CONTINUOUS STECKEL MILL ENHANCEMENT AT ACESITA[1]

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Abstract

ACESITA, located at Timóteo, Minas Gerais, Brazil, is South America's only producer of stainless-steel flat products. Approximately 820,000 t/a of austenitic stainless, silicon and carbon steel grades are rolled on their Steckel mill, which was originally built by VAI (DAVY) in 1976, and started up in 1979. Since that time, ACESITA has contracted three consecutive modernization steps with VAI in 1995, 1997 and 2001, comprising of improvements of e.g. the HAGC-system, the automation system and new Steckel coiler furnaces. This paper outlines the successful cooperation between ACESITA and VAI, which serves as an outstanding example of a life-cycle partnership with mutual benefits for both parties, and with a promising outlook in technological evolution for the future.

Key words: Steckel mill stainless rolling; Modernization; Life-cycle partnership.

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INTRODUCTION

VAI (Voest Alpine Industrieanlagenbau) is continuously improving technological aspects of hot strip mills and has been the successor of this mill at ACESITA after VAI has acquired DAVY / KME. ACESITA, located at Timóteo, Minas Gerais, Brazil, is South America's only producer of stainless-steel flat products. Approximately 820,000 t/a of austenitic stainless, silicon and carbon steel grades are rolled on their Steckel mill, which was originally built by VAI (DAVY) in 1976, and started up in 1979. Since that time, ACESITA has contracted three consecutive modernization steps with VAI in 1995, 1997 and 2001, comprising improvements of e.g. the HAGC-system, the automation system and new Steckel coiler furnaces.

This paper outlines the successful cooperation between ACESITA and VAI, which serves as an example of a life-cycle partnership with mutual benefits for both parties, and with a promising outlook regarding technology evolution for the future.

ACESITA - COMPANY PROFILE

Acesita S. A. is a company of the Arcelor group, one of the world's largest steel producers. Acesita is a public listed company and is the only integrated producer of flat stainless and silicon steel in Latin America with an annual capacity of approx. 820,000 tons per year. The products are mainly austenitic stainless steel grades AISI 304, 316, and ferritic and martensitic grades as 409, 420 and 430, but there are also grain-oriented and non-grain-oriented silicon grades, as well as low, medium and high carbon steel grades.

Acesita is a leader in its Brazilian markets, with a 90 % market share, as well as a global player, exporting to 52 countries.

Acesita's plant in Timóteo, Minas Gerais, is totally integrated, from the pig iron production to cold rolled stainless steel coils, its investments focus on higher value–added steel products. Acesita and VAI have co-operated since the 1960s with several installations along the entire production route. In recent years VAI installed a new annealing and pickling line with in-line skin pass mill, a new AOD converter, modernised the blast furnace and the combination caster. In the hot rolling mill area VAI undertook 3 modernization steps of the Steckel mill to increase the production capacity and productivity as to improve the quality of the hot rolled strip.

VAI STECKEL MILL TECHNOLOGY

With many years of experience since the early developments of the Steckel Mill Process, VAI has been involved in ongoing technological development of Steckel mill mechanical equipment, automations systems and the rolling process itself. Examples for these activities are the VAI Steckel Mill design and specific process models for the Steckel Mill process. New layout solutions such as the Single Stand Steckel Mill or the addition of finishing stands behind the second coiler furnace complete the improvements in this field.[(1)]

Steckel Mill technology fits perfectly to the design capacity of the integrated steel plant at Acesita. The typical production capacity of a Steckel Mill with a rougher is in the range of 500,000 – 1 million tpa. The variety of steel grades in Acesita's product mix requires a mill with high flexibility, which is met by the Steckel Mill technology.

STECKEL MILL INSTALLATION AND MODERNIZATION STEPS

The Acesita Steckel Mill was originally built by VAI (DAVY) in the late 1970s (see below Figure 1) . Over recent years an extensive modernisation program has been carried out to improve mill availability, strip quality and to increase the maximum coil weight that can be produced. The mill layout features 3 reheating furnaces, a reversing rougher and a Steckel Mill stand. Currently strips of 1.9 – 14.0 mm thickness and 900 – 1550 mm width are produced. shows the current layout and indicates the scope of the 3 modernisation steps.

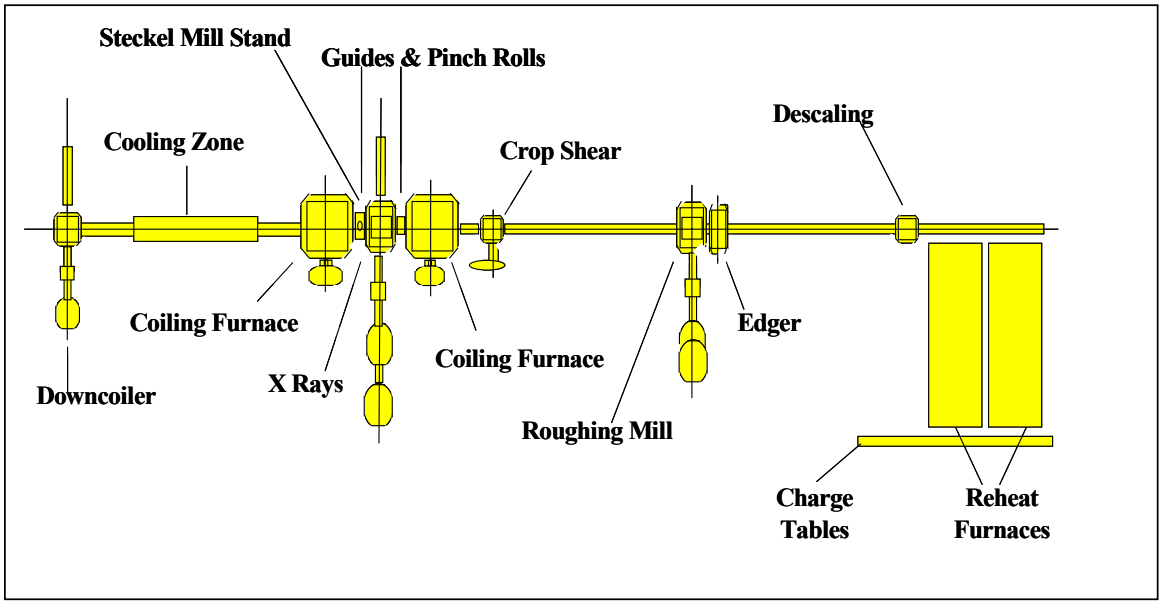


Figure 1. Steckel Mill in original condition in 1979.

1995 Modernization Project

This project focused on the improvement of the strip thickness performance of the mill by an upgrade of the hydraulic AGC cylinder and the gauge control system. The original Steckel Mill design incorporated hydraulic AGC cylinders at the top of the mill window. This system has been upgraded on a number of occasions and in 1995 the original analogue AGC system was replaced by a new digital AGC system, with implementation of digital position transducers, over stroke protection and a transducer actuation ring. The implemented digital HAGC control system included digital position and load control, gauge error feed forward and back up roll eccentricity compensation.

With this HAGC system Acesita reaches thickness performance figures of typical 50 - 65 µm for the produced thickness range of 1.9 to 12.7 mm.

At this stage a table-based scheduling system was installed, which was replaced by a fully adaptive model in one of the later modernization projects. Additionally an automatic mill zeroing function, an automatic mill stretch function and new operator control desks and displays were implemented.

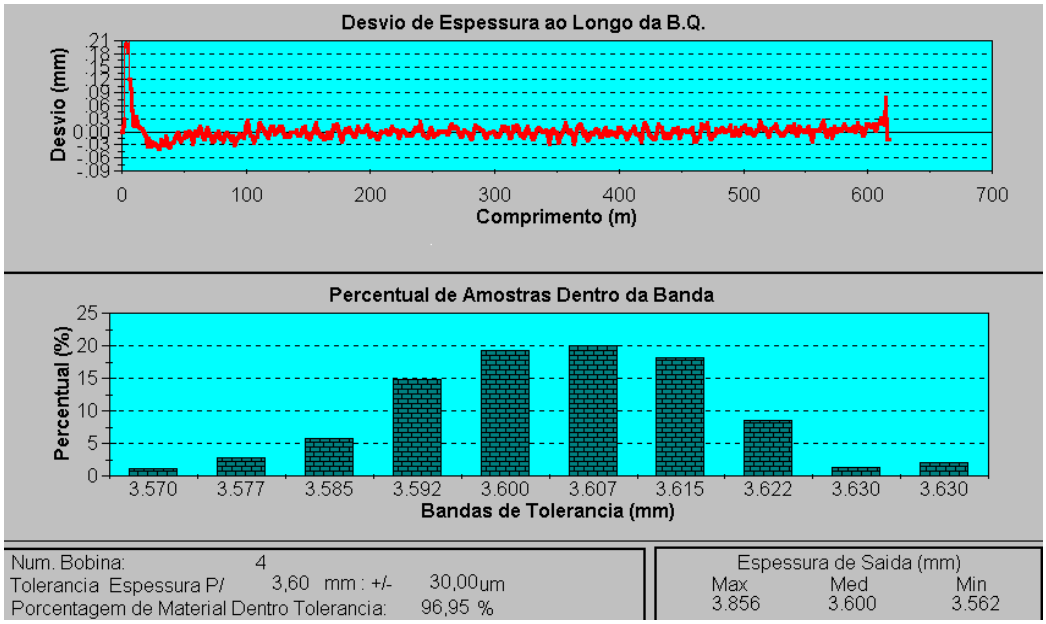


Figure 2. Gauge Performance at ACESITA Steckel Mill applying the Adaptive Set up Model

1997 Modernization Project

At this stage modifications and improvements along the entire rolling mill were carried out. The reversing roughing mill and edging mill stands remained basically as per the original design, both retaining electro-mechanical screwdowns. Modifications in the roughing mill area were an improvement of the descaling headers in both the primary descaler and the roughing mill stand for improved surface conditions and new hydraulic entry and exit guides. The new guides lead to a reduction in maintenance and were specified for the increased slab weight, improved slab guiding and reducing of the camber of the transfer bar.

The crop shear cutting accuracy was updated by the addition of a crop optimisation system to increase the yield by 0.5%.

The Steckel Mill stand received several major upgrades. A new work roll cooling system was installed for improved thermal control of the roll to help profile control. Positive work roll bending was installed for automatic shape and profile control with bending forces of 1400 kN per side. A fume extraction system, required for rolling of silicon and stainless grades was installed. The introduction of new hydraulic entry guides improved reversal times, reduced maintenance and improved strip guidance. At this time also the Steckel mill pinch rolls were changed from pneumatically to hydraulically actuated cylinders.

The downcoiler was upgraded partly to improve coil quality and partly for the future increase of coil weight from 17 tonnes to 25 tonnes. New hydraulic entry guides were installed for improved response and strip guidance and an outboard bearing to reduce mandrel bending. The new fully hydraulic pinch roll unit allows for improved response and strip tension control leading to a better coil build up. The pneumatic wrapper roll actuators were replaced by hydraulic ones allowing for step control which reduces head end impact, strip surface damage and improves mandrel life. For improving the coiling tension the mandrel torque had to be increased and a new gearbox was installed. Additionally an automatic mandrel and outboard bearing lubrication system was installed.

The automation system was also significantly upgraded. The Level 1 system was completely replaced and a Level 2 system supplied. The level 2 system provided automatic, adaptive set-up of both the roughing mill and the Steckel Mill, in conjunction with material tracking from the reheat furnace to the downcoiler and coil handling equipment.

2001 Modernization – "Heavy Coil Project"

The increase of coil weight to 25 tons required an increase to the slab weight and also the slab length. In order to maintain throughput an additional reheat furnace has been installed (supplied by Stein-Heurtey) with a throughput of 150t/h for stainless steel grades. VAI supplied the new furnace charging and discharging equipment and the new entry roller tables to incorporate the RHF into the mill line. The existing exit reheat furnace tables were modified and the primary descaling box was relocated due to the interference with the new reheating furnace.

The modifications to the Steckel mill area were carried out to enable the increased coil weight to be rolled. New VAI designed coiler furnaces were installed (Figure 3.), which also improve fuel efficiency and reduce temperature losses due to their unique closed bottom design. The fuel consumption in the coiler furnaces was reduced by 50%.

Figure 3. Steckel Mill with New Coiler Furnaces.

The automation system was improved by a general modernization of the existing systems. New Level 2 hardware, new operator stations and a state of the art Level 1 / Level 2 HMI concept was installed. The process automation software, e.g. mill rolling set-up model and interfaces were adapted and transferred to the new hardware, extensions caused by the modifications in the mill and furnace area were performed. An automatic and optimized operation of the combustion system for the new Steckel Mill coiler furnaces was realized with a new control system.

Before the shutdown the new automation system including the interfaces to the existing systems was tested on site in detail to avoid 'surprises' after a minimum shutdown period. At this stage of the modernisation VAI supplied new and modified fluid control systems, and the associated civil and erection works for the above described installations.
The project was carried out with a very challenging time schedule.
Figure 4 shows all the revamp steps from 1979 to the "heavy coil project" executed in 2001.

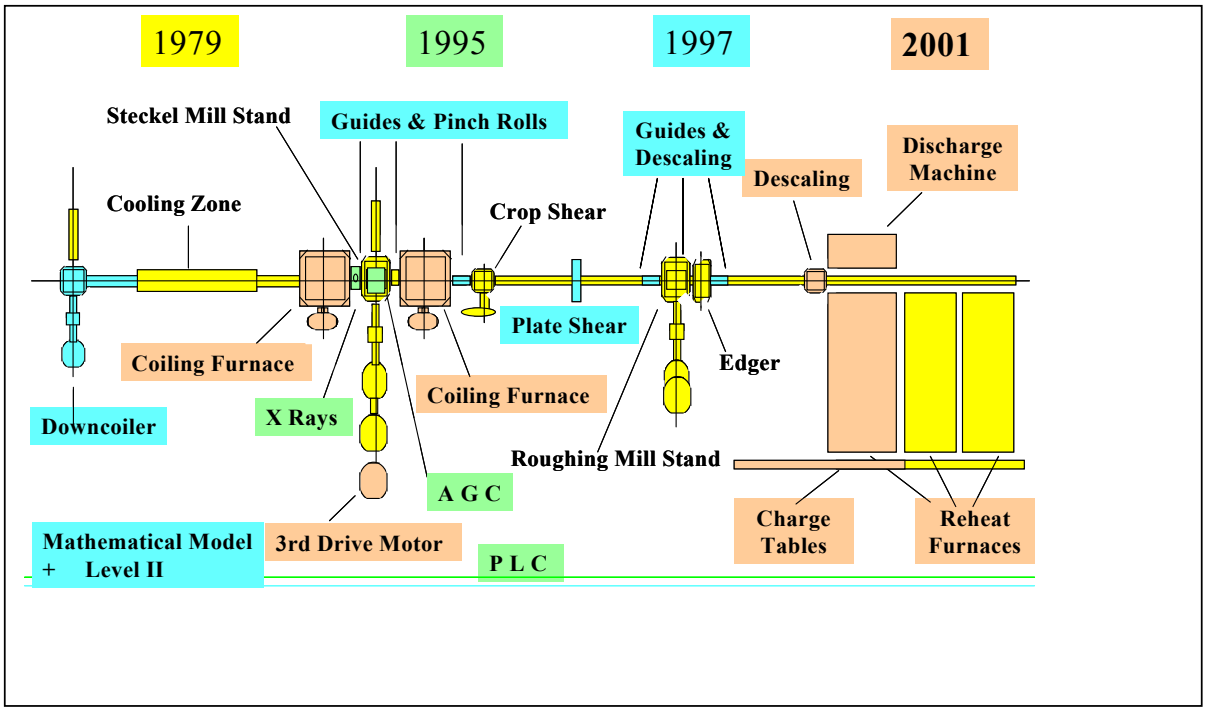
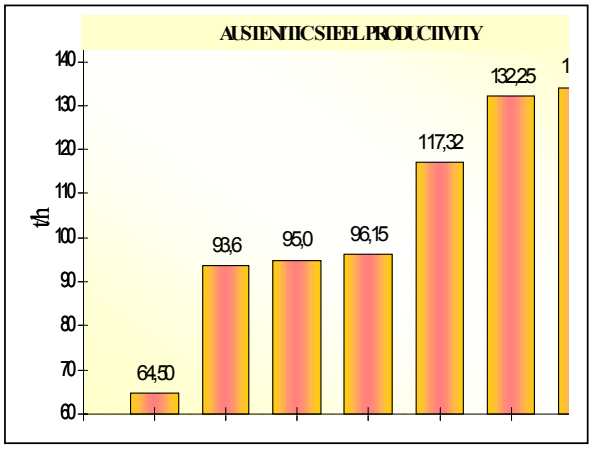


Figure 4. Investment steps from 1979 to 2001.

The mill has improved significantly in all the years of operation, where always focus was given to productivity and quality. Figure 5 and 6 show the evolution of the main parameter of this mill.[2]

PARAMETER	1979	2002
Production (tons/year)	440.000	850.000
Basic products - 304 (mm)	1250 x 3,0	1250 x 2,5
Coil Weight (tons)	13	25
Productivity (tons/hour)	65	128

Figure 5. Results obtained in Production and Productivity



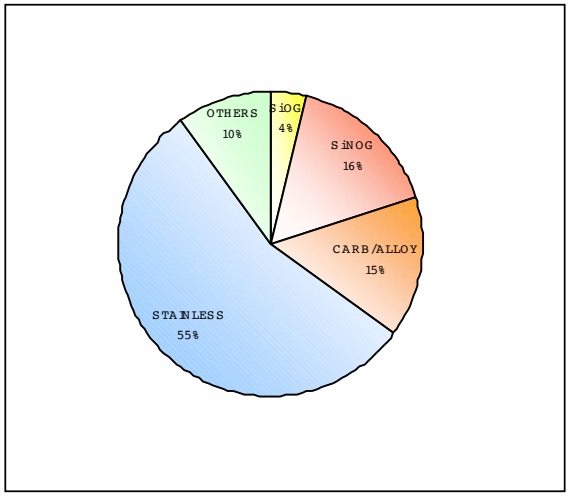


Figure 6. Productivity of Stainless Steel

Sales Distribution of Acesita

As the main product of Acesita is stainless steel it has always been the goal to concentrate on this product. In the chart above (Figure 6) can be seen that the productivity has increased from 64.5 to 134 t/h – in other words it has doubled.

CONCLUSION

In accordance with VAI's business principle of being a "Life Cycle Partner" for its customers, the Steckel Mill has been continuously upgraded since the original installation in 1979.
To date Acesita has contracted three consecutive modernisation steps with VAI:
In 1995 the HAGC system was upgraded with digital position and load control, new control functions including gauge error feedback, eccentricity compensation, automatic mill stretch and mill zeroing.
In 1997 the descaling systems were upgraded, new side guides and hydraulic pinch roll units for the Steckel mill and the downcoiler were installed. The mill stand was enhanced with work roll bending. The automation of the mill was improved by the installation of new Level 1 and 2 systems including step control for the downcoiler and mill set-up models.
The 2001 modernization stage included new charging and discharging equipment for the new reheat furnace, two completely new Steckel mill coiler furnaces and a new mill drive system with the addition of a third motor.
Besides reduced fuel consumption and temperature control through new Steckel Coiler furnaces the latest modernisation step raised the mill capacity above 800,000 tons per year and the coil weight up to 25 tons. Acesita's monthly production is about 67,000 tonnes with the record production of 70,000 tonnes. The production consists of 53% Stainless steels 25 % Silicon grades and 22 % Carbon Steel grades

OUTLOOK

These three successfully accomplished mill upgrading steps are not the end of the continuous co-operation between Acesita and VAI. Further potentials for improvements are investigated continuously with the potential next steps being X-ray gauge at Steckel mill entry, surface defect inspection system, passive deflector rolls, work roll lubrication, work roll shifting with SmartCrown and a strip profile control system. Further improvements could be reached with the installation of a hydraulic AGC system on the roughing mill, a renewal of the crop shear, and improvement of down coiler area and coil transportation.

The continuous improvements at Acesita may result in new arrangements of further stands, where some investigations are already made to finally achieve a production of more that 1.5 million tpa.
In this case, new finishing stand would have to be installed according to the layout shown in case nr.4 of Figure 7.

Steckel Mill Layouts

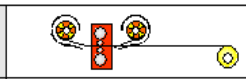
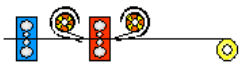
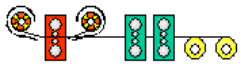
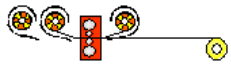
		Typical Capacity	Typical Strip Thickness/ Width
Single Stand Steckel Mill		0.8 million tpa	2-12 mm / 800-1650 mm
Twin Steckel Mill		1.3 million tpa	2-12 mm / 800-1650 mm
Steckel Mill with Rougher		1 million tpa	1.8-12 mm / 800-1650/ 2100 mm
Steckel Mill with 2 or 3 additional finishing stands		1.7 million tpa	1.6-12 mm / 800-1800 mm
Steckel Mill with additional Coiler Furnace for multi-piece rolling		0.8 million tpa	2-12 mm / 800-1650 mm
Plate-Steckel Mill with single stand		Plates: 0.75 million tpa	5-50 mm / 1600-3250 mm
		Strip: 0.25 million tpa	2.5-20 mm / 1600-2500 mm
Plate-Steckel Mill with roughing stand		Plates: 1.1 million tpa	5-50 mm / 1600-3250 mm
		Strip: 0.4 million tpa	2.5-20 mm / 1600-2500 mm

Figure 7. Outlook with additional finishing stands.

At this opportunity it is worth to mention also the reference mills of VAI, started up in the last years whereby VAI became leader in supply of Steckel mills worldwide (Figure 8).

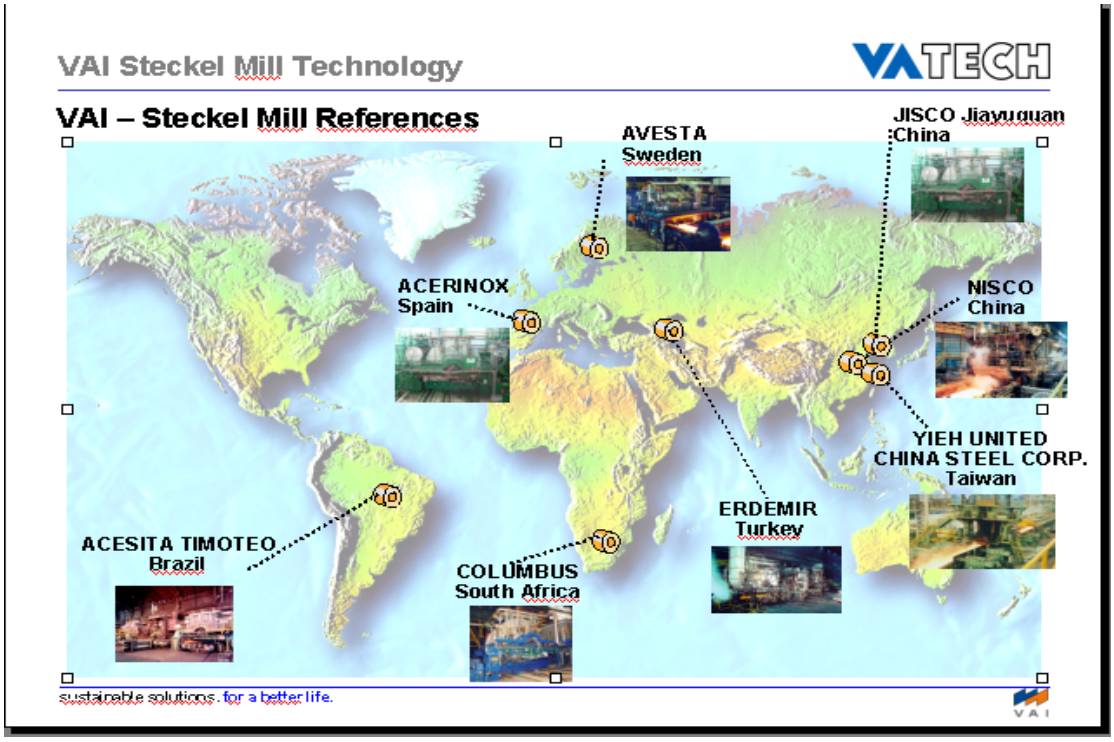


Figure 8. VAI Steckel Mill References worldwide

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