Efficient and effective descaling in the Steel industry

Rob Collins, Technical Sales Director at RMI Pressure Systems, looks at the latest developments in descaling technology and how efficiency can be maximised.

Steel rolling mills, like most modern industries across the world, are looking to improve efficiency and product quality by investing in technology which has a short return on investment (ROI). One of the key factors in determining the quality of the final product is the scale removal process; scale which isn't properly removed can be combined with the steel billet as it passes through the mill, resulting in defective or lower quality steel.

Scale can be created from oxides of iron (FeO, Fe3O4, Fe2O3), which arise on heated surfaces of steel exposed to the air. The two main factors affecting the removal of these scales are impact pressure and thermal shock applied by the water contacting the surface. Impact pressure is dependent on nozzle selection combined with the correct pressure and flow, distributed evenly and immediately taken away from the surface.

Within the hot rolling mill, descaling equipment is placed before the mill or after the mill stand and it takes the low pressure water from the plant water supply, creates high pressure water, which is sprayed onto the surface of the hot steel to remove the scale. The steel needs to be scale-free before entering the mill stand to ensure that it has perfect surface definition and quality. Removing the scale also helps to reduce the wear of the mill stand's rolls. Pickup on the rolls, if not properly cleaned, can easily be transferred onto the strip and may result in the strip falling below the customers quality standards.

The equipment required for this process basically consists of a high pressure pump, powered by an AC motor, which can be controlled by a variable speed drive; all of which supplies water through specifically designed header and nozzles, which are directed at the hot steel. The combined action of the water pressure and the rapid cooling of the steel results in the scale removal. In many cases several pumps are required to operate in parallel in order to generate sufficient pressure and flow.

The design of de-scaling equipment is an exact science with header design and water pressures carefully calculated for the best results. Some steel variants only require a water pressure of 150 bar but the volume of water can be high, however, with high alloyed steel grades, the water flow can typically be reduced by 50%. However, each application is different and there may be a need for large volumes at high pressure in order to meet the impact specification; all of which needs to be accommodated by the high pressure pumping system.

Steels with high silicon content are very problematical because of the intense adherence of scale, requiring high impact pressures as well as increased quantities of water for this kind of scale. It's important to use the correct pressures as too low can result in scale being left behind, while too high will be inefficient and lead to unnecessary costs.
With modern steel rolling mills producing an array of different steels, it is important that the plant has the ability to adjust any settings as easily as possible so that each steel type is produced reliably and efficiently. These differing requirements pose potential problems for the production facility and, unless they are optimised, could lead to increased production costs and reduced margins. This places added pressure on the de-scaling equipment as, not only must it perform reliably at all times, it is also required to allow for the adjustment of pressures and water flow rates as the steel type changes.

Optimising nozzle pressure is just one aspect; clearly the distance of the nozzle from the steel is a key factor in determining the impact force effectiveness of the process as well as the specific design of the nozzle and header arrangement.

While the design of the nozzles and the distance from the surface have significant effects on the performance of the descaling system, the control of the pumps makes a considerable saving in energy consumption. Clearly the high pressure nozzles only need to be operating when hot steel is passing through; for the intervals in between, the pumps need to operate in a standby or bypass mode, ready to deliver the high pressure water at the moment when the next section of steel arrives.

Many pump designs operate a bypass system where the system pressure actually increases due to the reduced flow and this can lead to increased wear in the pump as well as the pipework. The ranges of Trimax and Quinmax industrial pumps, designed by RMI Pressure Systems, are carefully tailored to each application. In the case of descaling plants, the pumps can be equipped with the Stored Energy Offloading System, which gives the stop-go capability required for this industry.

The unloading system is a soft action solenoid control system which allows the pump to run without generating further pressure. The pump continues to idle in a pressurised standby condition so that it can quickly and efficiently return to the pressure and flow settings dictated by the grade of steel which is passing through the descaling plant.

Previous experience with similar projects has helped RMI develop an excellent understanding of the exact requirements of de-scaling plants and how to deliver them. Based on this experience, RMI has been able to deliver individually designed, high pressure pumping solutions to the steel industry, which have resulted in substantial savings both in energy and maintenance costs; an important factor when deciding on the most suitable package.

Many of the more recent systems that RMI has designed for the steel industry have been supplied using the very latest On Demand Intelligent control system, ODIN. Working closely with the client to understand the varying demands for flow and pressure is critical to achieving the maximum reduction in energy usage from the pump station. Traditionally in a rolling mill the mill stand pumps have been selected to cater for the design flow rate required for the maximum coil, billet, bloom or slab size. However, as we know, during operation the mill will produce various sizes and differing material specifications, all of which has a direct correlation to the actual flow and pressure required.
Taking this information on flow, along with the time taken per product, RMI calculates the flow and pressure requirements for all the variants and specifies the most efficient pump selection, size and quantity. On each pass of the material, the pumps will ramp up to the optimum speed for the duty required, ensuring that both flow and pressure are optimised in order to minimise energy losses.

During the engineering review process RMI will also look at the overall control system and nozzle selections in order to recommend any further enhancement that will improve the overall efficiency of the entire system. This complete system review strategy has often resulted in significant savings for the client, such as reduced pump size and quantity as well as reductions in the size of the main system pipework.

Taking ownership of the customer's process, by working with them to understand their operational needs and process improvements, enables RMI to offer a full turnkey or system solution which will deliver all the improved outcomes desired by the customer. This can result in a payback on the investment of less than 2 years on both new projects and modifications to existing systems.

Photo Captions:

Photo 1: 
RMI has been able to deliver individually designed, high pressure pumping solutions to the steel industry, which have resulted in substantial savings both in energy and maintenance costs

Photo 2: The design of de-scaling equipment is an exact science with header design and water pressures carefully calculated for the best results

Photo 3: The ranges of Trimax and Quinmax industrial pumps, designed by RMI Pressure Systems, are carefully tailored to each application

About RMI Pressure Systems

For more than a century, RMI has been producing premium-quality high-pressure pumps for global mining and industrial applications. An early innovator in the design and manufacture of high-pressure systems for Longwall mining, today RMI employs the expert resources at its UK engineering research centre to great effect, introducing new solutions designed to reduce process complexity and optimise customers’ productivity.
The collaborative relationships RMI forms with clients creates a climate of proactive response, inspiring progress and resulting in consistently high service levels. At RMI, we aim to deliver enhanced value and reliability to customers, focusing our efforts on helping them to become more productive by cutting operational costs and boosting output. We can only achieve these advancements by listening to - and learning from - the issues that are important to our clients. It is this unwavering commitment to the learning process that helps RMI drive innovation with, and for, the customer. It elevates our ability to better serve our customers - and, ultimately, the world in which we live.
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