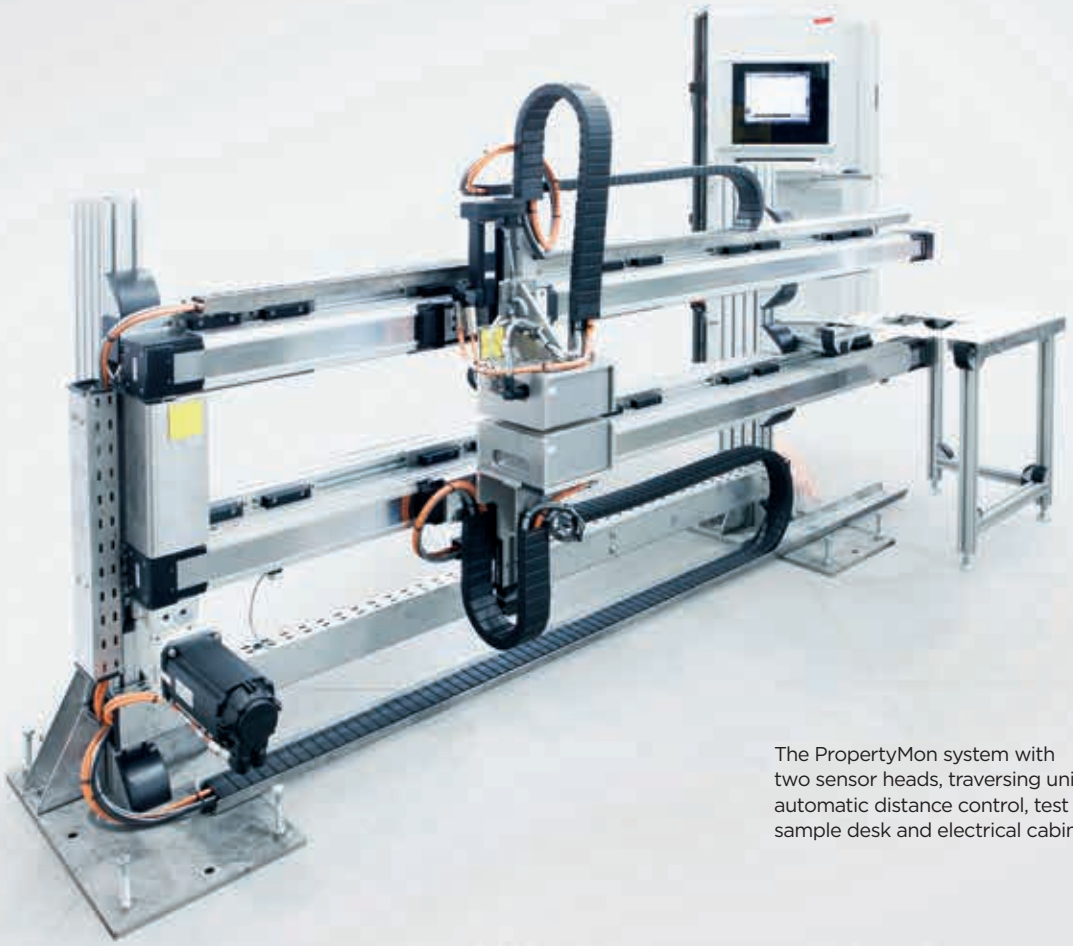
INLINE MEASUREMENT OF ELECTROMAGNETIC PARAMETERS FOR CHARACTERIZATION OF MATERIAL PROPERTIES OF STEEL STRIP, WITH A FOCUS ON MAGNETIC VALUES

Paper number: 40; Principal author: Dr. Alois Koppler

Inline measurement of mechanical and magnetic properties of steel strip with contactless, non-destructive techniques offers considerable potential for further technological optimization and new applications. Such techniques are available with the PropertyMon system from Primetals Technologies, which employs state-of-the-art methods for indirect measurements using electromagnetic signals. By measuring the hysteresis curve of the steel strip, mechanical and magnetic properties can be determined using regression calculations. The required coefficients are obtained via regression analysis of test measurements and corresponding laboratory samples. This method gives reliable results for tensile strength, yield strength, hardness, magnetic losses and magnetic polarization.

Recently, test trials to determine magnetic power losses P and polarization J were carried out on an annealing line at thyssenkrupp Steel Europe in Bochum, Germany, for non-grain-oriented (NO) electrical steel. This paper presents test results for these magnetic parameters, which are particularly important for electrical steel strip-production processes. Continuous calculations of P and J can be achieved with a high degree of accuracy for online process monitoring and quality control.

The PropertyMon system exhibits several unique features such as the simultaneous detection of mechanical and magnetic properties, directional measurements for anisotropic properties, and space-resolved measuring in which compact sensors are passed across the strip width. This approach therefore complements or outperforms standardized destructive laboratory testing procedures in many ways.



The PropertyMon system with two sensor heads, traversing unit, automatic distance control, test sample desk and electrical cabinet

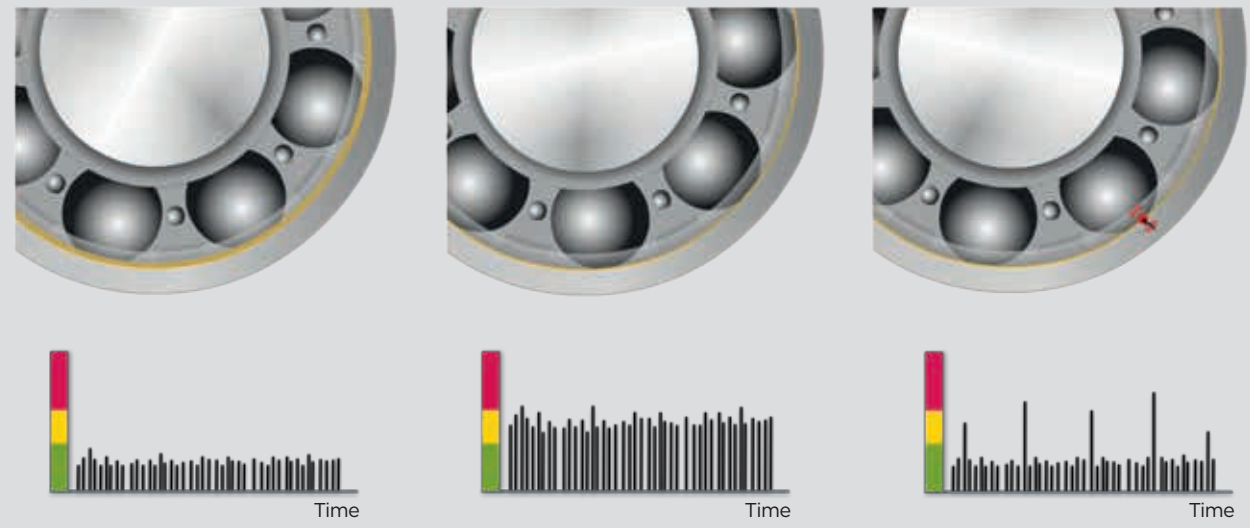
The 24/7 acoustic monitoring system can be ideally installed at environmental plants, steel mills, casting and rolling facilities.

OFF THE BEATEN PATH: NEW CONDITION-MONITORING APPLICATIONS IN STEELMAKING

Paper number: 86; **Principal author: Anna Mayrhofer**

For fast-rotating equipment (bearings, pumps, motors, gears, etc.) various condition-monitoring techniques, predominantly vibration analysis, allow predictive maintenance practices to be applied. For slow-rotating equipment – in the range of one revolution per minute (rpm) – the situation is quite different. Vibration monitoring is not typically possible, because there is not enough energy in the vibrations to be measured and analyzed. However, with the proven technique of shock-pulse measurements, it is possible to obtain accurate information about the condition of this type of equipment. Application of the shock-pulse measurement technique is presented for two examples of very slowly rotating equipment – the ladle turret and the LD (BOF) converter.

Another new approach for condition-based maintenance assistance is the Acoustic Expert System from Primetals Technologies. Recording and analysis of sounds produced by plant equipment and components leads to a wide field of applications for monitoring assets and production processes. This 24/7 acoustic monitoring system can be ideally installed at environmental plants, steel mills, casting and rolling facilities as well as material-handling areas, which underlines the versatility of the system. The paper outlines several installation examples and the results achieved.



Monitoring of bearing condition using shock-pulse measurements
Left: new bearing delivers a characteristic noise level (carpet level)
Center: worn bearing with increased noise levels (no repetitive pattern visible)
Right: damaged bearing showing repetitive peaks that allow the damage type to be identified

HOW TECHNOLOGICAL ADVANCEMENTS IN PROACTIVE AND PREDICTIVE MAINTENANCE CAN INCREASE THE LIFECYCLE OF PLANT EQUIPMENT

Paper number: 72
Principal author: Arno Haschke

Maintenance is gaining increasing attention in the steel industry, as companies realize that it is critical to monitor the condition of assets to increase plant availability and reduce the risk of unplanned shutdowns. Due to global overcapacity, modernization investments have been reduced, which pushes existing plant equipment to operate up until their maximum lifetime limits. To minimize unplanned shutdowns, increase operational availability and enhance plant performance, steel producers are turning to the latest maintenance solutions and technologies. An integrative solution based on the installation of mechatronic packages with monitoring functions in steel mills, continuous casters, rolling mills, processing lines and others can be used to monitor critical equipment or processes that are at risk of causing bottlenecks in the production chain.

Condition monitoring from Primetals Technologies includes the evaluation of mechatronics, technological controls, process models, third-party systems as well as a lifecycle service concept. Upstream and downstream examples from metallurgical plants show how an intelligent monitoring system can be used to supervise advanced production.

Mobile and user-friendly access to key plant data

An advanced planning and scheduling system helps iron and steel producers meet the challenges and increase their competitiveness.

VALUABLE PRINCIPLES FOR EFFECTIVE PLANNING & SCHEDULING: A HOLISTIC APPROACH

Paper number: 81
Principal author: Rene Grabowski

Iron and steel companies are permanently challenged to optimize utilization of production facilities, reliably meet due dates and reduce raw material and energy consumption. An APS (Advanced Planning and Scheduling System) helps iron and steel producers meet such challenges and increase their competitiveness.

A sophisticated APS supports the overall planning process by applying complex rules based on product and order mix, production routings with corresponding processing and transport times, and resource availability. Specific technological constraints, including those related to steel grade and energy, are also considered to ensure that company-specific key performance indicators are met.

Orders describe the type and amount of products to be produced by a required due date in a specific production plant. In general, the task of an APS is to support the preferred work-to-order scheduling by assigning work orders to available production facilities along the product-specific process route and by generating optimized material sequences for critical work centers.

KNOW-HOW BASED ROOT-CAUSE ANALYSIS TOOL TO ENSURE HIGH PRODUCT QUALITY AND PROCESS STABILITY

Paper number: 92; **Principal author: Gerhard Kurka**

The challenging and competitive market situation caused by worldwide excess capacity is forcing an ever-increasing number of steel producers into the market of high-quality, high-price products in order to improve profitability. Compared to commodity grades, high-quality products pose substantial demands on quality management, with the need to operate and manage a plant within tight tolerances across the entire production route. Additional documentation is required to fulfill product- and customer-related quality standards. All of these activities rely on advanced IT (information technology) system support and appropriately trained employees.

To support steel producers who want to improve product quality and production efficiency, Primetals Technologies has developed the TPQC (Through-Process Quality Control) system. TPQC is a know-how-based, through-process quality management and control system that performs automated rule-based quality checks at each step of the value-added production chain. The system is driven by a unique know-how based root-cause analysis from Primetals Technologies. TPQC provides product-specific assistance for quality engineers and operators to help them identify the causes of detected quality deviations. Thanks to the root-cause analysis, detailed instructions for eliminating the causes of nonconformities are made available. TPQC is thus both a quality system and a learning tool, which improves quality and process sustainability through supplemental technological know-how. The specific root-cause analysis feature is the result of teamwork between IT specialists, automation experts and metallurgists at Primetals Technologies, who contribute to the required product- and steel-grade-specific know-how.

The combination of rule-based quality grading and process-parameter evaluation across the entire production route is decisive for ensuring outstanding product quality.

Example of a blast furnace control pulpit supplied by Primetals Technologies

INTEGRATED STEEL PLANT OPTIMIZATION BY MEANS OF A PROCESS-INTEGRATION FLOWSHEETING PLATFORM

Paper number: 65; **Principal author: Dr. Bernd Weiss**

Iron- and steelmaking requires a wide range of different raw materials that significantly influence process performance. This demands a continuous optimization of process routes with respect to energy efficiency as well as environmental emissions. Steadily changing raw material prices and qualities, market conditions and product variations pose major challenges for integrated steel plant operators with respect to production planning and cost optimization.

In terms of investment planning, in-depth knowledge and comparisons of possible process routes is necessary. For greenfield plant investment decisions, a thorough comparison of available processes is essential, taking into consideration all site conditions and raw material specifications. For analyses of brownfield plant investments, detailed knowledge about existing process routes and a comparison with the desired route is required.

Up until now, the steel industry has not been able to generate accurate overall mass and energy balance models covering integrated steel plants that can be used by both producers and engineering companies alike. Detailed evaluations by Primetals Technologies confirmed this situation, which led to the development of a holistic metallurgical model library in a flexible flowsheeting environment. This paper presents an introduction to the iron- and steelmaking process-integration platform.

THE DIGITALIZATION OF STEEL PRODUCTION

Paper number: 91; **Principal author: Kurt Herzog**

State-of-the-art automation information technology and connectivity supports the digitalization of steel production that goes far beyond conventional industrial automation. Initiatives around the globe are fostering digitalization, such as IIoT (Industrial Internet of Things) in the U.S., Industry 4.0 in Germany, and the Chinese industrial program "Made in China 2025." Primetals Technologies is actively driving digitalization that is shaping the future of steel production.

Intelligent combination of sensor technology with digital models, as well as quality and production planning and control systems, leads to new dimensions in product quality and production-cost reductions. New diagnostic techniques allow intuitive fault tracing or processing to achieve faster maintenance. Digital assistants support both operation and maintenance using context-oriented or self-learned information.

Primetals Technologies is actively driving digitalization that is shaping the future of steel production.

MECHATRONICS & AUTOMATION HIGHLIGHTS OF PRIMETALS TECHNOLOGIES

- Team of 1,260 automation and mechatronics specialists dedicated to the iron and steel industry – the world's largest
- Vast experience of Primetals Technologies in the supply and installation of Level 1 automation systems and Level 2 process-option systems available for the benefit of customers. Number of references since 2000:

Process step	Level 1 basic automation	Level 2 process optimization
Sintering	25	30
Blast furnace ironmaking	24	79
Hot-metal desulfurization	3	18
LD (BOF) steelmaking	63	103
Electric steelmaking	36	42
AOD stainless steelmaking	38	32
Secondary metallurgy	112	167
Continuous casting	302	276
Long rolling	175	135
Plate rolling	84	74
Hot-strip rolling	120	100
Cold rolling	270	190
Strip processing	295	180