Hydraulic Drive Technology for Mold Oscillation in Continuous Casting Plants

Your Development Partners: The Rexroth Application Centers
The Rexroth Technology Package for High Power-Density

Rexroth, the single-source supplier of technologies for motion control, drives and open and closed loop control systems, offers extensive know-how in virtually every branch of industry. Our customers benefit from best-in-class solutions and our applications centers offer competence as well as co-operation with the worldwide sales network. As system partner we can provide swift and reliable automation solutions for complex applications and control tasks – and this also applies to metallurgy.
Thanks to the steel boom steelworks around the world are now working to the limits of their capacities. As well as building new factories, many companies are also modernizing their installations to enable them to achieve a rapid increase in productivity. To this purpose Rexroth offers highly efficient technology packages, optimized to meet the specific requirements of steel production.

Mold oscillation is one of the most important systems within a continuous casting plant. The latest Rexroth electrohydraulic systems permit oscillation of the mold to match the curve profile exactly. This process improves surface quality of the cast product.

However, mold oscillation also places great demands on the automation system, as up to 20 or 30 tons may have to be moved with the utmost precision. The Rexroth technology package permits up to 400 strokes per minute and amplitudes of up to 10 mm for a range of curve profiles.
Hydraulic linear drives can be used to control the complete oscillation process. These drives are able to generate a range of different curve profiles. It is even possible to vary both stroke and frequency, either separately or together, during the casting process.

In order to meet the ever-increasing demands with respect to quality, productivity and functional safety, modern continuous casting plants require a precise oscillation, combined with flexibility of both stroke and frequency. Rexroth offers the complete solution.
In order to meet the increased demands for high quality and productivity, modern continuous casting systems require a precise oscillation and a high level of flexibility with respect to stroke and frequency.

The oscillation promotes the penetration of casting powder into the gap between the wall of the mold and the strand shell.

The molten flux, which penetrates at the meniscus into the gap between the mold wall and the strand shell, acts as a lubricant in the contact area between the mold and the strand. This helps to reduce friction between the mold wall and the strand shell and so prevents shell sticking.

Lubrication control by means of optimized mold oscillation is thus an important factor for functional safety and strand surface quality, in particular with high-speed casting.
In contrast to conventional drives, hydraulic systems can also realize asymmetric oscillation forms, at the same time offering a unique power-density as well as easy energy accumulation.

Electromechanical drives are still frequently being used in older systems. These drives require complex mechanical conversion to change the stroke length.

The Rexroth hydraulic rotary drive with secondary control, on the other hand, offers an easy way of revamping a conventional drive to permit mold oscillation using an electric motor with gear and eccentric. Different curve profiles can be realized at variable frequencies using this method. These secondary units are distinguished in particular by high accuracy and high dynamics.
Highly Flexible – Linear Drives from Rexroth

Characteristics
- Hydrostatic pocket bearing
- Integral positional transducer
- Extremely low friction
- High static rigidity
- Excellent damping
- Excellent absorbing capacity for transverse forces

The hydraulic linear drive permits complete control of all oscillation forms during the casting process. This flexibility of control means that different curve profiles can be used to optimize oscillation. In addition to this, stroke amplitude, oscillating frequency and casting speed can all be varied during the casting process.

Main features of the Rexroth servo cylinder are its optimum dynamic response, accuracy and low co-efficient of friction, combined with a high absorbing capacity for transverse forces thanks to the piston rod hydrostatic pocket bearing. Furthermore, Rexroth servo cylinders also offer a high level of static rigidity and excellent damping.

If there is no transverse loading the Rexroth high-performance cylinder can be used as a cost-effective alternative. Apart from their low-friction seals and a special piston rod gap bearing these cylinders correspond to the standard series designed for the heavy industrial applications.
Maximum Dynamics – Servo Control Blocks and Valves

Servo control blocks from Rexroth are compact hydraulic subsystems and support the excellent dynamic characteristics of the hydraulic drive.

Together with the servo valve they form a functional unit that is mounted directly on the servo cylinder.

The standard version can be adapted to suit the relevant application. The compact design means that dead volume is reduced to a minimum. Pressure control valves are installed on both sides of the cylinder to limit the hydraulic force.

In the case of high dynamic mold oscillation diaphragm accumulators can be fitted in the pressure and return lines near the servo valve.

The new 3-stage servo valves from Rexroth are characterized by high dynamics and, at the same time, high flow rates. Further features are the integral electronics and an inductive position sensor for the control spool.
Integral closed loop control electronics are used to adjust all electrical settings, ensuring optimum setting of the controller and the valve dynamics. Servo valves from Rexroth demonstrate a high level of response sensitivity, together with extremely low hysteresis and zero offset. These valves are thus excellently suited to the task of controlling mold oscillation.
MAC-8 from Rexroth – High-Performance Multi-Axis Control

The Rexroth high-performance multi-axis control system generates different types of oscillation which can be represented as the various curve profiles in the graphs below – sinusoidal, asymmetric sinusoidal or saw-tooth oscillation.

The modular multi-axis NC-control system with special hydraulic closed loop control characteristics offers an extensive, freely-configurable control concept for each axis, including, for example, control of pressure and speed and condition monitoring.

Parameters are modified by the multi-axis control in real time by converting into commands to the drive axes. The special features of the hydraulic closed loop control system, such as condition, position, pressure/force, speed and synchronous control, are stored in algorithms, thus simplifying the automation process.

The MAC-8 can either be used as a stand-alone subsystem or can be fitted with a PC display and connected to a master control system. Depending on customer requirements Rexroth can set up the complete visual display system for the mold oscillation with process display, product and machine data, error display and protocol, diagnostics and service displays and trend curves. Moreover, Rexroth will also support external display systems and parameterization.
Thanks to special simulation technology the functional characteristics within a continuous casting plant can be incorporated to meet all your individual requirements at every stage of development.

The design and optimization of closed loop-controlled hydraulic drives require a high degree of experience and a sound knowledge across a wide range of technologies. The complex combination of hydraulics, electronics, open loop control and sensor technology results in a highly sophisticated drive. In the case of mold oscillation HYVOS simulation software is practice-oriented and affords effective support at the development stage of these drives.
The Drive & Control Company

Rexroth is unique. No other brand on the world market can offer all drive and control technologies, both on a specialized and integrated basis. With approximately 28,000 employees in more than 80 countries around the world, Rexroth has an infrastructure designed with partnership and customer proximity in mind. Over 500,000 customers worldwide utilize the know-how of the technology leader.

Intelligent Hydraulics in New Dimensions

Whether it's a case of raising or lowering loads smoothly, undertaking linear or rotational movements, achieving even acceleration or accurate positioning, maintaining preset speeds, transmitting power or linking motion sequences – in fact, wherever economical power is required, this is where hydraulics comes into its own.

Using hydraulic drive and control technology from Rexroth will help you become more competitive than ever.
Hydraulic systems from Rexroth prove themselves for decades in metallurgical installations worldwide.

<table>
<thead>
<tr>
<th>End customer</th>
<th>Country</th>
<th>Facility</th>
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