Variable Speed Control for Descaling Pumps in the Metals Industry

DriveIT ACS 1000 Medium Voltage AC Drives for speed and torque control of 315 kW – 5,000 kW motors

Case Study

Metals industry

China Steel Corporation, Taiwan

Application: Water Supply for Descaling Pumps

Problem

The water supply plant for the China Steel Corporation's (CSC) facility in Kaohsiung, Taiwan, is used to feed a melt shop, a slab caster plant and a hot rolling mill (refer to figure 1).

Within the hot rolling mill, descaling pumps are used to remove scales from the surface of the hot steel. The descaling pumps are placed just before the mill stand and they take the low pressure water from the water supply plant and create high pressure water which is sprayed onto the surface of the hot steel to remove scales. The steel needs to be scale-free before entering the mill stand to ensure that it has perfect surface definition and good quality. Removing the scales also helps to reduce the wear of the mill stands rolls.

The water supply plant feeds water to the hot rolling mill using fixed speed booster pumps. For over five years, CSC has been using a mechanical return (bypass) valve, controlled by an external PID controller, to regulate the pressure of the water being fed to the descaling pumps.

Highlights

- Payback within 28 months
- Reduced energy and water costs
- Lower maintenance
- Improved product quality

View of booster pumps.

View into the control room.

View of one isolation transformer.

However, the descaling pumps only operate when steel passes through the rolling mill. At this moment they need to provide high-pressure water to clean the scales off the incoming metal. This demands high peak water pressure for a short time. When peak pressure is required, the return valve is closed and maximum water is fed to the descaling pumps.

When descaling is not required, then the return valve is opened in order to reduce the water supplied to the descaling pumps, but the system's booster pumps being fixed speed, still operate at full speed even though the system does not require high pressure water in this operating condition.

There are three disadvantages with this technique. Firstly, the booster pumps operate continuously at full speed providing maximum water flow at all times even though the process does not require this. The water supplied to the descaling pumps is regulated from the maximum water flow via a return-valve meaning that the additional water that is not required by the process, is returned back to the water supply plant. The cost of electricity is, therefore constant and always at a maximum, thereby wasting huge amounts of energy.

Secondly, the water supplied from the water supply plant is treated water. Therefore, the additional water that is not required by the process during the periods when the descaling pumps are not running, has already been treated. Despite this, this water is returned back to the water supply plant where this same water then passes through the treatment system, once again. This is an expensive process and adds significant cost to water treatment.

Finally, the system response time with the return valve is slow and it is difficult to stabilise the water pressure. This results in undesired variability in water pressure which gives a poorer steel surface quality.

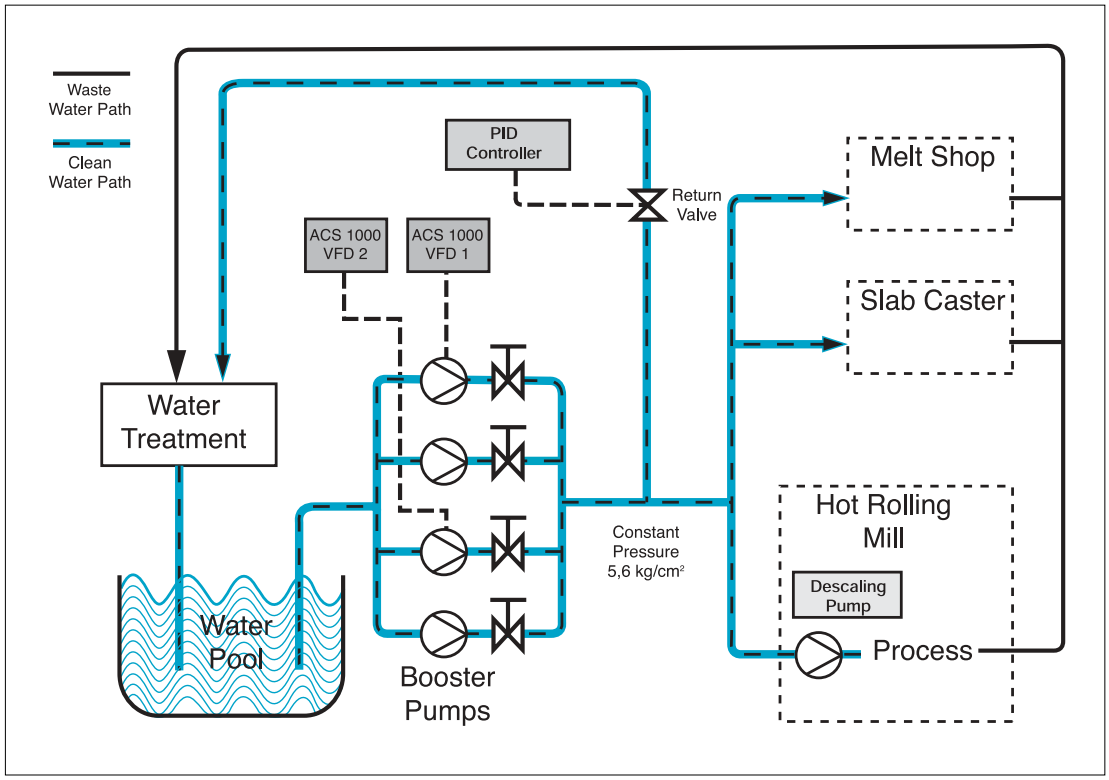

Figure 1: Water Supply Plant System Diagram.

Solution

By retrofitting two ACS 1000 Medium Voltage drives to the existing 336 kW fixed speed booster pump motors which supply water to the descaling pumps, CSC can supply peak pressure when needed, without using the return valve. Thus, the amount of high-pressure water is supplied on demand.

The process demands that the line is constantly pressurised in order to feed water to the factory and it is the role of the first ACS 1000 to maintain this pressure. When peak pressure is required, the second ACS 1000 kicks in to increase the flow rate of the booster pumps.

When the descaling pumps are not running, one drive always runs at a low speed of 720 rpm to ensure that water is continuously pumped throughout the system and to keep the system charged to the minimum required level. When the descaling pumps start, both drives are used to accelerate the booster pumps in order to supply the required water to the descaling pumps.

CSC selected the ACS 1000 as part of a programme to upgrade its process quality and reduce energy and water costs. Several distinguishing features attracted CSC to the ACS 1000. The technology used by the ACS 1000 means that it is suitable for direct fitting to existing and new medium voltage AC motors.

Direct retro-fit without matching the drive to the motor is possible because the ACS 1000 features a patented sine filter. This, by producing a pure sine wave, avoids high voltage spikes and common mode voltage, which can damage the motor insulation and bearings.

The use of IGCT semiconductors contributes to the small footprint of the drive and this proved beneficial to CSC because of the restricted space in the hot mill plant.

Despite using leading-edge technology, the drive maintains a simple construction that is easy to install. This means that CSC's own maintenance team can carry out the installation.

View of one ACS 1000 drive (on the right) installed at CSC.

Benefits

The installation has successfully met the objectives of CSC by reducing the energy and water treatment costs. In addition, the use of drives makes the system response faster than a traditional system with return valve. This stabilises the water pressure, bringing improved steel quality as well as reducing the wear of the mill stand.

Each year, CSC estimates that the installation will save 2.93 million kWh (NT:1.5 dollars /kWh) and 65,000 tons water (13 NTD/ton)

CSC invested USD 350,000 (NTD12 million) for the two ACS 1000 drives, including transformers, MCB/ bypass panels, wiring, modified DCS and civil works. As such, the first drive, which has been running continuously for over a year, is expected to pay for itself within 28 months.

Such is the success of the installation that CSC purchased three more ACS 1000 drives for use in other applications in their plant.

A major contributory factor in CSC's decision to award the contract to ABB, was its global track record of ACS 1000 installations and its ability to service and support its drives anywhere in the world.

Background

The centrifugal descaling pumps are manufactured locally by San Tai Mach MFG. They are used in conjunction with Taiwanese manufactured motors, both of which are located some 200 m from the ACS 1000. CSC carried out the drives installation using its own maintenance team.

CSC is currently Taiwan's sole integrated steel producer, with an annual capacity of crude steel standing at 8,054 million tons. About 80% of its production is for domestic consumption, with the remainder used for export.

Its product quality is firmly established domestically as well as worldwide, which has earned the company the highest government recognition in the form of the National Quality Award from the ROC Executive Yuan.

After being privatised CSC actively embarked on its course to evolve into a global industrial conglomerate of world-class scale with manufacturing at its core and concurrent interests in foreign trade, transportation, engineering and construction, finance, service and industries involving emerging technologies.

Technical Data

The ACS 1000 medium voltage drive offers many benefits as standard, including:

- highest reliability and availability
- high efficiency, > 98 % including sine wave filter and auxillaries
- lowest lifetime costs
- smallest footprint and overall physical size
- greatest transformer flexibility
- high performance, through Direct Torque Control (DTC)
- retrofit-ready, for fit to any standard medium voltage squirrel cage motor, without derating
- every drive fully factory-tested
- two-day on-site commissioning
- full compliance with international standards including EMC, IEEE 519-1992 and the first medium voltage drive to be UL Listed.

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