TANGSHAN: FIRST COIL ROLLED WITH POWER 6HI TECHNOLOGY[1]

Stanislas Mauuary[2]
Claude Bonaud[3]
Jean Pierre Robinet[4]
Olivier Germain[5]
Olivier Deschamps[6]

Abstract
In March of 2004 TANGSHAN Iron & Steel Co made the decision to order a new 5 stand Tandem Cold Mill from Siemens VAI for their new plant located in Tangshan, Hebei province, People's Republic of China. This decision is the result of the mutual trust that has been developed between the two companies in the past years during other cold rolling projects such as welders, reversing mill and continuous galvanizing line. The new TISCO's 5 stand Tandem Mill has been coupled to an existing pickling line in Tangshan. This line, originally designed for coil-to-coil operations, had its exit section modified and the accumulator's capacity up-graded to fit with coupling operations requirement. The total project duration will be 25 months with a Pickling Line outage on month 18 and the first coil rolled after 21 months. The project is handled by Siemens VAI who supplied the mechanical equipment and complete automation system based on the Technological Control System (TCS) for process control and S7 PLC's for sequential control. In December 2005, only 21 months after order the first coil was successfully produced. This success cleared the first challenge of this project. Fully automated by Siemens VAI, the tandem mill is now in production. The first results show the big potential of this advanced facility incorporating the POWER 6Hi technology.
Key words: Cold mill; Pickling line; Automated tandem mill.

TANGSHAN: PRIMEIRA BOBINADEIRA COM TECNOLOGIA POWER 6HI

Resumo
Em março de 2004 TANGSHAN Iron & Steel Co decidiu encomendar 5 novas cadeiras de laminação a frio da SIEMENS VAI para a nova planta localizada na província de Tangshan, Hebei, Republic of China. Esta decisão é o resultado da confiança mútua entre as duas empresas desenvolvida nos últimos anos em outros projetos de laminação a frio como máquinas de solda, laminador reversível, e linha de galvanização contínua. O novo laminador a frio de 5 cadeiras da TISCO foi ligado a linha de decapagem existente em Tangshan. Essa linha, originalmente projetada para operações bobina–bobina teve sua seção de saída modificada e a capacidade do acumulador foi aumentada para suportar os requisitos da operação do laminador. A duração total do projeto foi de 25 meses a linha de decapagem foi parada no mês 18 e a primeira bobina foi laminada depois de 21 meses. O projeto foi coordenado pela SIEMENS VAI que forneceu os equipamentos mecânicos e todo o sistema de automação baseado no "Technological Control System (TCS)" para controle de processos e PLC's S7 para controle seqüencial. Em dezembro de 2005, somente 21 meses depois foi laminada primeira bobina com sucesso. O sucesso deixou claro o desafio do projeto. A linha SIEMENS VAI totalmente automatizada esta hoje em operação. Os primeiros resultados mostram o potencial da incorporação da avançada tecnologia POWER 6Hi.
Palavras-chave: Laminação a frio; Linha de decapagem; Laminação automatizada

[1] *43rd Rolling Seminar – Processes, Rolling and Coated Products – October 17 to 20, 2006 – Curituba - PR*
[2] *Product Manager – VAI Clecim*
[3] *Automation and Rolling Mills Director – VAI Clecim*
[4] *Product Manager – VAI Clecim*
[5] *Automation Level 2 Product Manager – VAI Clecim*
[6] *Senior Expert Level 2 Automation – VAI Clecim*

Introduction

In March of 2004 TANGSHAN Iron & Steel Co made the decision to order a new 5 stand Tandem Cold Mill from Siemens VAI for their new plant located in Tangshan, Hebei province, People's Republic of China.

This decision is the result of the mutual trust that has been developed between the two companies in the past years during other cold rolling projects such as welders, reversing mill and continuous galvanizing line.

In December 2005, only 21 months after order the first coil was successfully produced. This success cleared the first challenge of this project.

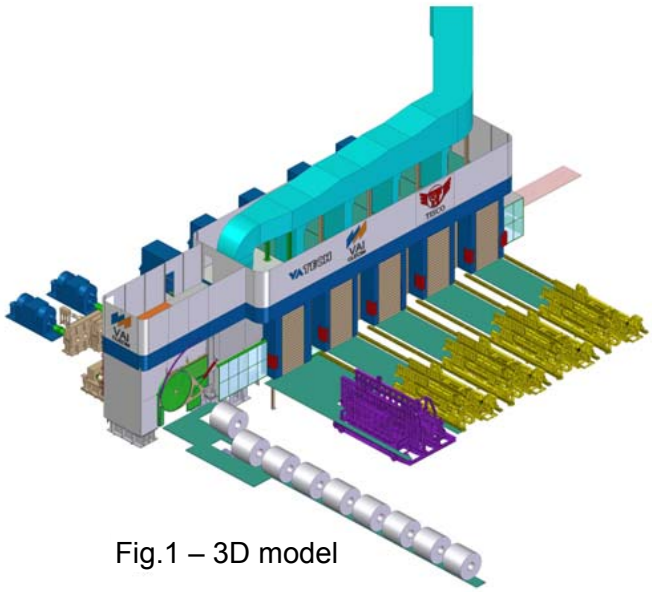
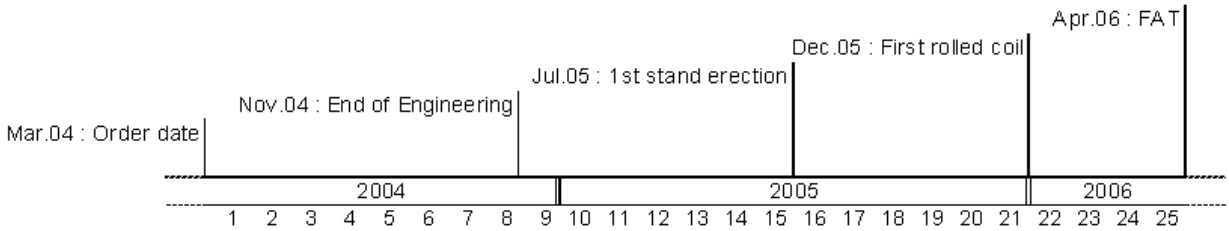


Fig.1 – 3D model

Fully automated by Siemens VAI, the tandem mill is now in production. The first results show the big potential of this advanced facility incorporating the ***POWER 6Hi*** technology.

Project Key Milestones



Advanced technology for cost effective solution

The new TISCO's 5 stand Tandem Mill has been coupled to an existing pickling line in Tangshan. This line, originally designed for coil-to-coil operations, had its exit section modified and the accumulator's capacity up-graded to fit with coupling operations requirement.
The total project duration will be 25 months with a Pickling Line outage on month 18 and the first coil rolled after 21 months..

The main technical highlights of the Tangshan Tandem equipment are:

- Versatile 4-Hi design for stand 1 to 4 : this design has a provision to integrate the WR shifting function. Use of the SmartCrown® contour work roll is then possible as powerful flatness actuator.
  Other option is to install the patented X-HI® insert specially developed to roll the Ultra HSS (above 1200 MPa) thanks to small work roll diameter.

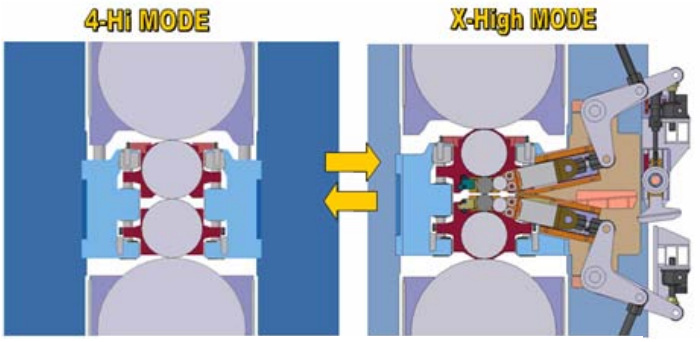


Fig.2 – comparing the modes

- ***POWER* 6Hi** for stand 5 : Combining intermediate roll long stroke shifting with heavy bending (positive and negative) on work rolls and intermediate rolls, this solution offers a wide range of flatness action with the quickest response time.
- Carousel coiling section: state of the art continuous coiling section providing cutting speed of 300 mpm for high productivity and limited off gauge length.

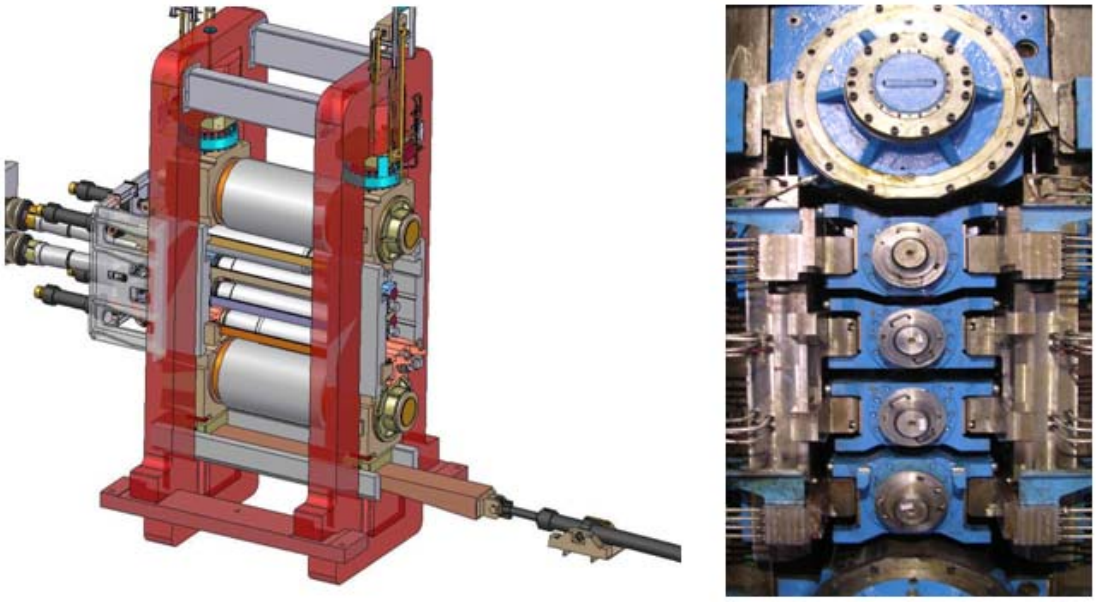


FIG.3 - POWER 6Hi stand from 3D to reality

The following tables summarize the product and equipment main characteristics

TISCO 5 stand Coupled Tandem Mill- Products characteristics	
Steel Grades	: CQ, DQ, HSLA
Entry Thickness	: 1.5 to 4.0 mm
Exit Thickness	: 0.3 to 1.5 mm
Maximum width	: 1650 mm
Maximum Coil Diameter	: 1950 mm
Maximum Coil Weight	: 29.7 Tonnes
Yearly Production	: 1.500.000 Tonnes/year
Average product size	: 0.684 x 1207 mm

TISCO 5 stand Coupled Tandem Mill- Equipment characteristics	
Maximum exit speed	: 1200 m/min
Installed power per stand	: 4250 kW
Max rolling force	: 2500 Tonnes
Work roll barrel length	: 1800 mm
Work roll diameter	: 455-525 mm (4-Hi) 425-485 mm (***POWER 6Hi***)
Intermediate roll diameter	: 520-580 mm (***POWER 6Hi***)
Back-up roll diameter	:1300 -1450 mm (4-Hi and ***POWER 6Hi***)
Coiling section	: Carousel reel with 2 x 2000 kW motors

The project is handled by Siemens VAI who supplied the mechanical equipment and complete automation system based on the Technological Control System (TCS) for process control and S7 PLC's for sequential control, in Consortium with an electrical partner for the electrical engineering, motors and inverters.

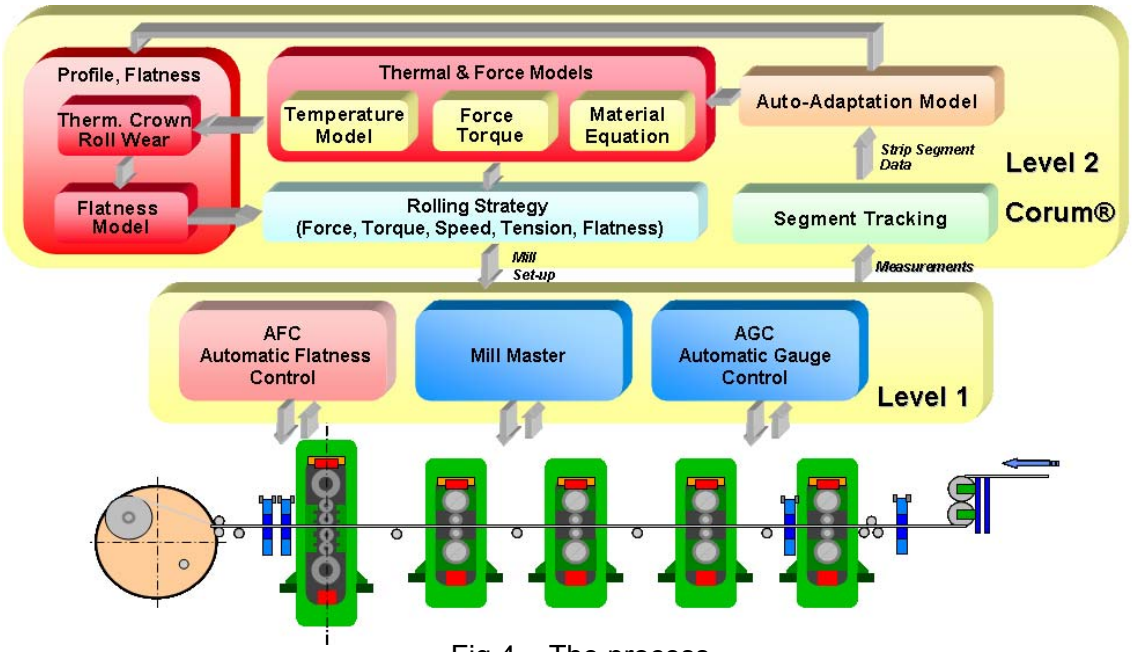


Fig.4 – The process

The main Technological Control functions are:

Weld tracking, Automatic Gauge Control (AGC), Flying Gauge Change (FGC), Automatic Flatness Control (AFC), Overall Equipment Efficiency (OEE) and Product Throughput Optimisation (Smart PTO)

The Automatic Sequencing functions are:

- Automatic WR & IMR rolls change
- Automatic coil delivery operation
- Semi automatic off line coil inspection
- Emulsion system management

By completely integrating equipment and automation, Siemens VAI's has an actual control on productivity, quality and availability performances, which are key factors for TISCO's profitability

Smooth project implementation for ambitious schedule

The first ambitious goal of the project was clearly to roll the first coil within an extremely short period while the market of steel was clearly under tension. This goal has been achieved showing our competences in the field of management for complex projects.

Design

The wide product range of Siemens VAI offers "out of the box" solutions for quick implementation of the design phase. The following can be cited:

- hydraulic roll force cylinder
- versatile 4-Hi technology
- continuous coiling section with flying shear and CLECIM® carousel
- roll coolant
- automation package with AGC, AFC…

On the other hand, the technological improvement process is a key point of Siemens VAI and new solutions are offered to meet the new requirement of the market. In addition, our close cooperation with steel producers and the industrial culture of VAI Siemens impose us to provide mature and developed product on the market.

We followed this policy while offering the ***POWER 6Hi*** as last stand for Tangshan. Capitalizing on our experience with 6-high mill in ARCELOR Montataire and PANGANG Plants, we developed our product up to industrial phase before the submission to our customers. The final engineering process of the ***POWER 6Hi*** has been done within the schedule thanks to a complete design with the most advanced 3D CAD software. The complete 3D development gives great advantages including:

- Interface with finite element calculation software
- Secure interference risk
- Improve operator training
- Facilitate the fabrication job

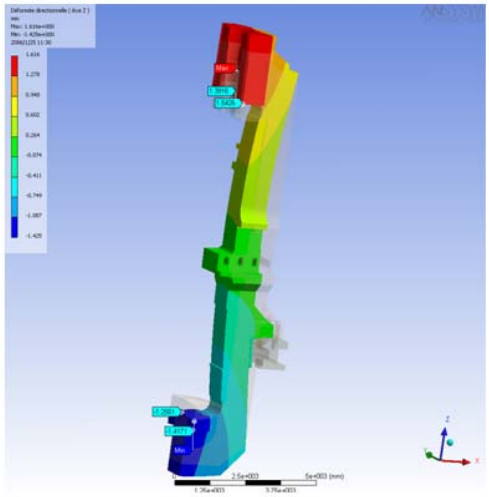


Fig.5 - Finite element calculation of mill housing

Procurment

The second step was the manufacturing, control and shipment of more than 3500 tons of equipment in Europe and in China.

The co-manufacturing happens in a close cooperation atmosphere that leads to the respect of the quality demand and the requested delivery time. The co-manufacturing parts, among all equipment, include the housings of the 5 stands (fabricated and pre-erected by CMMP), the interstand equipment, the exit equipment, the inspection station…

The key process equipments were fabricated in Siemens VAI workshop, Montbrison (France). Our workshop provides the unique advantage of having an outstanding experience in the fabrication of high value added equipment and the facilities to test the equipment.
CLECIM® Laser and Flash butt welders, Carrousel reels, Hydraulic roll force cylinders can be fully tested before shipping. For e.g.;, the roll force cylinder test procedure includes hysteresis, response time, friction…

Fig.6 - Carousel Reel tested in Montbrison workshop

On the automation side, the complete system has been installed in our automation testing platform. Then the extensive integrated tests have been carried out by our team. On a second step the platform has been used to support the training of the engineers of Tangshan team. The 12 trainees spent 4 months in order to complete the full training session for the level 1 and 2.

Fig.7 - Integrated Test for Tangshan tandem mill

The control of the global procurement and fabrication process is the key point to keep the project on schedule and to give enough room to ensure perfect site works.

Erection and commissioning

The job starts really in June 2005 with the delivery of the first set of mill housings. Thanks to the workshop pre-erection, the task runs smoothly. 90% of the erection, including the modification of the existing CPL, was completed not later than the beginning of November 2005. This impressive result has been achieved thanks to a very close cooperation with the customer and a faultless preparation by the site team.

Fig.8 - Erection of stands

The cold tests were already started at the same period and mobilized the full commissioning team up to the first transcoiling on December, 16th. The final tuning of the drives and the tension control were finalized to turn into rolling mode.

Successful start-up and encouraging results

Only 3 days after transcoiling were necessary achieve the successful rolling of the 3 first coils, thanks to the invaluable job achieved by Tisco and Siemens VAI teams.

Fig.9 - Site Team after the first coil

Fig.10 - First coil on the Carrousel reel

The ramp-up process can start and the first results promise great performances. The production achieved during the first month was clearly over the target. End of January, the mill was operated in fully continuous mode 3 shifts a day. In February, the production target has been reached at mid-month which shows clearly the maturity and potential of our mechanical and automation equipment.
Next steps will be focused on the fine tuning of the strip quality actuators, especially thickness and flatness to achieve guaranteed values and demonstrate our technology strength.

Following the coupling of Benxi, Pangang and Wugang tandem mills, these projects clearly confirm the technical expertise in the field of endless rolling as well as Siemens VAI capacity to implement major integrated cold rolling project worldwide.