

Operator of the future

Investing in sustainability, the environment and safety are high on the agenda in the steel industry today. Important issues in this regard are the prevention of risky activities and improving ergonomics, for example, when performing maintenance or refilling consumables. Recently, Tebulo Robotics has developed new robotic applications to significantly improve operators' working conditions.

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In many cases, setting up a safe and ergonomic working environment may seem easier than it turns out to be in the steel industry's daily practice. This is due mostly to space limitations while having to create sufficient distance between operators and hazardous processes in conjunction with the transport of steel coils. For example, it is still common practice for operators to enter a production line to replace consumables. Not only is this not ergonomic, it also leads to unwanted production losses. A similar situation occurs when performing maintenance on a strapping head, for example, where operators often find themselves in the line. Responding to this, Tebulo Robotics has therefore recently developed new robotic applications, making it possible from now on to perform all of the above activities in a safe working area.

EYE STRAPPER

The first demand for a plant, as described above, came during the pandemic from China's Liangang hot strip mill. This plant processes about 5 million tons of steel annually. After rolling the hot sheet material, it is rolled onto coils varying in diameter and width. Every hour, about 30 coils of steel must be fitted with three straps each and in a timeframe of no more than 120s per coil, including transport. Aside from applying the straps, performing maintenance on the strapping head is an unsafe, if not impossible job for operators as the rolls are extremely hot. Tebulo Industrial Robotics was therefore invited to develop a so-called "eye strapper" for these hot rolls, being a robotic installation fully integrated into the line.

PROJECT

Rob Beentjes, Director of Tebulo Robotics, has described a strapping head as an installation in itself, purchased as a complete electro-pneumatic unit. The control of this is integrated into the control system of the "eye strapper", so that both the robot and the peripheral device are controllable from a single PLC. This was one of the constraints for the development of a 6-axis robotic system. When designing this configuration, careful consideration had to be given to the optimal arrangement for feeding the strap material. This was necessary to cope with the

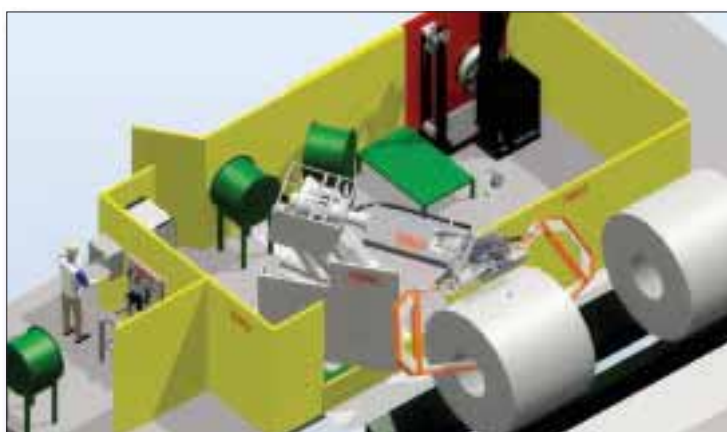


Fig 1 Robotic eye strapper design

enormous variety of roll sizes. The design is shown in *Figure 1*.

It was also important to make the strapping frame and robot tooling as compact and light as possible, while taking into account the temperature of hot rolling. To cope with the latter aspect in particular, engineers from Tebulo Robotics drew on their many years of experience with hot robotic marking systems. Since the strapping head and strapping frame together weigh about 500kg, ABB's largest 6-axis robot was chosen. In addition, the weight limit for the chosen solution necessitated incorporating the solution for absorbing the transverse force into the control of the smart robot software, rather than as a mechanical solution.

ERGONOMICS

Compared with a conventional strapping machine, the strapping head on this robotic system can be made available to maintenance staff in various ways outside the production line behind heat shields, so they can easily access it at any time (*Figure 2*). Consider, for example, replacing the tension and transport wheels. It is also worth mentioning that, depending on the employee's height, the strapping head can be adjusted to the proper working level. So, an employee no longer must unnecessarily bend down or work above his or her height. ▶



🔍 Fig 2 Robotic eye strapper in maintenance position



🔍 Fig 3 Robotic eye strapper installation



🔍 Fig 4 Continuous Galvanizing Line design

REMOTE ACCESS

The above Chinese application was developed entirely in the Netherlands. Next, it was programmed and, together with the Chinese distributor, assembled on site and commissioned remotely. This was realized by building a remote access into the installation so that TEBULO could remotely look into the software from the Dutch town of Warmenhuizen and provide support during commissioning. During final testing, a strapping cycle was first performed without hot steel coils. When this functioned as desired, the installation was put into further operation. The result is a well-functioning robotic installation that has greatly improved safety and working conditions for on-site operators (Figure 3).

COLD APPLICATION

Recently, TEBULO Robotics was also asked by Tata Steel in the Netherlands to consider a possible solution for replacing the existing strapping machines in Continuous Galvanizing Line 1 (CGL 1). To clarify, CGL 1 has two coilers, each with its own exit section and strapping machine. The new solution to be developed had to take into account the existing footprint, the limited space available and the already selected strapping/TIG welding head (Figure 4). It was also important to improve ergonomics and safety for operators. After conducting a feasibility study, the choice fell on TEBULO Robotics. Tata Steel and TEBULO have a longstanding, positive working relationship, and Tata Steel was also inspired by the recently developed innovative cross robots at its CGL 3 and out-of-the-box solution that TEBULO Robotics had realized in China.

CONTINUOUS GALVANIZING

At this installation the galvanized steel coils weigh dozens of tons. To perform regular maintenance and replenish consumables such as strap material, stickers, labels and underlayers, operators in conventional strapping installations have to stand in line, with all the risks that entails. Tata Steel chose to set up both robot installations in such a way that the operators can safely carry out maintenance on the strapping heads outside the line and replenish the consumables. This was achieved by ingeniously making use of the robot's flexibility, combined with smart tooling and peripheral equipment.

ADDED VALUE

Moreover, in the situation described above, this robot application offers a clear added value because, as with the Chinese application, multiple functions can be performed by one and the same robot. Although in principle the Tata Steel application could be performed with one robot installation, the customer explicitly chose to set up two robot installations, to allow for redundancy. Compared with the Chinese application, Tata Steel works with considerably thinner straps, making it possible to make do with a smaller strapping head and lighter robots. Detailed engineering is currently being finalized for the Tata Steel installations. The related manufacturing and assembly are scheduled to take place later this year.

CONCLUSION

With the innovative out-of-the-box solutions described above, TEBULO Robotics now offers the new generation of operators a modern, safe and pleasant working environment, both ergonomically and in terms of safety. **MS**

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