SLAB CASTER MODERNIZATION — FOR MOST MODERN AND FLEXIBLE CASTERS [1]

Gerald Hrazdera [2]
Reinhold Leitner [2]
Oliver Schulz [2]
Peter Juza [2]

Abstract
With relatively low expenditures for upgrading compared to new installations, it is possible to dramatically improve caster productivity, flexibility and product quality. Thus the modernization of a caster is the ideal answer for steel companies that are forced to upgrade their existing casting machines to adapt to the changing market situation. Siemens VAI as one of the world's leading suppliers of continuous casting facilities has developed a modular concept of the casting machine featuring technological packages for the critical parts of the caster. With this approach, the Siemens VAI revamping expertise ranges from substitution of single components with state-of-the-art technology and automation upgrades to complete caster revamping projects on various generations of slab casters of different original suppliers. In this paper, three different slab caster modernization projects are described that show examples of the benefits derived with the installation of the latest technological solutions.
Keywords: Slab casting; Revamping; Product quality; Fexibility.

MODERNIZAÇÃO DE MÁQUINAS DE LINGOTAMENTOS DE PLACAS – PARA OS LINGOTAMENTOS MAIS MODERNOS E FLEXÍVEIS

Resumo
Com relativo baixo custo de atualização comparado a instalações novas, é possível melhorar drasticamente a produtividade do Lingotamento, sua flexibilidade e a qualidade do produto. Assim a modernização de um Lingotamento é a resposta ideal para Siderúrgicas que são forçadas a atualizar suas máquinas de lingotamento existentes adaptando-as às situações de mudança do mercado. A Siemens VAI, como um dos fornecedores líderes no mundo de instalações de lingotamento contínuo, desenvolveu um conceito modular de máquina de lingotamento onde pacotes tecnológicos representam o papel principal para as partes críticas do Lingotamento. Com esta abordagem, a habilidade da Siemens VAI em reformas estende-se de substituição de componentes individuais com tecnologia do “estado-da-arte” e atualização de automação, a projetos de completa reforma do lingotamento de placas de diversas gerações e de diferentes fornecedores originais.
Nesta apresentação, três diferentes projetos de modernização de lingotamentos de placas são descritos os quais mostram exemplos dos benefícios decorrentes da instalação das últimas soluções tecnológicas.
Palavras-chave: Lingotamento de placas; Reforma; Qualidade do produto; Flexibilidade.

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[2] *Siemens VAI Metals Technologies GmbH & Co. Turmstrasse 44, P.O. Box 4, A-4031 Linz/Austria. E-mail: casting.metals@siemens.com*

Introduction

With relatively low expenditures for upgrading compared to , it is possible to dramatically improve caster productivity, flexibility and product quality. The modernization of a caster is a perfect answer for steel companies to adapt to changing market situations.
Siemens VAI Metals Technologies (Siemens VAI) as one of the world's leading suppliers of continuous casting machines has developed a modular concept of the casting machine featuring technological packages (Figure 1) for the critical parts of the caster.

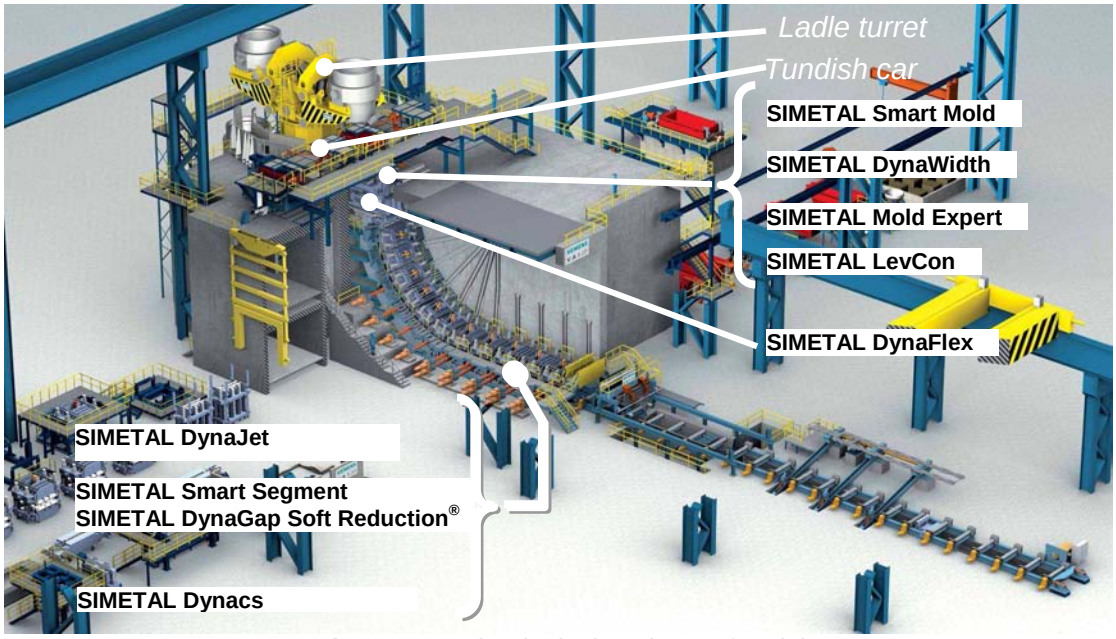

Figure 1: Technological packages for slab caster.

Siemens VAI's revamping expertise ranges from substitution of single components with state-of-the-art technology and automation upgrades to complete caster revamping projects on various generations of slab casters of different original suppliers.
Typical objectives of a revamp are an increase in production, improvement of quality, increase in flexibility and reduction of turnaround times. This can be achieved, for example, with the implementation through one or more of the following actions:

- Conversion from curved to straight mold for improved product quality at higher casting speed
- Cassette-type mold for reduced turnaround time
- Dynamic mold width adjustment for high flexibility in production
- Hydraulic mold oscillation for improved surface quality and caster reliability
- Segmented strand guidance for short maintenance outages
- Optimized roller geometry for improved internal quality
- Extension of metallurgical length for increased productivity
- Upgrade of cooling system for increased productivity and improved quality
- Dynamic soft reduction for highest product quality

In this paper, three different slab caster modernization projects implemented by Siemens VAI are described that show examples of the benefits derived with the installation of the latest technological solutions.

Usiminas Cubatão

Modernization to a high-productivity caster

The Brazilian steel producer Usiminas, is the largest flat-steel production facility in Latin America. The company produces a wide range of uncoated flat-steel products, including slabs, hot- and cold-rolled sheets and coils and also heavy plates for a wide variety of industrial applications. With the objective of improving caster performance, operational flexibility and personnel safety, the company had assigned Siemens VAI in November 2005 to dismantle and replace Slab Caster No. 3 of its Cubatão Works, which was originally built by Concast in 1989.

Through the replacement of the one-strand slab caster Usiminas Cubatão is now able to cast both high-quality carbon and low-alloyed steel grades in thicknesses between 210 and 260 millimeters and in widths ranging from 1,000 to 1,900 millimeters.

Highlights

This caster, which is capable of producing approximately 1.2 million tons of high-quality slabs per year, is equipped with the SIMETAL LiquiRob robot system as well as with thickness-on-demand capability. The replacement of the slab caster took place simultaneously with ongoing operations of two adjacent slab casters.

SIMETAL LiquiRob

For the first time in a South American steel mill, a SIMETAL LiquiRob robot (Figure 2) has been installed on the casting platform to automatically perform steel sampling and temperature measurements in the tundish. The automation of these activities during caster operation reduces the presence of persons in the dangerous liquid steel area and thus is an important step towards considerably improving operator safety. Furthermore, SIMETAL LiquiRob ensures reliability, repeatability and the monitoring of operations which have a direct influence on product quality.

Figure 2: SIMETAL LiquiRob during tundish sampling.

Thickness on demand

Furthermore, the caster was equipped with "thickness-on-demand" (Figure 3) capability to allow fast changes in slab thickness through quick inline narrow face exchange and remote adjustment of the roll gap in a very short time during restranding without a loss in production. This is made possible by the combination of the technological packages SIMETAL Smart Mold, SIMETAL Smart Bender and SIMETAL Smart Segment. Consequently, Usiminas Cubatão now is able to react more quickly to new orders, which is a valuable advantage. This new Siemens VAI solution, “thickness on demand”, also allows the internal customer “plate mill” to optimize its pass schedule just in time through the selection of optimum casting thickness in order to reduce energy consumption and increase output, e.g., through fewer passes.[1]

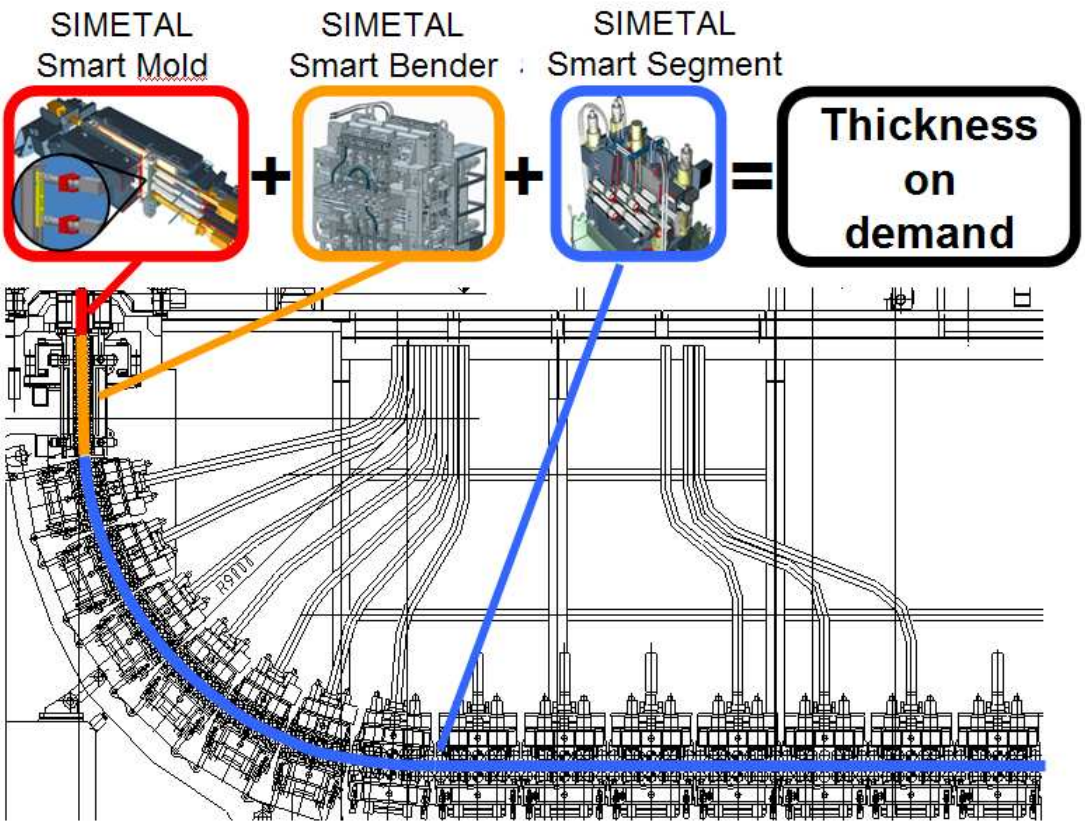

Figure 3: Thickness-on-demand technology.

But not only thickness on demand is made possible through the use of SIMETAL Smart Mold, SIMETAL Smart Bender and SIMETAL Segments. By combining SIMETAL Smart Mold and SIMETAL DynaWidth, the narrow sides can be laterally shifted to change the strand width during casting. Furthermore, improved internal strand homogeneity for the production of highest quality slabs is made possible with SIMETAL DynaGap Soft Reduction® technology in combination with SIMETAL Smart Segments. This is achieved by precisely adjusting the roller taper in the area of final strand solidification according to the SIMETAL Dynacs calculated set points.

Benefits

- Highest operator safety
- Implementation of latest technology for highest flexibility in operation
- Maximum system and plant availability at low maintenance costs
- Assurance of optimized solutions for unique and specialized requirements
- Excellent and professional project management dedicated during the project life

Acroni d.o.o.

Major Caster Modernization Completed within 38 Days

The Slovenian steel producer Acroni d.o.o. specializes in the supply of structural and special steel grades mainly for niche markets. In 2007, Acroni decided to modernize its 20-year-old slab caster within the shortest possible caster downtime, which was originally built by Demag. With the modernized continuous casting machine, higher product quality, higher capacity and wider slab widths had to be obtained. Maximum

flexibility with respect to adjustment of all operational parameters, including the casting thickness, was one of the major design criteria.
Siemens VAI was selected as the partner for this project on the basis of its extensive experience in the upgrading of continuous casting machines. The responsibilities for this project included the design, manufacture, delivery, supervision of installation, start-up and commissioning of the caster, as well as personnel training. The project scope also involved civil and assembly work, integration of new and existing equipment, and the improvement of the caster workshop area with new maintenance stands.
Through modernization the slab caster of Acroni is now capable of casting approximately 515,000 tons of steel per year comprising medium- to high-carbon, peritectic, structural, micro-alloyed, stainless steel (series 300 and 400) and Si grades. Slabs can be cast at thicknesses of 200 and 250 millimeters and in hot widths from 800 to 2,120 millimeters.

Highlights
During this project, the machine head and strand-guiding system were replaced and outfitted with the latest technological packages, systems and equipment to enable wider slabs to be cast with a significant improvement in quality. The entire work was finished within 38 days.

Machine Head
In the project, the previous curved mold was replaced with a curved SIMETAL Smart Mold which, in combination with SIMETAL DynaWidth technology, allows the mold narrow sides to be hydraulically shifted for the flexible casting of strands of different widths. Furthermore, SIMETAL DynaFlex hydraulic oscillation enables not only the frequency but also the stroke to be changed during casting. In addition, the waveform is no longer limited to sinusoidal patterns as it is for the electro-mechanical oscillators, which is a major positive influence factor for the slab surface quality. [2]

Strand Guide System
The strand guide system consists of 9 SIMETAL Smart Segments (Figure 4), which are installed in the bow, straightening and horizontal zones of the caster. The unique design allows the roller-gap settings to be remotely adjusted for fast changes in slab-thickness. The combination of SIMETAL Smart Segments with SIMETAL DynaGap Soft Reduction® not only allows the correct soft reduction range to be adjusted during all casting conditions but also provides the possibility of quickly changing the casting thickness by remote control. This precise calculation of the solidification process is of utmost importance to achieve best results. Together with the top-feeding dummy bar system minimum downtimes of the caster are guaranteed. Even in the case of thickness changes the limiting factor for the restart of the caster is the exchange time for the mold and vertical crack.

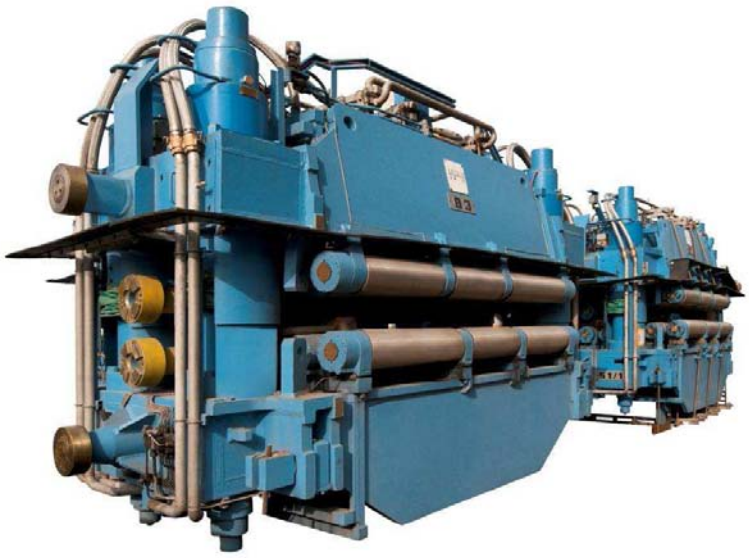

Figure 4: SIMETAL Smart Segment.

Secondary Cooling

With the fully automatic and dynamic Level 2 SIMETAL Dynacs secondary-cooling model, the strand-temperature profile and the required secondary cooling water quantities can be calculated at any position along the strand as the basis for defining the optimum secondary-cooling setpoints and final point of strand solidification.
Besides, part of the project has been the supply and installation of electrics, Level 1 and Level 2 automation systems in addition to the media, hydraulic and lubrication systems.

Benefits

- Increase of production capacity by 15%
- Slab width increased by 32%
- Higher flexibility and increased product quality due to technological packages
- Fast plant start-up ramp thanks to "connect and cast" solutions
- Flexible, cost-efficient casting of a wide range of products
- Fast project completion and operational availability

Bluscope Steel Limited

Kyeema Caster Automation Project—"A New Dawn"

BlueScope Steel Ltd., Wollongong, Australia, is an international flat steel solutions company, with a manufacturing and marketing footprint spanning Australia, New Zealand, Asia and North America. The company is the global leader in the provision of high-quality metallic-coated and painted steel products for the building and construction sector, and also in the general manufacturing, mining and automotive sectors. In May 2005 BlueScope Ltd. steel awarded Siemens VAI a contract for the caster system replacement project, known as the Kyeema project. It is integrated with existing upstream (e.g., BOS—Basic Oxygen Steelmaking, production scheduling) and downstream (e.g., slab yard operation control) systems. In May 2007 Siemens VAI additionally received the order to install the SIMETAL LevCon package on the

three slab-casting machines after the package proved successful on a test installation on site.
The project comprised 3 slab caster automation systems, one two-strand caster and two one-strand twin casters. The prime objectives of the Kyeema project were to reduce operational risk caused by the legacy system and increase production efficiencies.

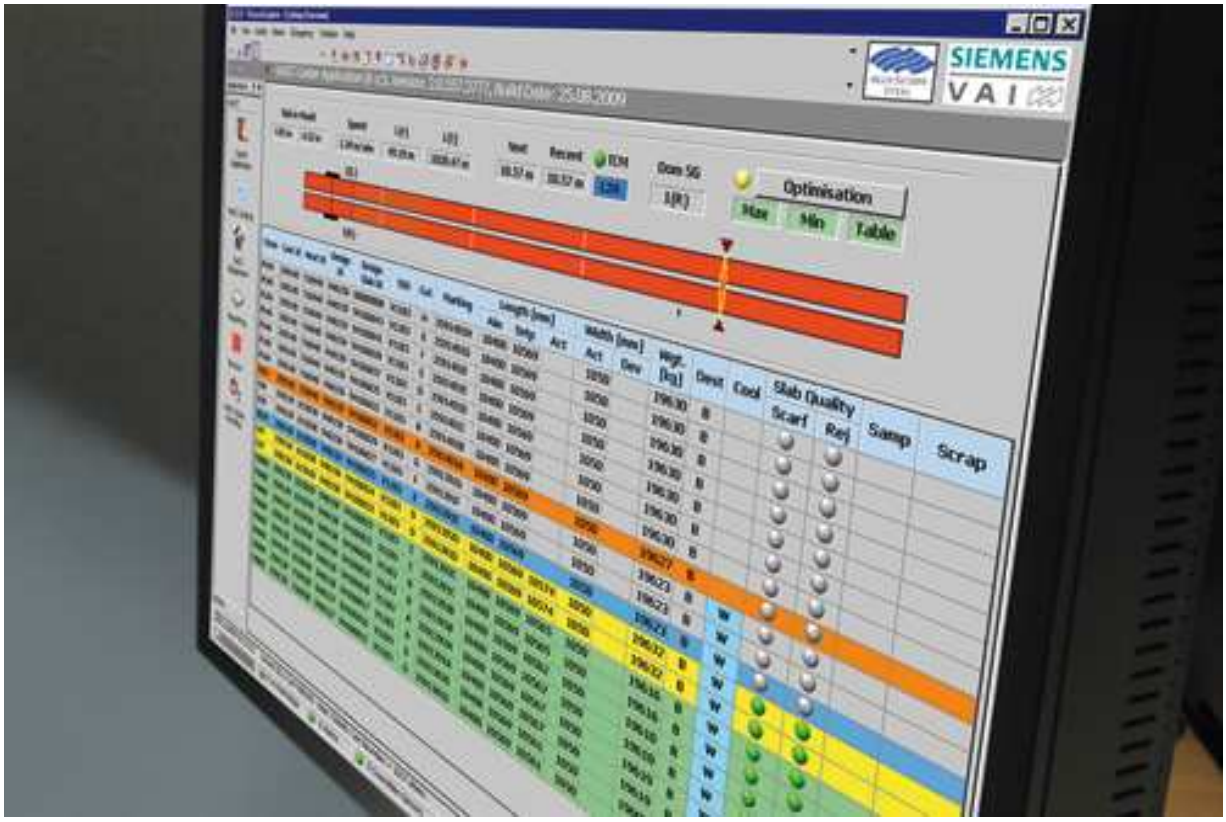

Figure 5: Yield Expert—Cutting overview screen of BlueScope twin caster CC3.

Highlights

These objectives were achieved through completely replacing the existing caster system running on a VAX with a modern standard solution providing the same functions plus additional capabilities to handle increased volumes of data, quality measurements and increasing customer quality requirements.

SIMETAL VAIQ quality control system

BlueScope Steel applies numerous and advanced business rules to control the quality of the produced slabs. This set of business rules was implemented on the basis of the SIMETAL VAIQ software components. The SIMETAL VAIQ system determines the production practice per heat, tracks process parameters and events influencing the resulting quality and decides about pass or fail of a slab compared to its quality requirements. The requirements were downloaded from a central repository (specification management system) and the actual results were compared to these specifications.

Plant status

An on-line visual representation of what process is currently being performed to a heat, including the current status and estimated completion time. This assists in pacing the plant when upstream or downstream delays are experienced. The plant

status overview displays dynamic icons and heat information data for each processing station involved in the steel making process.

Intermix Calculation

The Intermix Calculation cyclically determines the volume concentration of the heat mixture in the tundish and in the strand(s) and tracks it along the strand(s) together with the related heat numbers. The Intermix Model considers whether the tundish was changed or whether a separator plate was inserted.

The Chemistry Determination module calculates the chemical analysis along the intermix area of the strand(s). For that purpose, it needs the relevant chemical analysis of the two mixing heats as an input and uses the volume concentration of the mixing heats as determined by the Intermix Model.

Tundish Tracking

The tundish tracking system is an equipment maintenance application responsible for tracking tundish components (zones, cassettes, etc.) and usage (cycles). Its main function is to keep track of the events applied to a tundish before, during, and after the casting process, and then determine when tundishes and components are due for preventative maintenance. Algorithms are included which support time-based business rules that predict the cooling time for a tundish before work can commence.

SIMETAL LevCon

The SIMETAL LevCon package combines state-of-the-art mold level control with additional features that reduce clogging effects, SEN wear and mold level fluctuations that stem from bulging effects.

Benefits

- From a self-made solution to a standardized automation solution, which may be easily extended or upgraded
- Same Level 2 software is running on the 3 different casters, which leads to dramatically reduced maintenance costs
- Comprehensive operator guidance, alarming and process information
- Minimum production downtime for automation upgrade (2–5 days per caster)
- Full automation functionality provided from the first heat onwards
- Service contract and remote support for additional changes after start-up

Conclusion

Siemens VAI recognized the increasing market potential for revamping projects and as a consequence redesigned the principal structure of a casting machine. With the design of technological packages for the individual areas of the machine, it has become possible to develop tailor-made revamping concepts for each client. In addition, exact planning of the revamps ensures shortest outages of the machines and fast ramp-ups after the upgrades. Siemens VAI has proved its competence in this business in numerous projects worldwide for all types of slab casters, which has been acknowledged by our satisfied customers.

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