ROLLING AND STRIP PROCESSING LINE TECHNOLOGY

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Welcome to SMS Siemag’s symposium on “Rolling and Strip Processing Line Technology”. Following our successful first symposium on rolling and strip processing in India in 2006, we want to take the opportunity once again to discuss with you our latest technology and the future development of India’s steel industry.

The steel market in India is growing steadily. Increasing demand is coming from the automotive and construction sectors as well as from infrastructure projects. However, steel producers are also facing pressure mainly from high raw material prices and imports.

SMS Siemag meets these challenges with numerous innovations, focusing on the reduction of production costs, final product quality, increased flexibility and energy efficiency together with environmental aspects. Highlights illustrating the technological leadership of SMS Siemag are, for example, the new ECO hot strip mill and the further development of the CVC® technology in reducing energy consumption to a minimum, the CVC® plus M 18/4 cold rolling mill for full flexibility in the product spectrum from soft to high-strength grades or continuous annealing and galvanizing lines for high-strength steels for the automotive industry.

Since the last symposium, SMS Siemag has completed its strategy to become a system supplier. Today, our plants are integrated solutions for mechanical, electrical and automation equipment and process know-how from a single source. Our high standing is proven for example by the successful start-up of the new ThyssenKrupp Steel hot strip mill in the USA, several 5.0-m heavy-plate mills and the pickling line/tandem cold mill of the Russian steel producer MMK, which will be presented during the symposium. Also, the CSP® plants of Essar Steel and Tata Steel in India were completely supplied by SMS Siemag. Furthermore, SMS Siemag has recently widened its product portfolio by also focusing on furnace and environmental technology.

As the country is one of the most important future markets, SMS Siemag has a strong organization in India. The majority of the almost 900 SMS Siemag employees in India are based at the SMS India Pvt. Ltd. headquarters in Gurgaon. Here, the complete process from steel production to strip processing is covered. Our employees at the Kolkata location work mainly for the Electrical and Automation Division. The new service workshop in Bhubaneswar is located in the “steel state” of Orissa and is initially dedicated to caster mold copper-plate coating services. The workshop will be further expanded to meet the repair requirements of rolling mill core components such as mandrels, spindles or hydraulic gap-control cylinders. With the local service team and repair capacities established close to the customers’ locations, we can best serve our customers with value-added services.

Dear Guests, please participate in the fruitful discussions with our experts and learn about the best practical solutions and the latest innovations.

Dieter Rosenthal
Member of Managing Board of SMS Siemag
## LECTURES FIRST DAY
### OCTOBER 16, 2012

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# Lectures Second Day

**October 17, 2012**

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THE SMS SIEMAG WAY

SMS SIEMAG DEVELOPS AND BUILDS INNOVATIVE SOLUTIONS – WORLDWIDE. MORE THAN 140 YEARS OF EXPERIENCE IN METALLURGICAL PLANT AND ROLLING MILL TECHNOLOGY GO INTO THE PLANTS. THIS PROCESS KNOW-HOW IS CONSTANTLY EXPANDING THROUGH OUR RESEARCH WORK AS WELL AS THROUGH MANY GLOBAL COOPERATION PROJECTS WITH COMPANIES AND SPECIALIST INSTITUTES. ENSURING THAT TODAY – AND ABOVE ALL IN THE FUTURE – WE MEET YOUR EXPECTATIONS.
The SMS group is, under the roof of SMS Holding GmbH, a group of global players in plant construction and mechanical engineering for the steel and nonferrous metals processing industry. It consists of the SMS Siemag and SMS Meer Business Areas and the industrial participations. Operating jointly under the SMS brand, these two areas supply integrated solutions for metallurgical process technology, casting and rolling technology, and for other shaping and refining processes. The SMS group combines the flexibility of company units that operate as medium-sized enterprises and the broad resources of an internationally active company.

As the financial organization, SMS Holding GmbH is responsible for strategic planning and controlling. The sole owner of the SMS group is Siemag Weiss GmbH & Co. KG, the holding of the Weiss entrepreneurial family.

Revamps, new plant construction, or erection of turnkey systems, all this belongs to the scope of the SMS Siemag business area with its operating companies. SMS Siemag enjoys a global reputation as a leader in technology and as a supplier of the solutions that industry demands. Included in the range is everything from reduction metallurgy, steelmaking and secondary metallurgy, to continuous casting, CSP® technology, hot and cold rolling mills and further to strip processing lines and heat treatment.

Further SMS Siemag ensures automation solutions that meet the requirements of improved mechanical equipment and new process technologies. And with the worldwide service network SMS Siemag is always close to the customer. Now, more than 30 locations and 1,100 employees around the world offer service solutions – from spare parts, inspection and maintenance service, Integrated Maintenance Management System (IMMS®), trainings up to maintenance outsourcing.
This is duly ensured by SMS India through proactive coordination with its experts on client enquiries, selection of components which are locally available or supported, stocking of critical spare parts and ensuring a fast response to the customer’s call for assistance; besides the constant endeavor to keep customers competitive by means of the latest technological innovations. This aim is furthermore supported by the fact that according to its policy SMS India feels committed to supplying the most advanced equipment and technical solutions of the highest and most reliable quality.

Thanks to its predecessor companies, SMS India is already well established in India. The Mannesmann subsidiary Indomag Steel Technology Ltd. was launched in Delhi in 1989, followed by SMS Schloemann Siemag who founded SMS India in 1994 at Mumbai. With the merger of the metallurgical plant construction division of Mannesmann Demag and SMS Schloemann-Siemag in 1999, these two companies in India also merged, and since then SMS India has continued to expand. Today it operates offices in Gurgaon and Kolkata together with a service workshop at Bhubaneswar in the state of Orissa.

The SMS India management team of Marcel Fasswald, Ravi Shankar and Ulrich Greiner-Pachter look forward to the future with optimism: “With almost 200 major projects implemented, SMS India is in an excellent position to convince customers of our performance capacity. Our references range from steelworks equipment to rolling mills and strip processing lines. We are continually expanding our range to meet market demands. That includes everything from organizational and structural measures with new workshops or central locations, to expanding our range of products and services, for instance with Indian key account support teams for spare parts.”

In the new building at Gurgaon all business units from Steel Making to Strip Processing Lines as well as Electrical & Automation and Services are represented at a single location. The Hot and Cold Rolling Mills departments mainly support the corresponding German departments with technical sales, basic and detailed engineering and project management. A notable in-house development is the engineering for roll shops and the corresponding equipment for hot rolling mills. The team also undertakes detail engineering for various hot and cold rolling mill equipment and is fully geared-up to take up engineering jobs for technological structures around the mill, civil assignment drawings for the complete mill area or detail engineering for all interconnecting piping. In an endeavor to serve customers through faster response and provision of focused solutions coupled with optimized total cost of ownership, the team addresses the selection of components which can be locally supplied in full conformity with SMS Siemag’s global standards. The software teams within...
India are part of the global resources of SMS Siemag, having jointly worked through the commissioning of numerous international and local projects in India such as Essar and Tata Steel CSP® plants.

The Strip Processing Lines department has 60 engineers and draftsmen who work on basic and detail engineering for processing lines, using the most advanced 3D modeling software. Throughout the last few years, more and more product responsibilities have been shifted from German headquarters to this department. Standardization of line equipment is also followed consistently in order to optimize the efficiency of engineering. The engineering is carried out in close cooperation with the colleagues in Germany. Also, project and order handling capacities are starting to be set up.

Acknowledging the importance of automation and system engineering, the E/A Division at SMS India, employing more than 120 persons, is staffed with adequate resources to serve the complete lifecycle of the project, from Sales to Final Acceptance Tests. A distinguishing feature of the deliveries is the "Plug & Work" concept, whereby automation systems are thoroughly tested in a simulated environment prior to delivery. The basement at SMS India has a test field for the integration tests to be carried out as part of the Plug & Work solutions.

Responding to the growing demands for more efficiency and higher plant availability in recent years, SMS India has established its own Technical Service Division in India. With the aim of improving the Overall Equipment Effectiveness (OEE) of the customer plants, the service team is focused on spare part & service requirements such as condition monitoring, automation-related services via remote locations and annual maintenance via outsourcing concepts.

As a first step towards local repair capabilities in India, SMS India has established the first repair workshop in Bhubaneswar. In the first phase, it is focused on mold copper plate coating services. The workshop will further be expanded to meet the repair demands of rolling mill core components such as mandrels, spindles, hydraulic gap-control cylinders, reconditioning of cardan shafts or reconditioning and hard-facing of slab caster segment rolls. With the local service team and repair capacities established close to the customer locations, SMS Siemag serves its customers with value-added services.
MMK'S NEW 5-M PLATE MILL

Magnitogorsk Iron & Steel (MMK) is one of Russia's largest steel producers. In order to serve the market with plates for large pipes, infrastructure projects, shipyards and boiler applications, MMK has awarded SMS Siemag the complete supply of a state-of-the-art 5-m heavy plate mill and a new slab caster to provide the plate mill with slabs up to 300 millimeter thickness and 2,700 millimeter width. The plant went into production in July 2009 and is designed for an annual capacity of 1.5 million t of heavy plates in thicknesses of 8 to 160 millimeter and finished widths of 900 to 4,800 millimeter. SMS Siemag supplied the entire mechanical and electrical equipment including the complete automation systems for the heavy plate mill, starting from the slab yard through to the plate yard and including the heat treatment lines.

ROLLING MILL

The heavy plate mill at MMK incorporates high-performance equipment with modern technologies. With a maximum rolling force of 120 MN and driven by two 12 MW motors, the 4-high mill stand is one of the world's most powerful. It is the first heavy plate mill stand in Russia that features CVC® plus technology. The housings are of multi-part design, which reduced the delivery time and made transport to Magnitogorsk easier.

CVC® plus increases the adjusting range for profile and flatness far beyond the possibilities of the bending system. Especially in the final passes, high rolling forces can be realized and large reductions made without impairing profile and flatness. This means that CVC® plus helps to save passes and to improve the productivity of the plant, as well as achieving thinner final gages. In 2012, a new CVC® plus solution was realized for the first time at NLMK DanSteel. The coaxial CVC® plus with vertically moveable shifting cylinders stands out through its extremely compact design and theoretically unrestricted maximum roll gap.

SMS Siemag has developed improved drive elements due to the demand for higher rolling force and torque. The new generation of slipper-type spindles reliably transfer extremely high rolling torques and are fitted with length compensation for CVC® shifting.

COOLING AND HOT LEVELING AREA

Plate cooling at MMK consists of a combination of spray and laminar cooling with a pre-leveler in the entry area and a hot leveler in the exit area in front of the cooling bed. This newly developed and patented spray cooling solution is ideal for accelerated cooling and direct quenching of plates directly from the rolling heat. The high-pressure section is equipped with pinch rolls for homogeneous cooling and substantial improvement of plate flatness after cooling. Using spray cooling increases the cooling rates, making it possible to develop high-strength steels with optimum plate flatness. The physical-mathematical cooling model combines the values of the plate with metallurgical parameters that are available for each material and calculates the correct cooling strategy.
SHEARING AND FINISHING AREA
New developments allow the processing of plates of thicker gage and/or higher strength. The four shears, the crop shear, combined double-side/slitting shear and dividing shear, are designed for cutting high-strength plates up to 50 millimeter thick. The cold plate leveler can be operated with five or nine leveler rolls, which provides a very large leveling range. The changeover between the two modes is automatic and without any loss of time from one plate to the other.

HEAT TREATMENT AREA
With the integration of Drever International into the SMS group, the product portfolio of SMS Siemag now also includes heat treatment lines. The heat treatment area at MMK consists of a combined high/low-temperature roller hearth furnace for normalizing and tempering and a high-temperature furnace with subsequent roller quenching for hardening.

AUTOMATION
The X-Pact® automation system from SMS Siemag is of modular design and features the latest system technology. Level 0 controls the drives and energy supply. Technological control systems and sequences that have to run in real time make up the Level 1. Level 2 contains the technological process models, handles the detailed process data and synchronizes the process flow within different mill sections and between the consecutive process steps. Production planning and distribution of the overall production data to the subordinated levels is undertaken in Level 3.

SMS Siemag’s automation for rolling mills provides an ideal platform for the optimum production of normal-rolled, control-rolled and thermo-mechanically rolled plates. Batch-rolling modes for up to four rolling phases and up to eight slabs or plates are possible. The material tracking system accurately manages up to 20 plates in the hot rolling area, 60 plates in the shear area and 360 plates in the finishing area. Close sequences are ensured due to continuous speed calculation and synchronization by tracking sensors.

OPERATIONAL RESULTS
In July 2009, only five weeks after the commissioning of the new heavy plate mill, MMK entered the market for pipe grades. Seven months after commissioning, MMK was exclusively producing thermo-mechanically rolled plate for use in oil and gas pipelines. Already during commissioning, up to 90 percent of the plates were produced in multi-plate mode, half of them in groups of four to six plates.

The benefits of all-inclusive supply from SMS Siemag are also clear when it comes to producing quality plates with close geometrical tolerances. During commissioning, the thickness deviation for 90 percent of the plates was less than 60 µm and in terms of profile, 90 percent of the plates were within a tolerance band of 40 µm.
In today’s market situation, steel companies are evaluating their investments more carefully, focusing on supplying local markets with their specific demand structures. Thus, SMS Siemag supplies tailor-made, highly productive, cost-effective hot strip mills for any capacity, from Steckel mills (0.5 – 1.5 million t/year) and CSP® plants (1.2 – 4.0 million t/year) to compact hot strip mills (1.5 – 4.0 million t/year), and high-performance hot strip mills (3.0 – 5.5 million t/year). With further optimization of the high-performance hot strip mill, capacities up to 6.5 million t/year become possible. Besides choosing the right plant capacity, the product mix, the required final thickness and the flexibility within the product spectrum are of equal importance.

CORE COMPETENCES AS A SYSTEM SUPPLIER
The integrated expertise of the equipment manufacturer is a decisive factor for productivity, availability and product quality or, in other words, for the success of a plant. As a system supplier, SMS Siemag knows exactly what plant technology can achieve, and its integrated solutions build on this as well as on the firm’s in-depth expertise in process technology and on its design and manufacturing know-how.

The complexity of modern hot strip mills demands the integration of mechanics, media systems and electrical and automation systems, starting already with the design and manufacturing. This ensures high performance right from the start and long service lives of all components.

NEW STEEL GRADES AS A FUTURE CHALLENGE
What drives developments in plant technology is above all the demand for innovative, high-strength steels and wear-resistant grades. This means today’s plants are designed with much higher drive power, rolling forces and rolling torques as well as with stronger coilers than ever before.

SMS Siemag develops new plant technology that relies on a wide range of practice-proven and high-performance technologies:
- Slab sizing press for flexible adjusting of slab width to final strip width
- Camber-free rolling for the elimination of strip cambers
- Mandrel-less coilbox for a compact hot strip mill or for optimizing the energy efficiency of the plant
- CVC® plus, the actuator for strip profile, contour and flatness
- Roll gap lubrication to reduce rolling force and torque as well as energy consumption
- Hydraulic loopers for stable strip flow
- UNI plus coiler for coiling high-strength, heavy-gauge strip.

In addition to these practice-proven technologies, SMS Siemag has in recent years further improved its plant technology and launched innovations that support hot strip mill operators in meeting future market demands.

SMS SIEMAG HAS ESTABLISHED ITS POSITION AS A SYSTEM SUPPLIER DELIVERING HIGHLY INTEGRATED SYSTEMS AND CONSIDERING THE LATEST PROCESS KNOW-HOW. THIS GIVES THE CUSTOMER BENEFITS SUCH AS SUPPLY FROM A SINGLE SOURCE, ADVANCED FUNCTIONALITY, EFFICIENT DESIGN AND HIGH-QUALITY MANUFACTURING. TO FULFILL THESE EXPECTATIONS, SMS SIEMAG CONTINUOUSLY DEVELOPS FURTHER ITS HOT ROLLING TECHNOLOGY.
MICROSTRUCTURE MODELING
Effective microstructure modeling makes it possible to calculate the structural properties of the rolled material in advance, based on the temperature and forming pattern as well as on re-crystallization behavior. Due to precise prediction of the tensile strength, the yield strength and the grain size, fewer lab tests are necessary to determine the mechanical properties of the material, and fewer samples need to be taken. Microstructure modeling can also be used for process optimization. Many micro-alloyed steels are characterized by complex, temperature-dependent re-crystallization behavior. Here, the microstructure model allows varying reductions in the individual passes as well as temperatures in offline mode, so as to define stable rolling conditions. This allows new steel grades to be introduced reliably and quickly.

DRIVE TECHNOLOGY
The production of hot strip made of high-strength steel requires greater reductions, especially in the first finishing stands. This means higher rolling torques and forces. Because it is not always possible to enlarge the work roll diameter, it is absolutely necessary to increase the capability of the drive train.
To make this possible, SMS Siemag has optimized the geometry and materials of its Sieflex® spindles. This almost doubles the specific rolling torque of the new spindle compared to older types.

FLEXIBLE STRIP COOLING
To achieve a large product range, the cooling system must come with a wide choice of cooling rates. It must be capable of very high cooling rates, e.g. for direct-hardened strip, as well as low cooling rates. Also important is good controllability of the equipment to achieve flexible cooling strategies. These demands are met with differentiated cooling systems. They are based on laminar cooling with trimming zones for precise control of the water quantity and therefore of the coiler temperature. The next levels in laminar technology are “reinforced cooling” and “super-reinforced cooling”. Compact cooling represents an even higher level of cooling performance. It consists of pressure cooling that applies very high quantities of water to the strip over a short distance.

STRAPPING MACHINE AND SAMPLING STATION FOR HIGH-STRENGTH STRIP
For safe coiling of high-strength steels (e.g. pipe grades) up to a thickness of 25.4 millimeter, SMS Siemag has established the UNI plus coiler on the market. Other challenges here are the strapping of these strips and sample-taking. Very high holding torques must be applied to prevent the strip from abruptly opening and causing injuries to personnel. This is why SMS Siemag has developed a new coil strapping machine with optimized strapping material and a better joining procedure. The newly developed sampling station enables safe opening of the coils, with safe sample-taking and re-strapping.
On June 15, 2010, Çolakoglu Metalurji A.S., Turkey, produced the first coil on its new hot strip mill. Designed for an annual capacity of three million tons, the new rolling mill produces hot strip 800 to 1,650 millimeter wide and 1.2 to 25.4 millimeter thick. The product mix covers a broad spectrum of carbon steels, including HSLA grades, tube steels, DP and TRIP steels.

**Compact mill thanks to coilbox**

The compact hot strip mill is only 330 m long. The short mill length was made possible by the mandrel-less coilbox installed between the reversing roughing stand and the finishing mill. Moreover, the coiling of the transfer bar between roughing and finish-rolling leads to equalization of the material temperature which in turn ensures nearly constant conditions during finish-rolling.

**Modern technologies**

The complete mill is fitted with the equipment and technologies required for the economical production of high-quality hot strip. The four-high reversing roughing stand with edger features hydraulic adjusting systems for precise setting of the transfer-bar thickness and width. All of the seven finishing stands use the CVC® plus system which, in combination with work-roll bending systems and the profile, contour and flatness control system, enables optimum strip geometries. The two downcoilers are equipped with Automatic Step Control for smooth strip winding.

**Automation system**

In addition to the Level 1 and Level 2 automation for the complete hot strip mill, SMS Siemag supplied the main and auxiliary drives, inclusive of converters and motors in each case. Technological measuring systems as well as instrumentation and sensors, plus a common HMI, were also part of SMS Siemag’s package for the hot strip mill.

**1.2-millimeter-thick strip after only seven weeks**

Prior to delivery, the entire automation system had been tested using the Plug & Work concept. And the benefits soon became obvious: As early as the second month after start-up, the mill attained nearly one-third of its nominal production. Only seven weeks after production start, Çolakoglu Metalurji rolled strip with the desired minimum final thickness of 1.2 millimeter. The measuring results for such a strip showed that its thickness, width and final rolling temperature remained within very close tolerances over the full length of the strip.

Excellent strip quality was already able to be produced during the first weeks of operation. As early as in the third month after start-up, the thickness, width, profile and flatness of 99 % of all strips were in compliance with the agreed tolerances.

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**KEY OPERATIONAL RESULTS**

**THE NEW HOT STRIP MILLS OF ÇOLAKOĞLU METALURJİ AND THYSSENKRUPP STEEL**

IN 2010, SMS SIEMAG DEMONSTRATED ITS CAPABILITY AS A SYSTEM SUPPLIER BY SUCCESSFULLY COMMISSIONING TWO HOT STRIP MILLS WITHIN ONLY TWO MONTHS. FOR THE HOT STRIP MILLS OF ÇOLAKOĞLU IN TURKEY AND THYSSENKRUPP STEEL IN THE USA, SMS SIEMAG SUPPLIED THE ENTIRE PLANT TECHNOLOGY INCLUDING ELECTRICS AND AUTOMATION.
THYSSENKRUPP STEEL USA, ALABAMA

In July 2010, SMS Siemag put into operation the high-performance hot strip mill for ThyssenKrupp Steel USA in Calvert (Alabama). With an annual capacity of 5.3 million tons of steel strip, this represents the centerpiece of the new plant complex completely supplied by SMS Siemag.

High-capacity hot strip mill

The equipment of the hot strip mill includes a slab sizing press, a two-high and a four-high roughing stand, each with an entry-side edger, seven finishing stands, a laminar strip cooling line and three downcoilers. SMS Siemag’s package also contained the complete E&A systems and the drives so that all systems could be perfectly harmonized with each other. Furthermore, the reheating furnaces, the coil transport equipment and the roll shop were part of the scope.

The slab sizing press achieves width reductions of up to 350 millimeter, which permits the production of finished strips in different widths from one slab width. The roughing stands are equipped with strong side-guards which, in combination with the automatic roll alignment control (RAC), prevent transfer-bar cambering.

The seven-stand finishing mill incorporates the CVC® plus system, roll gap lubrication, interstand cooling systems, hydraulic and differential-tension loopers, including optimized process models and control systems. The downcoiler unit comprises three UNI plus coilers which are able to wind strips of high-strength tube grades of the X80 strength class up to a thickness of 25.4 millimeter.

Electrical and automation equipment of the hot strip mill

The Plug & Work concept was also applied for the hot strip mill of ThyssenKrupp Steel USA. The complete automation equipment was set up in a test field in our Hilchenbach workshops and was then extensively tested with the aid of simulations. Following optimization of the process models, the operators were trained on the original control systems.

The intensive operator training sessions within the scope of Plug & Work, conducted prior to commissioning, contributed to the quick run-up phase. Complete production scenarios were tested here in our test field under near-real conditions. Within a very short time after the first coil, the mill was able to produce a wide range of products with excellent product quality in a very flexible and stable manner.
CSP® technology (Compact Strip Production), combining thin slab casting with direct hot rolling, has become a standard technology for hot strip production. Since its introduction in 1989, SMS Siemag has continuously improved its CSP® technology, which is among the most important processes for the manufacture of high-quality flat steel. By mid-2012, as many as 27 plants have gone into production.

The main characteristics of CSP® are:
- Minimized number of process steps
- Minimum investment and processing costs
- Environmentally friendly technology with low energy consumption
- Excellent product quality and production performance
- Large product mix covering all relevant steel grades demanded by the market.

### CSP® IN INDIA

Four CSP® plants are located in India: JSW Ispat, Bhushan Power & Steel, Essar Steel India and Tata Steel. The total nominal capacity of these plants is approx. 10 million tons of hot strip per year, representing about a quarter of the total hot strip capacity in India.

### JSW ISPAT – A HIGHLY PRODUCTIVE PIONEER

The thin slab pioneer in India was JSW Ispat. The plant, located in Dolvi started production in 1998. In 2003, capacity was doubled by installation of the second CSP® strand.

Designed for an annual capacity of 2.4 million tons, JSW Ispat achieved a monthly hot strip production of 264,300 tons in July 2008. This record value corresponds to 132% of the monthly production capacity guaranteed and would result in a yearly production trend of almost 3.2 million tons with two strands and vertical casting machines. JSW Ispat has attained these production quantities through continuously high casting speeds. With a casting speed of 8.0 meters per minute, JSW Ispat holds the world record for thin slab casters.

### BHUSHAN POWER & STEEL – IMPRESSIVE SEQUENCE LENGTH AND THIN GAUGE PRODUCTION

The CSP® plant of Bhushan Power & Steel in Rengali started production in April 2008 with one casting strand and five mill stands only. The investment costs were also reduced by the relatively small ladle size (90 t) and the short metallurgical length (6,340 millimeter). The strip width of 1,300 millimeters is in line with Bhushan’s cold rolling facility.

After the successful establishment on the market, production was doubled by the second casting strand in 2010. The rolling mill was expanded by a sixth mill stand and a downcoiler, allowing Bhushan to reduce the minimum gauge and to optimize its rolling operations. Today, Bhushan Power &
Steel is very much focused on the production of thin strip. In 2010, more than 45 per cent of production was ≤ 2.0 millimeters.

Another characteristic of Bhushan Power & Steel is the large number of ladles per sequence. In September 2011, a sequence of 45 heats during a net casting time of 28 hours was cast.

**ESSAR STEEL INDIA – THE WORLD’S FIRST 3-STRAND CSP® PLANT**

The CSP® plant of Essar Steel India will be the first 3-strand CSP® plant worldwide and is designed for a total capacity of 3.5 million tons per year. The plant was supplied by SMS Siemag including the complete electrical and automation system.

Essar Steel India started production at its Hazira based CSP® plant with two casting strands in March 2011. Already during commissioning, the plant showed impressive results. For example, the casting performance was record breaking: three weeks after commissioning, a casting speed of 6.5 meters per minute was realized. In October 2011 Essar Steel achieved a casting speed of 7.0 meters per minute for more than eight hours. The casting process was smooth and characterized by a stable mold level.

Essar Steel India has achieved a remarkable rolling stability and performance for ultra-thin gauges. 60 days after the first coil, the first strip with 1.0 millimeter strip thickness was produced and, 135 days after start-up, the first strip with 0.8 millimeter thickness. In August 2011 Essar Steel India realized rolling campaigns of more than 30 strips of ≤ 1.1 millimeter.

**TATA STEEL – INNOVATIVE PRODUCT MIX**

The most recent Indian CSP® plant started operation in March 2012 at Tata Steel’s Jamshedpur facility. The intended product mix of Tata Steel comprises a high share of value-added steel grades such as silicon grades, line pipe grades and dual-phase steels. Tata Steel will use a portion of its hot strip to supply the group’s own automotive factories.

For this plant, SMS Siemag supplied the complete plant and process technology including electrics and automation. Already 45 days after start-up, the minimum strip thickness of 1.2 millimeter was realized. Also, strip quality was excellent during commissioning.
FOR MORE THAN TWO DECADES, CSP® HAS BEEN THE MOST SUCCESSFUL THIN-SLAB CONCEPT WORLDWIDE. RECENTLY, EXPANDED MARKET DEMANDS HAVE LED TO NEW DEVELOPMENTS. TODAY, CSP® OFFERS A GREATER RANGE OF POSSIBILITIES REGARDING PRODUCTION CAPACITY AND PRODUCT MIX – ESPECIALLY FOR HIGH-STRENGTH GRADES. IN ADDITION, ENERGY CONSUMPTION IS REDUCED DRASTICALLY, AND CSP® IS THEREFORE THE MOST ECONOMICAL PLANT CONCEPT FOR THE PRODUCTION OF HIGH-QUALITY HOT STRIP.

The new developments were made without forfeiting the strong points of CSP® such as low operating costs, high availability and yield, absolutely uniform product properties and a wide range of different steel grades. To fulfill this, new components in the casting, heating and rolling areas were added to the CSP® concept. This allows tailor-made technological solutions to be provided.

CASTING MACHINE CONCEPTS FOR A WIDE CAPACITY RANGE
The key to boosting the annual capacity and increasing final strip thicknesses is the casting machine. So far VSB (Vertical Solid Bending) casting machines have been used. These casters, which operate with a solid core in the bending zone, achieve production volumes of about 1.5 million tons per year per strand. Typical features of VSB casters are symmetrical strand cooling and solidification, short mold and segment change times and ease of maintenance.

Production is raised by increasing the casting thickness. This requires a greater metallurgical length in the casting machine, which can be economically achieved by the use of a VLB (Vertical Liquid Bending) casting machine. VLB-type casters operate with a liquid core in the bending and straightening zones. Production volumes of 2.0 million tons per year per strand are possible.

ROLLING MILL CONCEPTS FOR THE PRODUCTION OF PIPE GRADES
A major development focus was on the production of pipe grades. High-strength pipe grades with excellent toughness properties up to a thickness of more than 12.7 millimeter can already be manufactured from slabs of thicknesses between 50 and 60 millimeter on the compact CSP® rolling mill. With the new Vario Mill (Fig. 2), the final thickness of e.g. API X70 grade can be increased to 20 millimeter.

For the production of high-strength pipe steel strip, it is essential that the hot strip features an entirely homogeneous, fine-grained microstructure. By suitably setting the pass reductions and temperatures, the CSP® Vario mill guarantees that the microstructure completely recrystallizes at least two times. An induction heating system is installed in the gap between M1 and F1. The temperature of the strip and its transfer time between M1 and F1 are controlled such that complete recrystallization will take place after the two stands. This technique enables the production of thicker hot strip with higher strengths and at the same time superior toughness properties. In comparison with concepts with one or two decoupled roughing stands, there is no premature precipitation of micro-alloying elements or substantial grain growth. Thus, higher micro-alloy contents can be attained, enabling hot strip of higher strength classes to be produced. Thanks to the complete elimination of non-homogeneities originating from the cast structure, thicker strip can be obtained from slabs of a given thickness.

TAILOR-MADE CSP® PLANT SOLUTIONS TO FULFILL RECENT MARKET REQUIREMENTS
This result was proven by intensive scientific research. The microstructure of an API grade X70 sample produced on the Vario mill consists of uniformly recrystallized grains and is free from non-homogeneous constituents. The grain size distribution shows a scatter band closely grouped around the mean grain size.

**CSP® ENDLESS ROLLING**

For customers aiming at a production with a very high proportion (above 50%) of thin and ultra-thin hot strip below 1.2 millimeter thickness, endless mode of operation can be added. To achieve acceptable final rolling temperatures in endless operation, inductive reheating is required in the rolling mill. Consequently, for energy-related reasons, batch operation should be applied to all products and final gauges which do not benefit from the endless casting and rolling mode. The main components of this plant concept are a caster of VLB type for high production, a Core Reduction (CR) stand, the Vario mill including inductive heating and a high-speed shear.

**ENERGY EFFICIENCY**

SMS Siemag has further developed CSP® with respect to energy efficiency and reduced consumption to a minimum. This ambitious goal was realized by analyzing the complete production process as well as all components.

Concerning the process, the temperature of the thin slab is no longer increased up to a temperature which is ideal for all grades and dimensions but is kept on a lower level close to the temperature after casting. At this lower temperature, the overwhelming proportion of grades and dimensions can be rolled without constraints in process stability and product quality. This leads to drastic savings in energy.

The reduction of the tunnel furnace temperature goes together with the installation of inductive heaters upstream of the rolling mill. When rolling grades or dimensions requiring a higher rolling mill entry temperature, this can be set precisely by means of inductive heaters. With this solution, the large product spectrum typical of CSP® and a reduction of energy consumption can be realized at the same time.

At the level of plant components, the largest energy savings can be realized by installation of dry-type furnace rollers. With new high-temperature alloy furnace rollers from SMS Siemag, the heat extraction from the tunnel furnace can be reduced by 50 per cent compared to water-cooled rollers. Further measures for reducing energy losses are the installation of a rotary descaler in the entry of the mill and the reduction of stand distance in the CSP® mill.

With the installation of dry-type furnace rollers, a rotary descaler and the reduction of the tunnel furnace temperature in combination with the inductive heating, parts of this concept can also be applied to existing CSP® plants. This modernization concept will be realized for the first time at the Nucor Steel plant at Berkeley (USA).
TOTAL ROLL GAP CONTROL (TRC®)

TRC®, the innovative assistance system for automatic threading, helps to compensate specific drawbacks in tandem and reversing batch mills. When the strip is being threaded in and out, it considers the wedge profile and thickness deviation at the strip head and tail ends. Depending on the material properties, it corrects the rolling force and the roll gap during threading so as to ensure strip flatness and straight flow. Direct roll gap measurement supports this by a more precise setting of the roll gap.

The first installation of the TRC® system was realized at the batch tandem mill of Bilstein GmbH & Co. KG, Germany, rolling slitted hot strip. The improved process stability and faster, more reliable threading in and out resulted in an increased production of 20%. Off-gauge length was reduced by some 50%.

T-ROLL PROCESS MODEL

SMS Siemag has developed T-roll, a technology package including new and enhanced physical model approaches to simulate the cold rolling process. Besides the complete mechanical and thermal description it includes a detailed and proven characterization of the tribological processes, which opens up new options for process improvements. In house T-roll is used for dimensioning of rolling mills.

NEW GENERATION OF LUBRICANTS

Based on practical experience with lubricants and theoretical evaluations with the T-roll model, SMS Siemag has developed a laboratory test service to check whether a lubricant fulfills the requirements of the rolling process or not. Together with the subsidiary, SMS Lubrication, new lubricants were developed which right from the beginning consider the particular rolling situation for the required product mix. Customers of SMS Lubrication benefit from this by the reduction of the oil-adjusting time, oil consumption, residues on the strip as well as improvement of rolling stability and surface quality. Thirteen first fillings as well as a large number of refillings since 2009 prove the success of this method.

ECOLUB

The ECOLub system is installed at the entry side of the mill stand and applies only the amount of lubricant which is actually needed in the roll gap. The lubrication reduces the friction in the roll gap and thus the rolling force and improves the strip flatness. ECOLub applies only a film which is thinner than the combined roughness of the strip surface and roll. Therefore, lubricant pockets which lead to imprints of the lubricant on the strip do not arise, enabling customers to increase the proportion of wet-tempered products. ECOLub thus combines the advantages of wet and dry skin-passing. As a result, roll wear is reduced, operating costs are cut and strip flatness is improved.
INSPECTION SYSTEMS AND ADVANCED ONLINE MEASURING SYSTEMS

To improve product quality, manual strip inspection and online measurement of quality-determining parameters are indispensable. That is the reason for SMS Siemag to improve continuously inspection systems and to look for principles to measure parameters relevant for process and product quality online.

Rotary Inspect
The manual inspection of cold rolled strip, especially to ensure high surface quality, is indispensable for many mill owners. Therefore SMS Siemag’s inline and offline inspection station “Rotary Inspect” is the new ergonomic, easy and safe way for reliable inspection of strip top and bottom sides. Especially for surface-sensitive products, like exposed automotive applications, the required high inspection frequency will be achieved.

X-Shape flatness measuring system
Due to the essential importance of the flatness measurement system for the performance of a cold rolling mill, SMS Siemag produces its own flatness measurement roll, X-Shape, using the license from the BFI. For highly accurate and reproducible measurement results, SMS Siemag has developed its own signal evaluation software, the so-called X-Shape Analyzer. Besides the visualization, this is the precondition for high-performance flatness control.

Online detection of residual oil
Quick, precise and continuous detection and recording of even the smallest amounts of residual oil on cold-rolled strip is mandatory for avoidance of scrap due to corrosion and for quality assurance. Therefore, SMS Siemag has teamed up with Kienzle to jointly optimize Kienzle’s online measuring system for use in SMS Siemag’s cold rolling mills. The online measuring system is based on time-integrated laser-induced fluorescence spectroscopy and offers a whole range of benefits. It permits continuous detection and documentation of residual oil over the width and length of the strips, optimizes the consumption of lubricants and allows the detection of tramp oil for quick identification of leakages.
SMS Siemag supports its customers either by specialized mill concepts or by more flexible solutions capable of handling a wide product mix, including niche products and smaller quantities.

HIGH-STRENGTH STEELS, SILICON STEEL AND THEIR MARKETS
The development of carbon steel during the last few decades has mainly been stimulated by the automotive industry. Today, the automotive industry demands not only high-strength steels (HSS) such as bake-hardening steels and HSLA steels with tensile strength in the range of 270 to 600 MPa, also so-called advanced high-strength steels (AHSS) with tensile strength up to 1,600 MPa.

The application of stainless steel grades is mainly driven by their corrosion resistance. However, because of their remarkable ductility at higher strength, especially austenitic grades are also a preferred material for complicated shape components.

The applications for grain-oriented (GO) and non-(grain)-oriented (NGO) silicon steel strip are motors, transformers, electromagnets, relays and transmitters. The expected demand on the silicon steel market is fuelled by the promotion of electrically powered vehicles.

In addition to the conventional 4-high, 6-high and 20-high mills, SMS Siemag has developed the CVC® plus 18 HS and the CVC® plus M18/4 multipurpose mills.

SOLUTIONS FROM SMS SIEMAG
Tandem cold mill
Since 2000, SMS Siemag has received orders for 16 tandem cold mills. Looking at the product mix, in 12 of the 16 mills the high-strength steels required are mainly HSLA steels. For these grades and soft DP and multiphase steels, powerful 4-high and 6-high mills are still the right solutions.

One of the latest references is the five-stand CVC® plus 4-high tandem cold mill for the new cold mill complex of MMK in Russia. The mill is designed to roll HSS and HSLA steels in strengths of up to 690 MPa. With its high drive-power rating and rolling force of 35 MN per stand, it is one of the most powerful tandem cold mills in the world.

CVC® plus 18 HS mill
For cold rolling of stainless steel and advanced high-strength steels, SMS Siemag has developed the CVC® plus 18 HS stand type. This type can be used in reversing mills as well as in tandem mills. The CVC® plus 18 HS, a further development of the 18-high mill, is in principle a 6-high mill. The small work rolls are laterally supported at the entry and exit sides by supports which are fixed in a so-called cluster. The benefit of this mill stand type is that it uses CVC® plus technology to adjust the roll gap in a wider range.

FOR MANY DECADES, THE STEEL INDUSTRY HAS BEEN WORKING ON THE IMPROVEMENT OF STRENGTH, FORMABILITY AND PHYSICAL PROPERTIES OF STEEL GRADES. THE DEVELOPMENTS ARE DRIVEN BY MINIMIZING THE AMOUNT OF STEEL USED, BY INCREASING THE PERFORMANCE OF PARTICULAR APPLICATIONS OR BY REDUCING ENERGY LOSSES. CONSEQUENTLY, HIGH-STRENGTH STEELS WITH THINNER FINAL GAUGES ARE REQUIRED AND THE LOADS PLACED ON MILLS DUE TO HIGHER TOTAL REDUCTIONS ARE INCREASING.

COLD ROLLING OF HIGH STRENGTH, SILICON AND STAINLESS STEEL GRADES

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In 2009, SMS Siemag put into operation the world’s first fourstand continuous 18 HS tandem cold mill (CTCM) for Posco in South Korea. The Posco tandem mill is designed to roll strips of AISI 300 and 400 grades in a width of up to 1,350 millimeter and a final thickness range from 5.0 millimeter down to 0.4 millimeter.

CVC® plus M18/4 mill

Only a few steel producers are able to utilize a highly specialized mill like the CVC® plus 18 HS mill. In order to ensure the economic production of commercial steel grades as well as of advanced high-strength steel and stainless steel, SMS Siemag has developed the CVC® plus M18/4 mill. This design makes it possible to change from CVC® plus four-high operation to CVC® plus 18-HS mode during a regular roll change. Thus, the CVC® plus M18/4 mill shows the following advantages: low investment costs, flexible production, from soft to extremely high-strength materials, and high productivity.

Mill solutions for silicon steel

For the cold rolling of silicon steel strip, SMS Siemag offers three mill concepts: the CVC® plus-HS reversing mill in 4-high, 6-high and 20-high mill design. Every mill has its own specific advantages. The favorable mill solution depends on customers’ individual requirements. The latest reversing cold mill reference for the rolling of silicon steel strip is Wisco, China. The powerful CVC® plus 6-HS reversing mill is designed to produce strip in final thicknesses between 0.85 and 0.2 millimeter, with Si contents of up to 3.5%. The mill is equipped with CVC® plus, positive and negative work-roll and intermediate-roll bending system, strip cooling system and multizone cooling system. The HS system (Horizontal Stabilization) allows setting of the horizontal forces acting on the rolls and enables the use of slim work rolls. The job of the Edge Drop Control system (EDC®) is to minimize the natural edge drop in the area of the strip edges and thus reduce material losses during subsequent trimming. Provided also with the X-Pact® electrical and automation system, Wisco is able to attain an annual production of over 300,000 t of silicon cold strip featuring the closest tolerances.
MMK’S NEW PLTCM

In summer 2011, the Russian steel company MMK, Magnitogorsk Iron & Steel Works, started operations in its new cold strip complex. MMK is one of Russia’s leading steel producers and is expanding its production of high-grade cold-rolled and galvanized strip with this cold strip complex. These strips are intended above all for the manufacture of automotive outer-body and interior parts and, furthermore, for domestic appliances and for the construction industry.

SMS Siemag’s supply scope comprised all of the mechanical components for the cold strip complex, the entire X-Pact® electrical and automation system, including the power supply and drive engineering and all auxiliaries.

The new complex consists of a pickling line coupled with a five-stand tandem mill, a hot-dip galvanizing line, a combined hot-dip galvanizing and continuous annealing facility, a recoiling and inspection line and a packaging line. The tandem rolling mill in the MMK cold strip complex is one of the world’s strongest plants as regards drive power. All mill stands incorporate CVC® plus and are, in addition, equipped with positive and negative work roll bending. Strip flatness and strip surfaces with no residues of rolling oil or emulsion are ensured by the multi-zone cooling system and the DS (Dry Strip) system in the last mill stand. SMS Siemag’s patented Rotary Inspect in-line inspection system permits prompt, reliable and easy checking of the quality of the rolled strip.

WITH ITS TECHNICAL EQUIPMENT AND ANNUAL CAPACITY OF 2.1 MILLION TONS OF COLD STRIP, MMK’S PICKLING LINE/TANDEM COLD MILL IS AMONG THE MOST MODERN AND POWERFUL MILLS OF ITS KIND IN THE WORLD. THE COMMISSIONING OF THE PICKLING LINE/TANDEM COLD MILL AT MMK SHOWS THAT SMS SIEMAG HAS ONCE AGAIN PROVEN ITS COMPETENCE AS A SYSTEMS SUPPLIER.

A SUCCESS STORY OUT OF ONE HAND

PICKLING LINE/TANDEM COLD MILL OF MMK

PLUG & WORK

The automation system of the pickling line / tandem cold mill was tested by SMS Siemag before delivery, using the tried-and-tested Plug & Work method: After the customer’s complete automation system has been set up in the test field, Plug & Work simulates the production process and allows the automation functions to be tested and optimized under realistic conditions before installation at the customer’s works. In addition to training of the customer’s personnel under very realistic conditions, this SMS Siemag concept has contributed to a significantly shorter commissioning period.

COMMISSIONING AND RESULTS

Six weeks before the contractually agreed date, it was possible to roll the first strip on the mill on 31 May 2011. The first 20 strips were pre-pickled. The tandem mill produced strip of saleable quality right from the start. The pickling line started production on 20 June 2011. Five weeks after the first strip was rolled, the plant was already producing in two-shift operation. During this phase, the first trial strips for applications in the automotive sector were manufactured and successfully certified.
As early as the first few weeks of the run-up phase, the plant was able to satisfy the production requirements for supply to the end-use customers. Within a period of merely two months, the production range involved here had covered virtually the entire contractually envisaged scope of strip gauges and widths.

As the technical optimization of the plant continued, the maximum rolling speed was also able to be increased very quickly to the contractually assured level. Already about three months after the first strip, it was possible to achieve a stable strip speed of 1,500 m/min in the final stand while maintaining the excellent strip quality.

The productive output of the plant was raised continuously during the first four months. Daily production quantities of up to 4,600 t have been attained during the first six months of commissioning. The product range comprises a wide variation of steel grades. Thus, during the first five months, strips extending from low-alloy carbon steels to dual-phase grades were able to be produced. These embraced a yield-point range of 210 to 690 N/mm².

**OPERATIONAL RESULTS**

In July 2009 after only five weeks following the commissioning of the new heavy plate, MMK entered the market for pipe grades. Seven months after commissioning, MMK was exclusively producing thermo-mechanically rolled plate for use in oil and gas pipelines. Already during commissioning, up to 90 percent of the plates were produced in multi-plate mode, half of them in groups of four to six plates.

The benefits of all-inclusive supply from SMS Siemag are also clear when it comes to produce quality plates with close geometrical tolerances. During commissioning, the thickness deviation for 90 percent of the plates was less than 60 µm and in terms of profile, 90 percent of the plates were within a tolerance band of 40 µm.

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pickling rate</td>
<td>max. 280 m/min</td>
</tr>
<tr>
<td>Millstands 1 to 5</td>
<td>CVC® plus four-high</td>
</tr>
<tr>
<td>Roll force: max.</td>
<td>35 MN</td>
</tr>
<tr>
<td>Drive power</td>
<td>45,000 kW (millstands and coilers)</td>
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<tr>
<td>Rolling speed</td>
<td>1,500 m/min</td>
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<tr>
<td>Capacity</td>
<td>2.1 million t/year</td>
</tr>
<tr>
<td>Strip width</td>
<td>880 to 1,880 mm</td>
</tr>
<tr>
<td>Entry thickness</td>
<td>1.2 to 6 mm</td>
</tr>
<tr>
<td>Exit thickness</td>
<td>0.28 to 3 mm</td>
</tr>
<tr>
<td>Coil weight</td>
<td>35.0 (43.5) t</td>
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</table>
INNOVATIVE TECHNOLOGIES FOR THE ELECTROLYTIC TINNING PROCESS

In the electrolytic tinning lines of SMS Siemag, soluble tin anodes are used, resulting in considerable economic advantages. For example, the reduced expenditure on the tin used and the continuously high surface quality and efficiency of the system without the need for edge masks. Moreover, there are no costs for restoring the anode surface and no oxygen is required for tin-dissolving. SMS Siemag also offers various innovative technologies for the electrolytic tinning process. For example, a preconditioning cell activates the strip and removes Fe hydroxide right before the strip runs into the first tinning cell, which creates some benefits for the tinning process. Another example is an evaporator behind the tinning process, which recovers the tin from the rinsing water.

OVERVIEW OF AN ELECTROLYTIC TINNING LINE

Electrolytic tinning lines are of modular structure and may possess various plant components which can be of differing designs. In the entry section, a modern high-speed electrolytic tinning line from SMS Siemag is equipped with two pay-off reels, followed by a welding machine and a trimming shear unit as well as a vertical strip accumulator. The process section commences with an electrolytic cleaning section, a tension leveler and an electrolytic pickling section. The tin layer is then applied in several vertical coating cells, the quantity of which depends on the desired strip speed. After the coating section, the electrolyte is removed from the strip surface in a cascade rinsing unit, during which some of the electrolyte is introduced into the rinsing section. In an evaporator, the rinsing water and the electrolyte are recovered together with dissolved tin. In the subsequent vertical flux tank, the strip surface is prepared for the reflow unit. The inductively driven reflow unit is followed by a passivation unit with a dryer. The exit section contains another vertical strip accumulator, an inspection stand, a flying shear and two tension reels.

WITH THE INCREASING STANDARD OF LIVING IN INDIA, THE DEMAND FOR TINPLATE FOR THE PRODUCTION OF TINS IS RISING. APART FROM SOPHISTICATED MECHANICAL EQUIPMENT AND RELIABLE PROCESSING LINE DESIGN, HIGHLY DEVELOPED PROCESS TECHNOLOGY AND PROCESS COMPONENTS ARE REQUIRED FOR THE PRODUCTION OF ELECTROLYTICALLY TINNED ULTRA-THIN SHEET. IN THE LAST YEAR, SMS SIEMAG WAS AWARDED ORDERS TO DELIVER THREE ELECTROLYTIC TINNING LINES FOR CHINESE CUSTOMERS.
HIGH COST EFFICIENCY THROUGH THE USE OF SOLUBLE ANODES

Electrolytic tinning lines can also be operated with insoluble titanium anodes, in which case the electrolyte then has to be continuously enriched with tin ions to enable the tin to be deposited on the strip surface. For this, however, a system is required in which the tin granulate is dissolved by using oxygen. An important economic disadvantage is the higher price of tin granulate, which is 5 to 10% higher than that of the tin bars used for the production of soluble anodes. Moreover, at least 4 to 10% of the dissolved tin is lost because when the granulate is being dissolved with the aid of oxygen, not only the required tin(II) is generated but also a large quantity of tin(IV). In combination with iron, this forms tin sludge from which the tin can no longer be regained.

Moreover, the active surfaces of the anodes, which are provided with a special metallic coating, have to be restored in an elaborate process at least once each year. The insoluble anodes also require edge masks in order to enable the anode width to be adapted depending on the strip width. This is necessary so as to prevent any over-coating at the outer sides of the strip surface.

When using soluble anodes it is moreover possible to adapt the width of the anodes, which consist of several bars, to the strip width, thus attaining uniform coating conditions. This guarantees a stable and high surface quality and efficiency of the system. Moreover, there are no costs for restoring the anode surface. Likewise, the costs of the tin and the losses caused by the formation of tin sludge are lower. Since no oxygen is required for dissolving the tin, the expenditure on oxygen can also be dispensed with.

CONCLUSION

The electrolytic tinning lines from SMS Siemag are efficient and profitable plants for the production of high-quality tin-plate. The utilization of soluble anodes essentially enables the tin consumption to be reduced, thus representing a sustainable solution above all in view of the high raw material prices. All in all, the lines define the state-of-the-art and include a number of innovative equipment units with which SMS Siemag sets standards as regards the product quality, efficiency and environment-friendliness of electrolytic tinning lines.
CONTINUOUS ANNEALING TECHNOLOGY INNOVATION FOR MODERN CARBON STEEL PROCESSING


PRODUCTION OF AHSS GRADES
Drever International has been present on the continuous annealing furnace market since 1966. Today, Drever is the first global supplier of vertical continuous furnaces with a global market share of about 32%. Since 2006, Drever International has been part of SMS Siemag.

Extensive metallurgical research has led to the development of high-resistance and high-formability steels, termed AHSS (Advanced High-Strength Steel), in order to reduce the weight of vehicles and the fuel consumption. Today, the modern car body is made of approximately 60% of these new materials.

The steel manufacturing processes have been adapted to the production of new materials. Basically, the new process routes are a technical and cost compromise between a steel chemistry that uses some added elements suitable for facilitating the thermal process and adapted heat cycles which combine high annealing temperatures and high cooling rates. The new chemistry usually involves adding elements such as Si, Mn, B and Mo. These elements have an important influence on the transformation temperatures (Ac3, Ac1, Martensitic), but what is their influence on the critical cooling rates? However, some elements are either expensive or detrimental for other processes, such as Si on zinc coating adherence. Cooling rates available via today’s technologies are achievable by adding some of these elements. The cost of elements must be compared against the cooling cost, basically depending on the selected system, and the optimum technical solution must be defined.

CONTINUOUS ANNEALING LINES
A typical modern Continuous Annealing Line (CAL) incorporates a vertical furnace with the technologies like:
- A heating section able to heat the strip up to 920°C for a full annealing of martensitic steel
- A soaking section able to hold the strip temperature at the maximum speed during speed for a long time
- Slow cooling at maximum 10°C/sec below Ac1 for dual-phase steel, but also able to maintain a high temperature for martensitic steel
- A rapid cooling gas-jet system boosted by an ultrafast cooling system able to raise the cooling rates up to 120°C/sec for AHSS qualities
- Water quench technology able to cool at a rate at 500°C and 1,000°C for martensitic steel.

CONTINUOUS GALVANIZING LINES
For galvanizing lines, the problem will be more difficult due to the coating temperature of 450°C, which is inapppropriate for some materials. Therefore, the compromise between chemistry and heat cycle will be more on the chemical side. Furthermore, the coating requires an oxide-free surface and therefore water quenching will not be possible, leaving the gas-jet cooling system only applicable for the galvannealing process.

A typical modern Continuous Galvanizing Line incorporates a vertical furnace with the following technologies:
- A heating section able to heat the strip up to 860°C for intermediate annealing of multiphase and TRIP steels

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WEDNESDAY
17.10.2012
TIME
10:00 H
For high-silicon steel, it is essential to prevent the Si migrating to the steel surface because oxidation will immediately occur, with a severe zinc adherence problem. One solution to internal oxidation has been developed to block the Si internally by adjusting the atmospheric dew point in the heat section range of 600–700°C.

A soaking section able to hold the strip temperature at the maximum speed for a long time.

Slow cooling at maximum 10°C/sec below Ac1 for dual-phase steel.

A rapid cooling gas-jet system primarily comprising a 70-80°C/sec system tailored towards commercial and drawable qualities, followed by an ultra-fast cooling system able to cool down the strip at a very high rate of about 100 to 120°C/sec.

A holding section after rapid cooling for TRIP steel.

NEW TECHNOLOGY

The pre-oxidation concept for internal oxidation of the Si has been developed with the Wagner model describing the Fe-Si binary conditions. The preoxidation concept for internal oxidation of the Si has been developed with the Wagner model describing the Fe-Si binary conditions. The proposed technology is a confined volume in the heat section with internal atmosphere circulation designed to limit the oxidizing gases migration to the heat chamber. This preoxidation chamber has been successfully installed on some automotive lines and shows a good control ability of the atmosphere in the heat chamber.

The gas jet system proposed by Drever is able to cool down the strip at a cooling rate of 120 K/sec*mm with a combination of the following:

- Efficient slot nozzles designed for a high strip stability, allowing impingement on the strip surface at a close distance and very high pressure
- Direct injection of pure H2 in the cooling chamber in order to reach a content level of approximately 20 to 30% without any increase of the H2 for the furnace and reducing by 50% the energy consumption of the fans and the gas impingement pressure.

The H2 is allowed to migrate to the upstream and downstream chambers to the rapid cooling section in order to feed them with reducing gas. Furthermore, the system is provided with a transverse cooling control system able to adjust the strip temperature distribution across the width.

Last but not least, a modern annealing system must be designed minimizing operational costs made basically of utilities such as combustion gas, electricity, hydrogen and nitrogen. The bench mark done by Shougang comparing their SMS Siemag/Drever CAL plant of 1 millions tons capacity to similar modern plants in China demonstrates the efficiency of the design allowing a payback of the complete furnace in less than 12 years. These excellent performances have been achieved by an optimum concept taking into consideration the global situation of the plant.
NEW DEVELOPMENTS AND OPTIMIZED METHODS
The process stages in cold strip processing lines that influence material quality are surface cleaning, annealing, cooling, galvanizing and post-treatment. SMS Siemag uses tried-and-tested technologies that are constantly being optimized for these process stages. Furthermore, SMS Siemag regularly introduces new developments that increase material quality and plant efficiency, as well as extending the material range. On top of this, comprehensive production know-how is necessary to produce high-quality material. In this paper some new developments and optimized methods are presented. Additional new technologies and methods for the cost-effective production of high-quality steel strip are the optimized air-knife system from FOEN and DUMA in galvanizing, the Nickel Flash system and the optimized chemical roll-coater (both for post-treatment).

EFFICIENT CLEANING SECTION
Manufacturers, especially in the automotive industry, demand high surface quality. Even very slight strip contamination can lead to surface faults. That is why it is so important to remove all contaminants such as abraded iron, oil and rolling oil residues from the strip before annealing. Modern lines from SMS Siemag feature integrated, efficient cleaning sections with vertical cells for spray and electrolytic cleaning, horizontal brush cleaning, and brush rinsing as well as cascade rinsing. Due to low evaporation losses, the cleaning processes are low-energy. Moreover, rolls can be changed during ongoing production. Special brush positioning devices extend brush service life.

FOEN DEMCO ELECTROMAGNETIC STRIP STABILIZATION
Conventional strip galvanizing lines use a large quantity of zinc. As the coating process is subject to fluctuations – such as strip movement due to cooling or rolling – excessive zinc must be applied to ensure that the minimum coating thickness is achieved at all points. If the strip is stabilized to reduce movements and crossbows, it can be more precisely coated over the length and width. The zinc saved makes this a more cost-effective way of producing high-grade galvanized steel strip. Furthermore, plant speed can be increased...
as a result of the stable strip running. There are also fewer
surface faults caused by contact between the strip and the
air-knife. Using inductive measurement of the strip position,
the DEMCO system for electromagnetic strip stabilization
controls the magnetic forces in such a way that they imme-
diately equalize unwanted movements or shapes of the strip
The adjustment is contact-free in the area above the air-
knives that adjust the zinc coating. In particular, the movable
outer coils correct crossbows in the strip.

**PRODUCTION KNOW-HOW**

Today’s market demands advanced high-strength steels with
increasing surface quality. This makes extensive plant and
process know-how in cold strip processing essential for sus-
tained market success. The expertise that SMS Siemag has
gained as a plant supplier with many years of experience is
an invaluable success factor for customers when new plants
are erected and commissioned. Customers benefit in many
ways from this know-how: The overall operating risk is re-
duced because they receive an optimized plant within a short
time, enabling them to offer a high-quality product range on
the market. Upon request, SMS Siemag experts are available
on site to support the manufacture of special steel grades
such as high-strength structural steels. In this way, SMS
Siemag customers can quickly enter the market for lucrative
automotive grades, for example. With superior steel quali-
ties, customers can set themselves apart from competitors
and supply a wide range of attractive products.
There are two groups of electrical steel strip: non-grain-oriented (NGO), and grain-oriented (GO). In NGO electrical strip, the iron grains are distributed in a non-ordered manner so that the material has largely the same, so-called isotropic magnetic properties in all directions. That is why NGO electrical strip is mainly used in rotating machines such as electric motors and generators with alternating field orientation.

In GO electrical strip, the microstructure (grains) are arranged in the direction of cold rolling. Following special heat treatments, this results in what is called cube-on-edge texture. Because of the uniform orientation of the grains, the electrical strip has a preferred direction in which the magnetization can occur relatively easily. Due to the high permeability and lower losses in this preferred direction, GO electrical strip is typically used in static machines such as transformers.

For many years, SMS Siemag has been benefiting from cooperation with Duferco. Duferco supports SMS Siemag with know-how regarding different electrical steel production routes, including the latest technologies. Duferco has extensive experience in the production of NGO as well as GO electrical strip. The cooperation covers both metallurgical and design activities as well as support during commissioning and operation of plants.

Different strip processing lines are required for the production of electrical strip, depending on the production route and requirements of the finished material. Generally, SMS Siemag supplies solutions for all required plant types, starting from preparation lines up to lines for re-crystallization, decarburization and nitriding of the material, including special surface treatment equipment such as laser scribing. Each line is always tailored to the desired customer capacities, material flow, quality requirements and works layout.

The line types most commonly used are annealing and pickling lines (APLs), intermediate annealing lines (IALs), decarburization and coating lines (DCLs), and final annealing and coating lines (FCLs).
PLANT TECHNOLOGY FOR ALL PROCESS STEPS

SMS Siemag supplies the full range of equipment for the treatment of electrical strip. All components are designed to fulfill the special demands of electrical strip processing, and comply with best technology. SMS Siemag designs all components in such a way that they mesh with each other, and maximize the capacity, quality and overall performance of the plants.

The Drever International furnaces in annealing and pickling lines are equipped with highly advanced water-cooling technology. Another example is the adaptation of the turbulence pickling system to the particular challenges of silicon-oxide sludge. A special tank shape and corresponding equipment in the circuit system provide largely automated sludge removal. Smooth strip running is supported by heating the coils as well as the strip edges in the lines. This special handling also reduces strip damage and tearing. Drever International furnaces with decarburization function feature a very precise, continuous atmosphere-control system for very good decarburization results. The coating on electrical strip has a decisive influence on the material properties of the final product. This is the reason why the special electrical strip roll coaters allow a high-precision and completely automated adjustment of the coating rolls. Top coating quality is additionally guaranteed by exact temperature control of the coating medium in the circulation system.

REFERENCE SITUATION

To date, SMS Siemag has erected a total of 30 lines for electrical strip processing. Since 2000 alone, 17 lines have been ordered and installed for customers like U.S. Steel Košice, Wuhan Iron & Steel (Wisco), China Steel Corporation or Baoshan Iron & Steel. The latest orders comprised the delivery of seven lines for the production of GO electrical strip for a customer in Asia and the delivery of two ARES furnaces for flattening and coating lines for Wisco, China.

CONCLUSION

The market potential for high-quality electrical strip is expected to remain very good due to this material’s advantageous electrical and magnetic properties. It allows the saving of energy in an environment of globally increasing electricity consumption. In recent years, SMS Siemag has installed several strip processing lines, proving itself to be an expert partner with technologically advanced solutions for the production of high-quality electrical strip.
LEVEL 1: OPEN AND CLOSED-LOOP CONTROL SYSTEMS
SMS Siemag's control systems are designed to ensure excellent technological and functional implementation of the setting values stipulated by the Level 2 systems by means of hydraulic and electronic actuator systems. The Level 1 automation ensures the best possible dynamics and precision in the control of the mechanical, drive-related and hydraulic equipment of the SMS Siemag machines.

The company uses state-of-the-art computer technologies for its real-time process control. X-Pact® Embedded is the SMS Siemag hardware platform for modern, sophisticated control systems and technological regulation systems for rolling mills. ProBAS software takes care of graphic programming and diagnosis. For plant areas with general-purpose control requirements, the widely used PLC Simatic S7 is mainly provided. Automation systems and real-time capable field bus systems guarantee the necessary interaction between the individual mechanical and electrical components. The X-Pact® ProBAS automation system uses the latest technologies in real-time capable field bus systems.

LEVEL 2: PROCESS MODELS AND CONTROL SYSTEMS
Flexibility in terms of producing highly sophisticated products with an exceptionally wide range of properties and dimensions requires a Level 2 process control system which, besides modern communication and database concepts, requires physically based process models for the generation of optimum setpoints for the lower-level technological controls. The focus in the development of the models was on the best possible physical description of the process to minimize the need for complex adaptation algorithms. To fulfill their role in quality assurance, process control systems must not only optimize processes but also ensure an efficient product and production data acquisition and reporting.

The X-Pact® Level 2 system is based on a state-of-the-art software design, which ensures the highest possible stability and computing performance as well as easy maintenance and extension capabilities. The use of standard server hardware and of a standard development environment with less need for additional third-party software guarantees riskless upgrades and migration in the future. The availability of a wide range of communication drivers and methods allows easy integration of the Level 2 into greenfield plants as well as into existing plants in case of modernizations. Just like the elements of the other automation levels, SMS Siemag Level 2 solutions are independent of the hardware structure.
OPERATION AND VISUALIZATION BY SMS SIEMAG

The SMS Siemag control station concept responds to all demands placed on modern, highly automated plants. Its division into meeting and working areas reflects the activities of the operators. Installed here are devices and control panels tailored to the SMS Siemag control strategy. They create an atmosphere in which the different areas of work support the production and even make long shifts easy for the customer’s personnel. Furthermore, the lighting designs for the various situations, the room function controls plus the materials used reflect the SMS Siemag philosophy of supplying appealing, yet superbly function-based systems.

A special feature of the SMS Siemag visualization interface is that it makes use of the human ability to perceive and process information. This means that operators are guided through the process chains and can operate the plant intuitively. Configurable detailed stages support intelligent navigation through the screen masks. It is at all times possible to intervene in operations. To minimize stress, the masks change quickly and systematically. All this enables the operator to fully control the complex plant.

FASTER COMMISSIONING WITH PLUG & WORK

Here is what the customer gets as part of Plug & Work, which starts early on, even before commissioning: SMS Siemag’s Electrical and Automation Systems Division carries out extensive integration tests on the system and also instructs the customer’s personnel on how to operate it. Next in line are careful checks at the SMS Siemag test fields, long before installation at the customer’s facility. In the test fields, the automation system is tested and optimized under near-reality conditions, using a simulation model that maps the entire mechanics, drive technology and process.
ECONOMIC AND ECOLOGICAL SOLUTIONS WITH SYSTEM

As a supplier of integrated systems, the portfolio of SMS Siemag comprises also a wide range of fresh and waste water systems, from design to construction and commissioning. These include fresh water treatment for the production of demineralized water, and open and closed cooling systems. In addition, SMS Siemag also offers innovative wastewater treatment facilities. The neutralization or microfiltration facilitates the return of the treated water in the production process. Our latest innovation allows for the recovery of 75% of the wash water in the pickling of stainless steel. The portfolio for energy and environmental technology includes new facilities as well as the renovation and expansion of existing plants.

The water circuits as lifelines within a steelworks carry large amounts of fresh water and waste water. For example, in a conventional hot rolling mill around 25,000 cubic meters of water per hour is needed. This represents more than double the drinking water consumption of a German metropolis.

Thanks to modern techniques of SMS Siemag, it is possible to create virtually lossless closed circuits. SMS Siemag upgraded to the water management of the works, for example, with a whole range of customized cooling and filtration systems. In this way, almost the entire amount of water is returned to the production process.

In the above example of a hot rolling mill, usually 98% of the water is cooled, cleaned, treated, and returned to the circulation. This recycling rate can be increased up to about 99.8% by means of special technologies.

RESOURCE CONSERVING WATER AT SSAB

Due to the fact that without water, hot and cold rolling mills cannot work, efficient solutions are called for. For example, the water treatment system for the Swedish customer SSAB was designed in a way, that over the entire life cycle costs and the impact on the environment are reduced. Background of the modernization was the supply of a new laminar cooling system by SMS Siemag. To supply it with sufficient water, SMS Siemag has built parallel to the laminar a new water management system.

The pumps in the plant at SSAB are operated with variable speed. This reduces the energy consumption and energy costs. The magnitude of the savings are 2.5 million kilowatt hours per year, the circuit is cooled by a heat exchanger, in which river water is used as coolant. The advantages: The loss of water through evaporation and blowdown at laminar cooling will be reduced by about one million cubic meters.
per year. The pipes, tanks and other water filter wetted parts are made of stainless steel to prevent corrosion and the use of additional chemicals. Sintered particles, oil, grease and other floating materials are deposited on an automatic rake on sedimentation-flotation basin to the sand filters and the thickener.

A special feature of the new water management system for SSAB is that the water is cooled in heat exchangers and not, as usual, in cooling towers. This has the advantage that the flow of water is only exposed to heat, and not dirt. The condition is that sufficient flow of water is present to keep the heating of the permissible range. And the customer is convinced: „With the new laminar we are able to produce hot strip for heavy equipment vehicles with better loading capacity and higher wear resistance than in our previous cooling street. Resulting from lower overall costs for our customers and a lower environmental impact“, says Borje Sundell, Technical Manager at SSAB.

DIRECT AND INDIRECT COOLING
Depending on the production process, a distinction is made between direct cooling (contact with the process) or with indirect cooling (heat exchanger). SMS Siemag has further developed solutions for both solutions. The cooling water systems can either be the primary circuit or secondary circuit (for example, sea water circuit, secondary cooling circuits or emulsion of rolling oil circuits).

TREATMENT AND RECOVERY
Along with the cooling systems all additional units are part of the supply range of SMS Siemag. Depending on the production process are used here: filter assemblies for sludge treatment, for treatment of make-up water, boiler feed water, industrial water, waste water treatment and for media distribution.

TREATMENT OF RINSING WATER AT THYSSEN KRUPP NIROSTA
SMS Siemag’s latest innovation allows for the recovery of 75% of the wash water in the pickling of stainless steel. The arising waste water from the pickling process is cleaned via microfiltration and is returned to the rinsing process.
SMS Logistiksysteme develops modern logistics and service solutions for the steel, aluminum and non-ferrous metals industries. Its product range covers the entire spectrum of fully automated transport, storage and packaging systems for heavy loads and, furthermore, strapping machines, marking robots, inspection and sampling stations as well as high-pressure grinding machines for slabs, billets and blooms.

The demand for high-strength steel grades, e.g. API X grades for pipeline construction or ultra-high-strength grades (direct-quenched steels) is growing continuously. Taking up this challenge, SMS Logistiksysteme has developed new technology to increase its competitive edge on the market.

STORAGE SYSTEMS

An essential part of the logistics concept at the customer’s works is the handling of material between the different processing steps. When material is taken over at the exit of a process line, it is often transferred directly to the next processing station. In many cases, however, the material needs to be stored immediately before being processed further. For example, in order to rearrange the sequences by taking into consideration the different process requirements (e.g. coffin shape for the reheating furnace of the HSM, requirements regarding work roll conditions for different passes), or for improving the material conditions before the next processing step.

In terms of length, height and number of storage locations, storage systems can be designed in accordance with the customer’s individual requirements. To save valuable space in the production area, the principle of storing coils in rack systems in a so-called Automatic Storage and Retrieval System (ASRS) is widely used, especially in the aluminum industry.

PALLET CONVEYING SYSTEM

Particularly suitable for the secure and careful transport of high-strength steel grades is the pallet transport system developed by SMS Logistiksysteme, which thanks to its modular construction can be used extremely flexibly in rolling mills.

In conventional coil transport systems the coils are frequently lifted out of the actual coil rest and further transported on a relatively narrow coil saddle. As a result, if coils are not strapped, there is an increased risk that they will come off the coil rest during transport, or, if the coils are strapped, that they will be damaged.

“LOGISTICS” MEANS THE PURPOSEFUL COMBINATION OF INDIVIDUAL FUNCTIONS – TRANSPORT, STORAGE AND PACKAGING – IN ORDER TO OFFER THE CUSTOMER COMPREHENSIVE AND ECONOMIC SOLUTIONS FOR OPTIMIZING PRODUCTION PROCESSES. THE DEVELOPMENT AND USE OF NEW MATERIAL GRADES IMPOSES NEW DEMANDS NOT ONLY ON THE PRODUCTION PROCESS ITSELF BUT ALSO ON THE TRANSPORT, HANDLING, INSPECTION AND STRAPPING OF COILS WOUND FROM THESE MATERIALS.
Since, on the pallet transport system, a coil is placed on a pallet only at the beginning by means of a transfer device and does not leave this until the destination point or crane transfer station is reached, even an unstrapped coil can be securely moved. This is not only an advantage with regard to security of transport but also, of course, with regard to careful handling of the coils. Moreover, the pallet conveying system offers the customer enormous economic advantages thanks to the high savings potential in foundation work and hydraulics.

**STRAPPING MACHINE FOR HIGH-STRENGTH STEEL COILS**

Steel coils wound from pipe grades and ultra-high-strength grades display a high bending moment in the winds, causing considerable problems during transport in the rolling mill. With conventional binding straps, high-strength coils can be secured only at great expense and effort and with up to 20 strappings.

SMS Logistiksysteme has developed a completely new strapping band plus a suitable strapping machine which can quickly and safely tie coils of high-strength steels by means of a few straps and a six-spot welded seal. The time needed for the total strapping cycle is reduced by more than 70%. For the customer this implies an essentially higher production rate, more safety during coil transport and less material waste.

**INLINE SAMPLING STATION FOR HIGH-STRENGTH HOT-ROLLED STRIP**

Steel producers now can also benefit from fast and safe sampling of high-strength, thick hot strip. SMS Logistiksysteme has developed a new and efficient inline solution which permits fully automatic sampling from the coils in the transport line. With this inline approach, high efficiency of up to twelve samples per hour can be reached. All process steps take place in a cordoned-off safety area without danger to the operating staff. Samples are no longer taken by a manual torch cut as usual, but instead the strip end is threaded into a horizontal shear arranged close to the coil.
SMS SIEMAG’S X-CELLIZE® SERVICE SOLUTIONS ARE BASED ON A GLOBAL APPROACH TO SUPPORTING GLOBAL-SCALE OPERATORS OF METALLURGICAL PLANTS OVER THE ENTIRE LIFECYCLE OF THEIR PLANTS. THIS GLOBAL APPROACH IS CUSTOMIZED TO MEET EACH INDIVIDUAL REGION AND ITS TYPICAL REQUIREMENTS. AN ON-SITE SERVICE FOR EVERYDAY DEMANDS IS ESTABLISHED, WHICH NEVERTHELESS CAN OBTAIN ALL INFORMATION AND QUALITY SUPPORT FROM THE WORLDWIDE NETWORK OF THE OEM (ORIGINAL EQUIPMENT MANUFACTURER).

SMS SIEMAG SERVICE DIVISION
SMS Siemag’s objective is to be a reliable partner for its customers over the entire lifecycle of a plant. For this, SMS Siemag has collected customer requests from all over the world and implemented them in its service strategy since 2000.

Service products are:
- Erection and commissioning of new plants as well as restarts or relocations
- OEM spare part service has already exceeded the mere supply of spare parts for a long time. SMS Siemag’s spare part service also includes consultation about all subject areas regarding spare parts (manufacturing and catalogue parts, minimum and maximum stock levels, reorder limits, ideal designs for warehouses, add-on products to improve technological properties or service lives)
- Inspection, maintenance and repair
- Technical consulting and training for plant operation, maintenance, production process and technology
- Maintenance activities taken over by the OEM
- 24/7 hotline and remote services for X-Pact® plant automation.

Based on this principle, SMS Siemag has analyzed and conceptualized individual service concepts for each region.

INSTALLED BASE OF SMS SIEMAG CUSTOMERS IN INDIA
For more than 60 years, SMS Siemag has been active on the Indian market and has developed, designed, produced, assembled and successfully put into operation more than 180 plants for the Indian steel industry. SMS Siemag is a reliable partner over the entire lifecycle of such plants as well as for all other plants worldwide.

Requirements of the Indian steel industry
Indian steel manufacturers’ requirements on the service of the plant builder:
- Local spare parts supply in the accustomed OEM quality
- High-level repair services for technological core components such as copper plates in continuous casters, coiler mandrels and adjustment cylinders in rolling mills
- Experienced service engineers onsite
- Decisive contacts for all service issues (Key Account Service Managers), e.g. for access to technological exchange and assistance, local and imported spare parts, inspection and repairs, taking over of maintenance activities, inventories and studies
- 24/7 hotline and remote service for X-Pact® automation systems.

SMS has assumed these requirements and implemented them on the Indian market over the past five years.
FULFILLMENT OF MARKET REQUIREMENTS

More than 130 experts in the field of services for Indian steel manufacturers are already out and about from SMS Siemag’s locations in India. Key Account Managers have been established for close contact with all our customers. They use the global network of SMS specialists in order to respond to customer enquiries in the expected quality and promptness.

It is compulsory for employees of the SMS Siemag Service Division to take part in continuous training sessions in the areas of technology, engineering and social competence in order to maintain a high consultation quality.

In the service workshop at Bhubaneswar, SMS Siemag has already established a service for repairing and coating copper plates for continuous casters. The second expansion stage is underway. Once completed, the service workshop will also be able to produce spare parts and to repair technological core components of rolling mills, e.g. adjustment cylinders and coiler mandrels.

The service technicians for electrical and automation services can be contacted 24/7 on the service hotline.

OUTLOOK

After five years of successful establishment, the Service Division of SMS Siemag in India can handle all challenges. Nevertheless, SMS Siemag will not rest and will continue to extend its service products, in order to support its customers in India to face their day-to-day challenges.

Spare parts
- Spare parts in OEM quality
- Advancement in spare parts
- Program with storage of critical spare parts for short delivery times
- Life cycle optimizing
- Installation service

Maintenance services/repairs
- Inspection/repairs (on-site or in the workshop)
- Spindle services
- Copper plate coating for caster
- Operation of roll shops
- Chrome plating of rolls
- Zinc pot equipment repair services

Technical customer support
- Commissioning service
- Training (on-site and off-site)
- Shut-down support
- Plant audits
- Studies and consulting
- Condition Monitoring System
- SMS Integrated Maintenance Management System
- Teleservice/Hotline

Mould bearings
- Original spare parts service
- Upgrades
- Repair services
- Training and consulting

Mould copper plates
- Copper plates for COP®
- Copper plates for conventional casters
- Storage in our service locations for short delivery times

1. Service portfolio
2. The SMS Siemag global service network

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