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SIEMENS VAI'S WINLINK® TECHNOLOGY[1]

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Abstract
WinLink® is the name of the innovative technology from Siemens Metals Technologies for the endless production of long products from liquid steel. Through the direct linking of a high speed/high productivity billet caster with a rolling mill in a highly compact production line, producers benefit from low investment expenditures, reduced transformation costs, significant energy savings, reduced CO_2 emissions and the highly profitable production of long products. WinLink® combines proven high-tech solutions with the experience acquired from more than two years of industrial operation of the Arvedi ESP (endless strip production) plant. Compared to similar solutions, WinLink® additionally offers the possibility of using a full-size meltshop and balancing the production among rolled product and saleable billets. WinLink is a registered trademark of Siemens VAI Metals Technologies GmbH.
Key words: Direct rolling; Direct casting; Energy saving; Compact mill.

TECNOLOGIA WINLINK® DA SIEMENS VAI

Resumo
WinLink® é o nome da tecnologia inovadora da Siemens Metals Technologies para a produção contínua de produtos longos a partir do aço líquido. Através da conexão direta de uma máquina de Lingotamento Contínuo de *billets* de alta velocidade/alta produtividade com um Laminador em uma linha de produção altamente compacta, as Siderúrgicas são beneficiadas com baixas despesas de investimento, custos reduzidos de transformação, significativa economia de energia, emissões reduzidas de CO2 e a produção altamente rentável de produtos longos. O *WinLink*® combina comprovadas soluções de alta tecnologia com a experiência adquirida em mais de dois anos de operação industrial da planta ESP (produção continua de tiras) da Arvedi. Em comparação com soluções similares, o *WinLink*® também oferece a possibilidade de usar uma aciaria completa equilibrando a produção de produtos laminados e tarugos comercializáveis.
Palavras-chave: Laminação direta; Lingotamento direto; Economia de energia; Laminação compacta.

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1 CONVENTIONAL MINIMILL SCENARIO

The recent economic crisis has led steel producers to reconsider the advantages of the original minimill plant concept introduced to the market around 40 years ago. This plant type is characterized by small steelmaking capacities in the range of 300,000 t/a to 600,000 t/a; the use of locally available scrap to produce steel that is sold on the regional market (reduced transportation costs); a low impact on the electrical energy grid; a high degree of flexibility to adjust production rates to market requirements; and comparably low investment expenditures.
Despite these advantages, the relatively long payback period has been the main obstacle for a much broader application of minimills for the production of long products. This is a consequence of the small profit margin and economy of scale inherent in low-output mills producing standard carbon-steel grades primarily for use in the construction industry and for infrastructure applications.

2 A NEW MINIMILL CONCEPT

WinLink technology addresses these drawbacks by combinings the advantages of small plant sizes with a fast payback period. Its concept is based on a billet caster directly linked to the rolling mill, whereby liquid steel is processed to rebars or other long products in a continuous, endless production line.

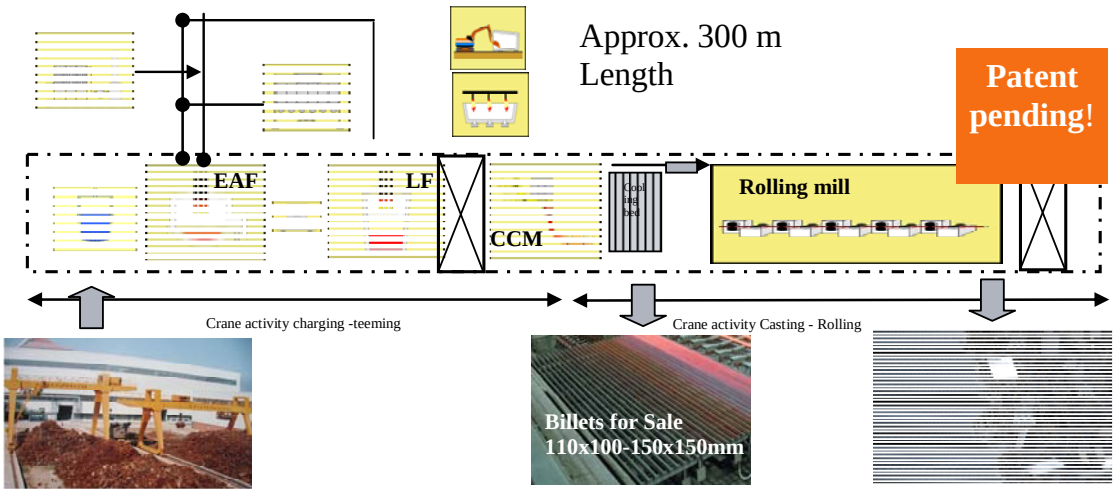

Figure 1. General flow sheet of a WinLink-based minimill.

To ensure optimum utilization of the respective EAF (electric arc furnace), continuous casting and rolling facilities, the WinLink solution foresees a high-speed billet caster equipped with at least two casting strands (Figure 1). The additional billet strands support a full production capacity of the steel shop, ensure that the mill is reliably supplied with steel to be rolled to the required product mix, and additionally allows billet semis to be separately cast for external sales. This solution approach maximizes plant productivity and throughput while providing a high degree of flexibility to generate rolled products – in addition to rebars, small flats and profiles – or billet semis as required by the market. A WinLink-based minimill is capable of producing between 400,000 t/a and

500,000 t/a of billets of which 300,000 t/a–400,000 t/a is directly rolled to rebars and 100,000 t of billets would be available for external sales. Siemens VAI offers different plant configurations and process options to enable a broad range of strand sizes and shapes to be cast, including rectangular and round formats. Producers thus have considerable flexibility to produce a wider range of product dimensions to also meet demands for small order lots. The main features of the individual plants installed in a WinLink-based minimill are outlined in the following.

3 EAF AND LADLE FURNACE

The EAF is designed for performance, and includes the latest Siemens' electric solutions to maximize furnace output and productivity.
The basic data are a 35 Ton tapping weight with 45 MVA transformer.
For example, the single-point roof-lifting system supports fast and efficient roof movements during scrap charging. The high sidewalls of the furnace shell allow single-bucket charging and thus reduced scrap-charging times. The application of RCB (Refining Combined Burner) technology fulfills numerous functions such as scrap preheating with a powerful burner at the start of the melting process; postcombustion to promote exothermic reactions and thus accelerated melting; and supersonic oxygen lancing for steel-refining purposes. These and other features contribute to a high degree of efficiency, low consumption figures and short tap-to-tap times down to nearly 30 minutes. An EAF furnace installed in a WinLink-based minimill would have a tapping weight in the range of 35 tons–50 tons. Adjustment of the required liquid-steel temperature for continuous casting and minor alloy additions then take place in the ladle furnace.

4 HIGH-SPEED BILLET CASTER

High-speed billet casters in WinLink concepts require modern equipment packages and systems, and foresee casting speeds in the range of up to more than 7 m/min with 9 meters machine radius. Special design features include the installation of an implemented version of DynaFlex hydraulic oscillation. Casting speeds in the range of the ones required for a direct rolling application were already obtained with such an oscillation unit in billet casters.
Such an already well proven technology, based on leaf spring guidance of oscillation, for a maintenance free system and avoiding presence of any deviation in the movements, is suitable for the optimum adjustment of the oscillation parameters over a wide range of casting speeds and gives complete freedom for on line adjustment of stroke and frequency eventually required.
Additional features include a new enhanced generation of the patented DiaMold mold tubes, designed for accelerated strand-heat removal at high casting speed without detrimental effects for product quality and ensuring correct shape and dimensions of the as cast product, therefore avoiding any risk for the rolling process, and a fully optimized strand-guiding system for optimum strand containment and guidance at high speed.
Furthermore, a well-proven secondary cooling system, specially designed for high speed application is installed, to promote an ideal and uniform strand-shell growth, while

avoiding reheating problems and excessive temperature loss, which minimizes the need for subsequent temperature equalization of the strand prior to rolling.
Suitable design of straightening unit avoids risk of excessive strain of the product at high casting speed.
High-level automation systems are also applied to monitor and perform the entire production process, ensuring that the required quality demands are met, and also reducing the human presence requirements. Steel grades and products are carefully tracked throughout the process up to final product dispatch.

5 INDUCTION FURNACE

A high-efficiency induction furnace is installed between the billet caster and rolling mill to equalize the temperature of a billet strand section. The capability is design to increase about 200°C the average temperature of the billet with a 4,000 KW installed power. This setup represents the best technical solution to rapidly achieve the required rolling temperature. The induction furnace replaces the conventional gas-fired reheating furnace, thereby reducing CO_2 emissions and the environmental impact.

6 ROLLING MILL

Long-rolling mills for the production of rebars must be equipped with state-of-the-art components, in order to guarantee the availability required by the endless rolling process.
The mill is using 18 stands with roll diameters from 600 mm in the roughing area and 360 mm in the finishing area.
Very rigid rolling stands (housingless double supported stands), precise guiding components, stand presetting equipment, efficient bar quenching systems, inline gap control are necessary to obtain long rolling campaigns, as required by the endless process.

7 ELECTRICS AND AUTOMATION

The comprehensive, worldwide experience of Siemens in the engineering and supply of electrical and automation systems, as documented by thousands of industrial plant references worldwide, is without parallel in the industry. Automation and process-control systems from Siemens are the customer's guarantee for smooth plant operations, reliable process control, exact temperature regulation throughout the WinLink production line – all which contributes to maximum plant productivity.

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Table 1. Typical plant parameters in a WinLink-based minimill

Ultimate EAF		Ladle furnace		Billet caster		Rolling mill	
Transformer	45 MVA	Transformer	8 MVA	Billet Format	e.g., 130 mm^2 or 150 mm^2	Product (rebar)	2x8 mm (min.) 40 mm (max.)
Tapping weight	35 t	Heating rate	4°/min	Casting speed	5.7 m/min–7.5 m/min	Finishing speed	1.3 m/s–16 m/s
Treatment time	36 min	Treatment time	25 min–36 min	Machine radius	9 m	No. of stands	18

8 MAIN BENEFITS AT A GLANCE

In comparison with conventional minimill plant configurations, WinLink offers a number of decisive advantages for producers (Figure 2):

- lower capital expenditures (Capex) for main equipment;
- lower operational expenditures (Opex) up to $ 40/t of rolled steel ;
- low inventory and working-capital requirements;
- reduced manpower requirements;
- reduced civil works and infrastructure costs;
- reduced energy consumption and related costs;
- 24-hour continuous mill operation;
- higher product yield due to long uninterrupted casting and rolling sequences;
- low CO_2 emissions (no billet reheating furnace) and fluid consumption;
- smaller minimill footprint in terms of space requirements;
- production of finished rolled products from scrap in less than 2 hours.

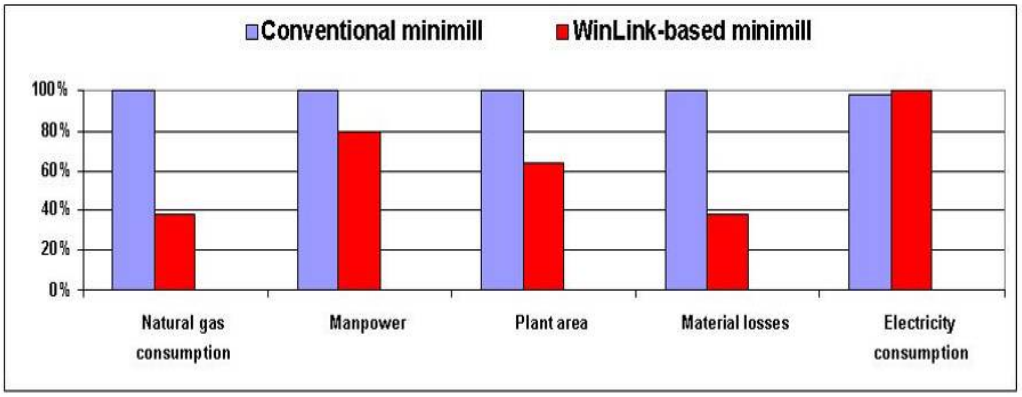

Figure 2. Comparison of key factors between a conventional minimill and a WinLink-based minimill

The WinLink-based minimill also builds on the experience acquired from the Arvedi ESP process for the endless production of flat products. Furthermore future connections with high efficiency production systems in EAF field, such as Quantum® is also under development.