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Drive saves 70% energy in hydraulic system for steel manufacturer

Installing an ABB industrial drive has resulted in a 70% energy saving on a hydraulic system for steel manufacturer Corus Colors at Deeside.

The hydraulic system used during the trial is located on a production line used for retreating and inspecting strip material, driving actuators and web guiding systems in a 24-hour process.

Typically, hydraulic systems waste much of their energy because a constant amount of fluid circulates at all times, although the work is only carried out in short bursts.

In addition, the pressure for the hydraulic system is normally provided with a positive displacement pump, a type of pump that offers far less potential to save energy than the more common centrifugal pump.

Nevertheless, Corus Colors, with the help of Phil Tomkinson from Radway Control Systems, achieved significant energy savings by retrofitting the existing system with a variable speed drive. The pump speed was greatly reduced both when the system was in neutral and during actuation of the cylinders.

When in neutral, power consumption was initially around 9 kW. Under drive control, power consumption was reduced to 2 kW, a reduction of 77%. With the system under load, power consumption was reduced from 22 kW to 12 kW, a saving of 48%.

With a 16% duty on-load time for the system, the average energy saving over time was 70%. The reduced energy consumption will allow a payback time of just 18 months and reduce the company's carbon footprint by 33 tonnes of CO₂ annually.

The reduction in energy consumption under load initially surprised Corus' engineers, as it should take the same amount of energy to move a hydraulic cylinder a given distance, regardless of whether a drive or direct-on-line operation is used. However, further tests showed that the drive used a lower motor speed to achieve the required pressure.

The drive automatically adjusts the pump speed to maintain system pressure. Pressure feedback is returned to the drive from a transducer. The ABB industrial drive supplied by ABB Drives Distributor Radway Control Systems has built-in PID control that helps keep external values, like pressure, under control.

The desired system pressure is 90 bar. As in all hydraulic systems, the on-load times are short. To prevent energy waste once the hydraulic system settles back into neutral, the drive operates in two modes: PID mode and single-speed mode. When the hydraulic system is in neutral and the pressure is at the desired level, the drive switches to a single speed of 450 rpm, the optimum constant speed setting established through tests. This way, the system will not overshoot its target pressure.

When the actuator is operated and the pressure drops, the transducer feedback switches the drive into PID operation. The drive reacts quickly to speed up the motor as fast as possible to reach its pre-set value, set to 93 bar. But as soon as the pressure reaches 90 bar, the transducer switches the drive back into single speed mode, preventing the motor from overshooting its target speed and reducing energy waste. The hysteresis control built into the drive stops it switching in and out too quickly. The drive's flux

optimisation feature reduces the magnetising current when the motor runs at constant speed and gives further energy savings.

In the past, drives were not used much on hydraulic systems, maybe because the very impressive energy savings available with centrifugal pumps are not achievable with positive displacement pumps.

Unlike a centrifugal pump, which uses centrifugal force to throw fluid out through the discharge end of the pump, the positive displacement pump uses an internal mechanism to press the fluid out. This means the output will be the same regardless of the resistance on the discharge side.

Positive displacement pumps tend to be used in hydraulic systems because this type of pump can produce high pressure despite high system resistance.

However, the energy consumption of the positive displacement pump is not reduced when the system resistance drops. For this reason, it does not offer the same energy saving potential as centrifugal pumps at reduced speed. While the centrifugal pump offers energy savings equal to the cube of the speed reduction, a change in flow by the positive displacement pump produces a linear change in power usage.

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Caption: Installing an ABB industrial drive has resulted in a 70% energy saving on a hydraulic system for steel manufacturer Corus Colors at Deeside.

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For more information please contact:

Layla Hewitt
Marketing Communications
Phone: 01925 741517
Email: layla.hewitt@gb.abb.com

ABB Ltd.
Daresbury Park
Daresbury
Warrington WA4 4BT

Emma Jenkinson
Armitage Communications
Phone 020 8667 2218
Email: emma.jenkinson@armitage-comms.co.uk