IO-Link Instead of Fieldbus

Laempe Mössner Sinto GmbH uses IO-Link in a new core shooter machine and achieves shorter cycle times with Turck's QR24-IOL IO-Link encoder

"When I first read about it, I thought: please don't add another fieldbus system. Today I know that IO-Link isn't a fieldbus but quite the opposite. In many areas, IO-Link means for us the end of bus systems because it makes communication simple once again," explains Tobias Lipsdorf, controller programmer at foundry machinery manufacturer Laempe Mössner Sinto GmbH. When the engineer talks about the IO-Link intelligent communication standard, you get a sense of genuine enthusiasm – so too with his colleague Andre Klavehn, who is responsible for the electrical planning. The two of them jointly redesigned the electrical planning of the new machine generation and implemented the automation entirely with IO-Link. The success has proved them right: the newly developed LHL30 core shooter was sold directly from the Gifa foundry trade fair in Düsseldorf 2015. The feedback at the fair was positive – not only with regard to the automation. Today the order books contain more LHL machines.

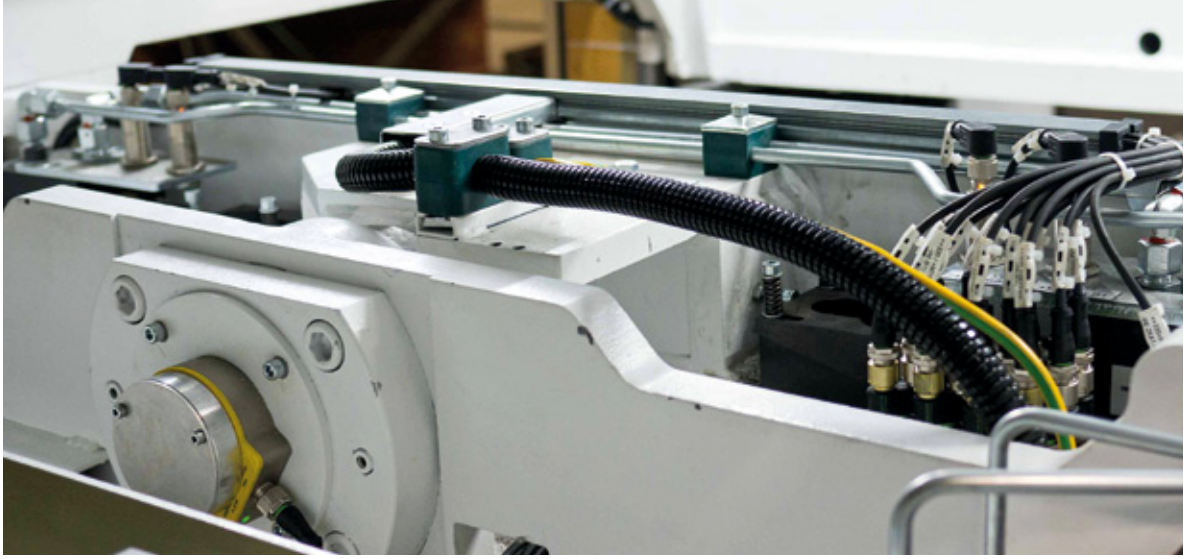
Laempe Mössner Sinto is a global leader in core shop technology for the foundry industry and one of the few manufacturers of core shooters worldwide. The machines produce sand cores for metal casting. If, for example, the casting of an engine block is required, cores are placed inside the casting mold to later produce the cavities of the engine. The cores are "shot" from a binder sand mixture with compressed air into a mold – the core box – at a high speed between 0.3 and 0.5 seconds. The mold mixture is then hardened in the closed core box using process gas or heat and can then be removed. After casting, the binder loses its hardness due to the heat from the filled melt. The cores disintegrate, the sand can be removed from the cast, leaving behind the required internal contour.

A key objective of core shooter manufacturers here is short cycle times. The molding plants installed downstream of the core manufacturing process "swallow up" the cores in 15 second cycles.

Trailblazers in inorganic core production

However, not only the cycle time is critical for modern core shooter machinery. The foundry industry has recognized that foundries will only have a future if

The LHL30 already received a lot of positive feedback from visitors at the Gifa 2015 fair in Düsseldorf



Three into one: Intelligent IO-Link field devices like the QR24 encoder are fitted with a standard cable instead of two bus cables and one power supply

their production is environmentally friendly and meets the more stringent work safety requirements in place. The organic binding agents that are widely used for the sand are burnt during the casting process and emit waste gases that are environmentally harmful and a health hazard. These gases in turn have to be treated using complex filter and extraction technology. The company has extensively pushed the development of a "white foundry" for the manufacture of cores using inorganic binding agents. The improved environmental compatibility and other benefits resulting from these binding agents, however, also present the core production and the downstream processes with several challenges. Laempe Mössner Sinto was the first manufacturer to develop the process from the theoretical solution to a viable industrial process for large-scale use.

The new LHL machine generation is an innovation leap in three ways. Besides the ability to use inorganic binder systems, it is equipped with a highly energy efficient hydraulic system which achieves energy savings of up to 60 percent. With a machine cycle time of only 13.8 seconds on the LHL30, the machine series also sets a benchmark in terms of productivity and efficiency. Machines in this series come in a range of sizes with shoot volumes of 30 to 300 liters.

IO-Link eliminates many disadvantages

It is also an absolute innovation in terms of its automation. "We have incorporated many intelligent components in our machines, which before normally had a bus connection. This meant that we had to connect the operating voltage and two bus lines individually to a positioning system. All three lines were run on drag chains and were consequently put under severe stress," Lipsdorf describes the previous wiring. "If you didn't have any advanced diagnostics systems in Profibus, you could take a really long time to locate a cable break," adds electrical planner Klavehn.

IO-Link rectifies many of these disadvantages: the two bus lines plus power supply are replaced with a standard three-wire cable which is run in the drag chains of the LHL30. "The savings in cost here enable us to use a very high quality cable," Klavehn says. A cable break is virtually excluded and even if it does occur, diagnostics with IO-Link is easy.

All intelligent analog sensors and devices now have an IO-Link interface and are connected to the PLC via an IO-Link master, while simple proximity switches and digital actuators are connected via IO-Link-capable hubs. Sixteen switch signals can be connected via a standard three-wire cable, which keeps wiring effort down to a minimum and also enables the implementation of basic diagnostics for the proxi mity switches. The planners also replaced some proximity switches with analog positioning systems. "With the new LHL30, we tested everything and no longer measured the end positions but the complete axes. This has thus enabled us to now produce a core shooter for Industry 4.0," Andre Klavehn reports, "even if I am quite skeptical about this buzz word."

End position detection problematic

The upper part of the core box on the core shooter can be swung 90 degrees out from its production position to a maintenance position. Depending on the binding process, the design of the core box and the contour of the core, this may be necessary several times an hour in order to check the core box for any residue and clean it. The swing movement was previously detected with end position switches. To increase the speed of the swing movement in other machine types, two additional proximity switches had been installed to

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Tobias Lipsdorf,
Laempe Mössner Sinto

QUICK READ

When the foundry machinery manufacturer Laempe Mössner Sinto planned the new LHL machine series, it decided to implement the entire automation for this with IO-Link. This produces several benefits: Besides costs, the manufacturer also saves the time required for the installation, wiring and electrical planning, whilst customers benefit from a more dynamic and faster machine. Faults occur less often and can be diagnosed and rectified more easily. The swing movement of the core box carrier has a major influence on the cycle time of the machine, and this can now be measured by Turck's QR24-IOL contactless IO-Link encoder.

»Turck's QR24 encoder met all our requirements and successfully passed all our tests, so that we no longer had to look any further«

Andre Klavehn | Laempe Mössner Sinto

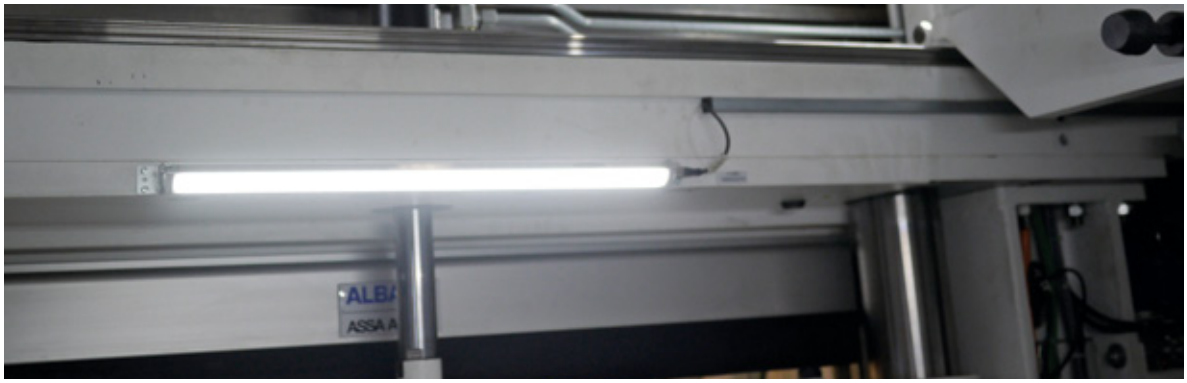
perform the rapid/creep speed switchover before the end positions are reached. This solution wasn't without its problems, as Lipsdorf explains: "Even if we only detected the end positions, it was difficult to find a suitable point for mounting the sensors. In order to detect the exact position, the design required us to fit initiators on the outside. However, the available mounting space for the required holders was limited. With four initiators this is even more difficult because space also had to be found for the two additional ones. Furthermore, in the harsh operating environment of the core shooter, each additional sensor is a potential fault source."

IO-Link encoder detects swing of upper core box

The solution was to detect the entire swing movement. If the rotation movement was detected at the axis of rotation, one bearing point for mounting the encoder was guaranteed, without the need for any additional supports. "For this we looked for an encoder which was as robust as possible, i.e. with a contactless operation, and which had an IO-Link output. Turck's QR24 encoder met all our requirements and successfully passed all our tests, so that we no longer had to look any further," Andre Klavehn describes the fast product selection process.

Turck's QR24 single-turn encoder operates with a measuring principle based on an innovative resonance coupling, which does not require the use of magnetic positioning elements. Thanks to the completely contactless operating principle, the robust sensors are both maintenance-free and wear-free, as well as offering outstanding reproducibility, resolution and linearity over a large temperature range. The QR24-IOL variant is the first contactless encoder with an IO-Link output. Previous IO-Link encoders only used the technology for setting parameters. If IO-Link is also used as a data interface, the user can make some effective cost savings, as is the case here. Expensive shielded or twisted pair cables, as required for conventional analog signal transmission, become a thing of the past. IO-Link works reliably with inexpensive standard three-wire cables.

Besides the cost saving benefit, the QR24-IOL boasts some clever parameter options. The user can select the zero point as required and does not have to make any compromises in mounting and commissioning. The device also enables predictive maintenance. Besides the 16 bits which are output as a position signal, the encoder also transmits 3 bytes of status information. These increase the diagnostic coverage and indicate whether the positioning element is measuring correctly or not, or is being operated in the border area. This information can also be provided early on via the controller, if blows or shocks have caused the encoder or positioning element to become loose prematurely – and before a signal failure occurs. LEDs directly on the encoder show this information as well and simplify diagnostics in the field and the correct mounting of the positioning element.



The WLS-28 dimmable LED machine light from the Turck portfolio is also connected with standard M12 connectors

The core shooters from Laempe Mössner Sinto produce different sand cores for metal casting

The 16-bit resolution of the QR24 encoder and the 1 kilohertz scanning of the angle signal were more than enough for the requirements of this application. As IO-Link does not transmit any overhead, the message reaches the controller in time without any real-time capability needed. The encoder is also provided with a data storage option thanks to IO-Link version 1.1. This enables parameter sets, in this case the zero point and orientation of the signal, to be stored in the IO-Link master and simply reloaded if the device is replaced.

IO-Link simplifies setup and wiring

The detection of the swing movement over the entire distance is already a major benefit when the machines are set up. Lipsdorf has programmed the controller to convert the degree data from the encoder into millimeter position information of the outer movement. This is useful when setting up the machine, if the move to the production position has to be performed from the controller. Instead of running long trial and error movements, the path covered can be controlled directly. The wiring of the entire machine couldn't be easier. "Previously, the electricians sat with the tools on the machine, shortened Profibus cables and fitted the shield manually according to the situation. With IO-Link we only had one large materials trolley with straight and angled M12 cables in different lengths. "That was it," Lipsdorf compares the situation with and without IO-Link.

For the customer it's not only the cycle times that are critical but also the times for cleaning, tool changing and quality assurance processes. This requires the core box to be swung out, which is now considerably faster thanks to the detection of the rotary movement. Another benefit occurs with basic cleaning, maintenance or repair: if cables or connectors are loose or damaged, the machine operator can quickly detect at switch-on whether the sensors are operating fault-free. Through the automatically generated error message, the operator knows immediately whether there is an electrical or mechanical problem and can inform the right specialist. When the swing of the core box was detected with end position switches, it was not always clear whether the core box carrier was located between the end positions, whether the connector of the sensor was loose, whether there was a wire break or whether the switch was damaged. The signal in the controller was zero in all cases. The indicated fault could have several causes.

Neither is the encoder solution expensive in terms of cost. If you compare the cost of four proximity switches with their associated cables and mounting requirements with an encoder with IO-Link, the overall cost of the encoder is less expensive. Compared to the encoders with a bus connection, the IO-Link variant is less expensive anyway.

Faster engineering

The customer recognizes the benefits of IO-Link and now aims to use the interface in the upstream mixing plants and downstream robot cells which Laempe also produces. Although this may sound like work for the PLC programmer, Lipsdorf puts the programming effort involved with IO-Link into context: "Actually everything is much faster now. I no longer have to program two pages as I manage entirely without any additional components and processing units. Apart from three analog sensors with signals we have to convert for the IO-Link master, we only have IO-Link devices in use, which go directly to the IO-Link master on the controller. I no longer need a conventional electrical plan. Nowadays, I just need a table to program a machine. I no longer have to see which signal types are sent in which signal range since the specifications of the devices used are enough."

Conclusion

The intelligent IO-Link interface has found two enthusiastic champions in Tobias Lipsdorf and Andre Klavehn. The initial enthusiasm for new solutions often decreases in time, but after delivering the new generation of LHL30 machinery the two colleagues are certain: "IO-Link is the only new system to date, in which we simply cannot see any disadvantages."

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