Temper Mill 1 Screw Down Revamping -SIDOR-VENEZUELA

INTRODUCTION

The obsolescence of Screw Down stands and the need to improve the quality of the temperate system justify the investment to carry on the revamping of the control system

This project is part of a comprehensive overhaul of Temper 1, which is being made thoroughly by Sidor's automation department.

This step of the project was started in November 2003.

TEMPER MILL DATA:

Stand 1 Main Motors power: 2 X 1100Kw. Stand 2: 1 x 1100Kw.

Maximum speed: 1524 mpm.

Diameter of input coil: 508-1670 mm.

Input Thickness: 0.18 to 2.03 mm.

Maximum width: 1270 mm.

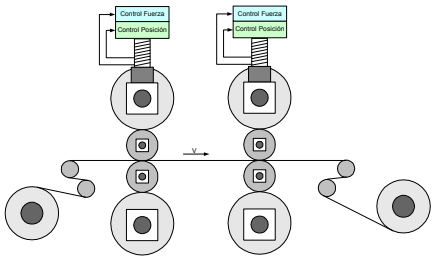
Screw Down Motors: 2 x 47Kw, 500-1000rpm, 420V-130Amp.

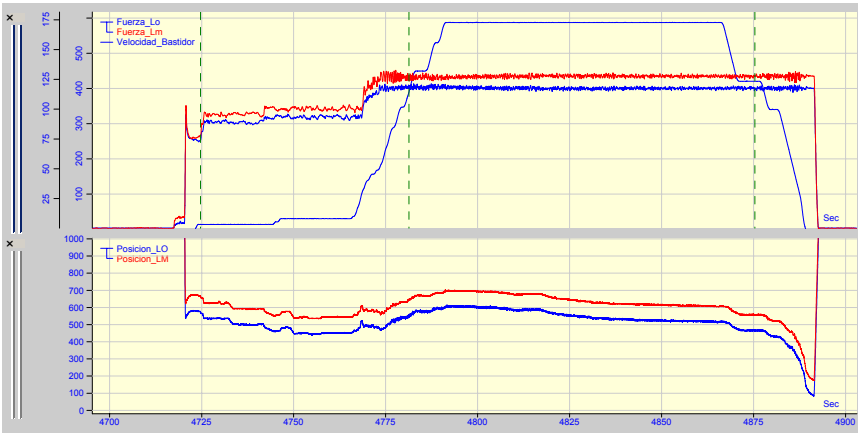
SCOPE

- Installation of a PLC Modicon to make the control
- Position, force and inclination regulators design and PLC programming
- Automatic calibration of position and Tilting
- Migration of the Drives to new generation ones
- Tuning of speed loops
- Re-wiring and substitution of field sensors
- Addition of human machine interfaces (HMI) panels.

CONTROL THROUGHPUT

- Position regulator with accuracy and precision < 2 µm.
- Automatic control of the Screw Down with accuracy < 2 µm.
- Force regulator overlapped with position control that guarantees the horizontality of the cylinders while regulating the force.
- Automatic commutation to change from position control to force control once reached 90 tons between the cylinders.
- Automatic calibration of the position and tilting system using a differential of force.
- Fast opening to a prefixed position and fast closing to a minimum force of 150 Ton.
- Automatic setting of the force preset once the Mill is ready to accelerate.
- Fast opening upon exiting of each stand
- *Maintenance* selector mode that permits to move the Screw Down "without regulation" in case mis-calibration, limit switch tripping, maximum strength, position measurement errors, failure in any drive, etc.
- Visualization of the Gap between the cylinders.
- Alarms, permissions and messages concerning the operation.





Operation of regulators of position and force

- The tilting control keeps the relative position between the LO and the LM while the force is being regulated.
- The maximum inclination error is just 2 µm.
- The force control compensates the changes in Morgoil film.

PROCESS OVERVIEW

In temperate's process it is very important the precision of the action of the Screw Down. Some position regulators might reach the precision of 10 microns. Also the system has some strengths regulators that reject any perturbation that tends to modify the position.

Some of these perturbations are: the film of Morgoil in the bearing of the cylinders (which is function of the speed and the load), changes of hardness of the material, changes of thickness of the material, thermal expansion of the cylinders, among many others.

Another variable that must be kept constant is the interstand tension, since along with the force applied by the cylinders; they determine the most important parameter of the process, which is elongation. The control of all these variables allows getting the major quantity of band within specifications so it improves the process.

Another parameter, not less important, is the shape of the band, which depends strictly of the force applied by the cylinders and the tilting.

While the more stable the force and tilting the faster will be to adjust the shape. So it is very important to keep this condition all through the coil.

The constancy of the force also affects the surface of the band due to wrinkles formation on the cylinders.

THE PROBLEM

The old PLC Control of Screw Down did not have either any regulation of position or force; it just delivered a fixed speed reference to every one of the drives.

This was very inconvenient due to the following reasons:

- It was not possible to keep the setting of the tilting due to a lack of position control. Not just by sending the same speed reference to every motor could one assure that the cylinders move horizontally.
- When starting the coil it was necessary to adjust manually the tilting taking a look at he shape of the band.
- The force had to be set manually after threading the band
- When the mill started to accelerate the operator had to adjust the position of the Screw Down to try to keep the force in a desire value.
- There was a high rate of cylinders changed prematurely, caused mainly by problems in the tilting of the screw, in the firsts coils after the change.
- Every opening, closing or setting of the force and inclination was done manually

Old Screw Panel to the left. New one to the right.

SUMMARY OF THE PROJECT

DRIVES

The drives of the motors were upgraded to model DCS600. They were all reconfigured in order to improve the acceleration/deceleration times and the performance of the speed control. The acceleration time from 0 to 500 rpm was set to 150ms and the accuracy control speed in steady state was set to 0.1%, approximately, after tuning the speed regulators.

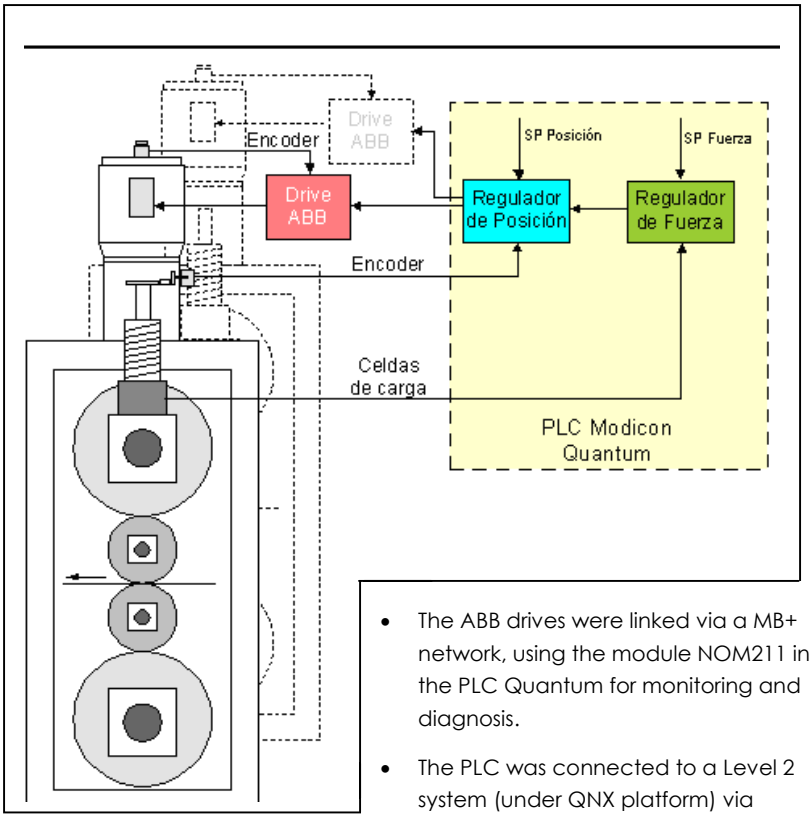
PLC MODICON QUANTUM

A model was made of the system transference function, where the input signal is the reference of the speed of the motor and the output is the position of the screw. This model was introduced using simulation software, with the objective of making a pre-tuning of the position control loops.

The same procedure was applied to develop the force and tilt regulators.

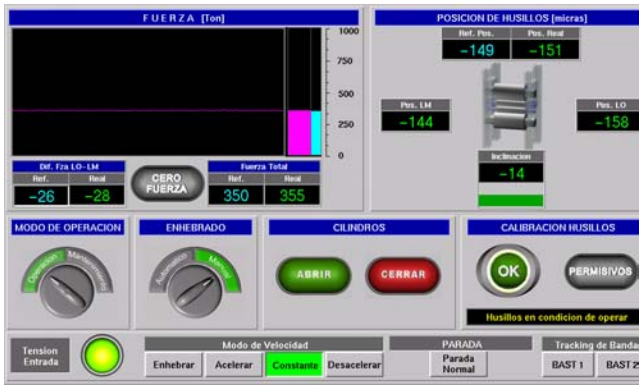
Thanks to the powerful programming software Concept XL V2.6 SR1, available for Quantum PLC's, it was possible to implement the models and to make the simulations of the process. This allowed debugging the logic associated to the regulators and the HMI interface during the development.

The analysis and simulation permitted to obtain a reduced time to start the system, even more to minimize the follow up.



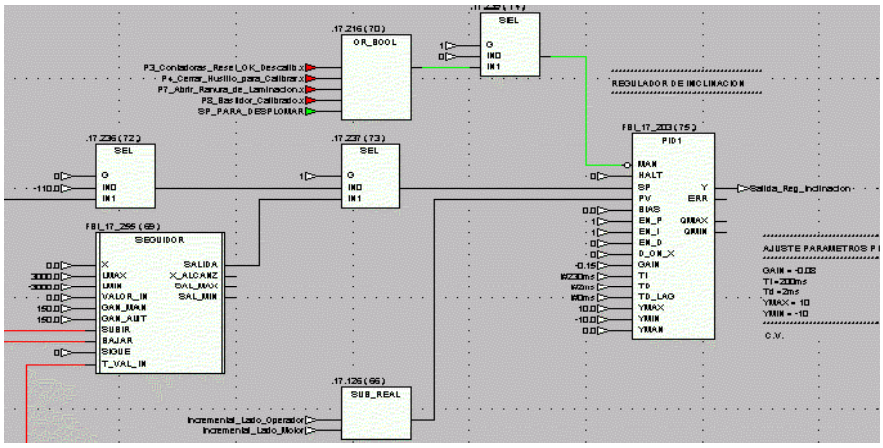
PROPERTIES OF THE SYSTEM

- The counters EHC202 were configured in quadrature to get the best possible resolution to measure the position (0,5µm).
- Current loops 4 to 20mA were used as analog inputs to minimize the influence of electromagnetic noise.
- The ABB drives were linked via a MB+ network, using the module NOM211 in the PLC Quantum for monitoring and diagnosis.
- The PLC was connected to a Level 2 system (under QNX platform) via TCP/IP network through the module NOE771, where some features embedded like HMI were used to provide monitoring and diagnosis.
- The scan time of the CPU 534, with the program of both stands and the load of the TCP/IP and MB+ communication process happened to be 10 ms.
- The updating time of more than 200 variables read by the N2 system was 150 ms.



Stand1 Operation Screen.

The Screw Down position is shown in a numerical way and the force has a historical trending of 10 seconds.



PROGRAMMING SOFTWARE Concept XL Version 2.6 SR1.

- Matches perfectly process control applications.
- Variety of libraries with math functions and regulation
- Allows the creation of user blocks to help to understand the process
- Runs under Windows.

COMMUNICATION NETWORKS

To communicate the subsystems two of the possibilities of PLC-s Quantum were used, Modbus Plus y Ethernet (Modbus TCP/IP).

For data acquisition and PC´s touch screen both alternatives were used in a redundant way, in order to guarantee 100% continuous service. The normal communication is established via TCP/IP but in case of a fault it is switched automatically to MB

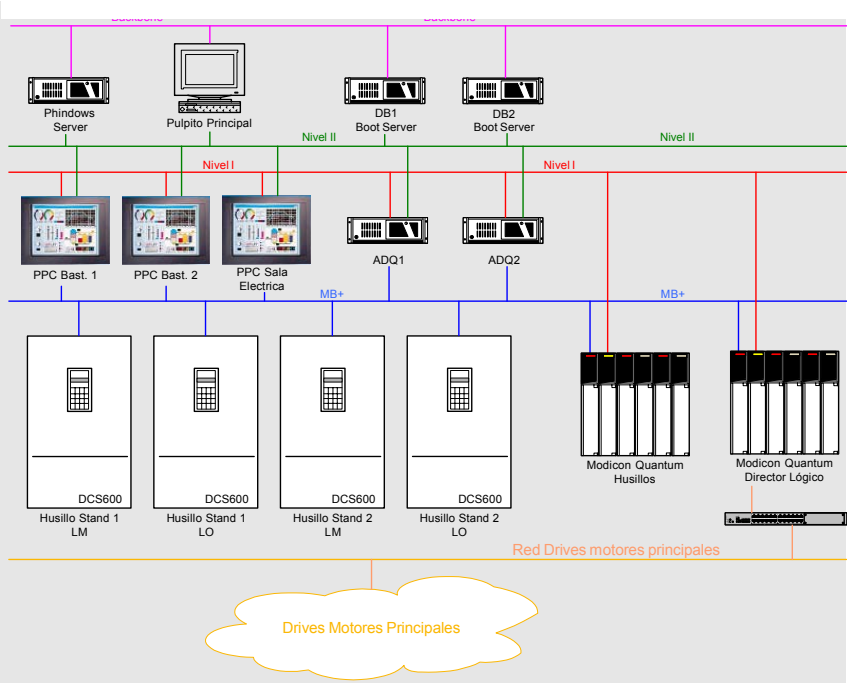
The operation panels and PC´s for data acquisition do not have hard discs but start through boot servers. The first one to answer to the service will be the one to provide the information to start and configure the applications.

The PC's are redundant and are switched automatically in case of a fault.

The database is replicated using the concept of primary and secondary DB. In normal conditions the applications are connected to the primary DB but upon a fault they will be connected to the secondary.

The Phindows server, which is also web server, makes possible remote monitoring, on-line or through historical trending of the variables. Besides, allows visualization on real time of the screens manipulated by the users to control, monitor and diagnose the system.

As mentioned before, the drives were communicated to the PLC using a MB+ network due to the availability of this protocol in the drives.



PROJECT TEAM

Cold Mill Area Automation Lider:

Mariano Benítez

Project Lider:

Carlos Pifano

PLC Programer:

Juan Carlos Lamanna

Technical Consulting:

Claudio Vecchiarto

http://www.sidor.com