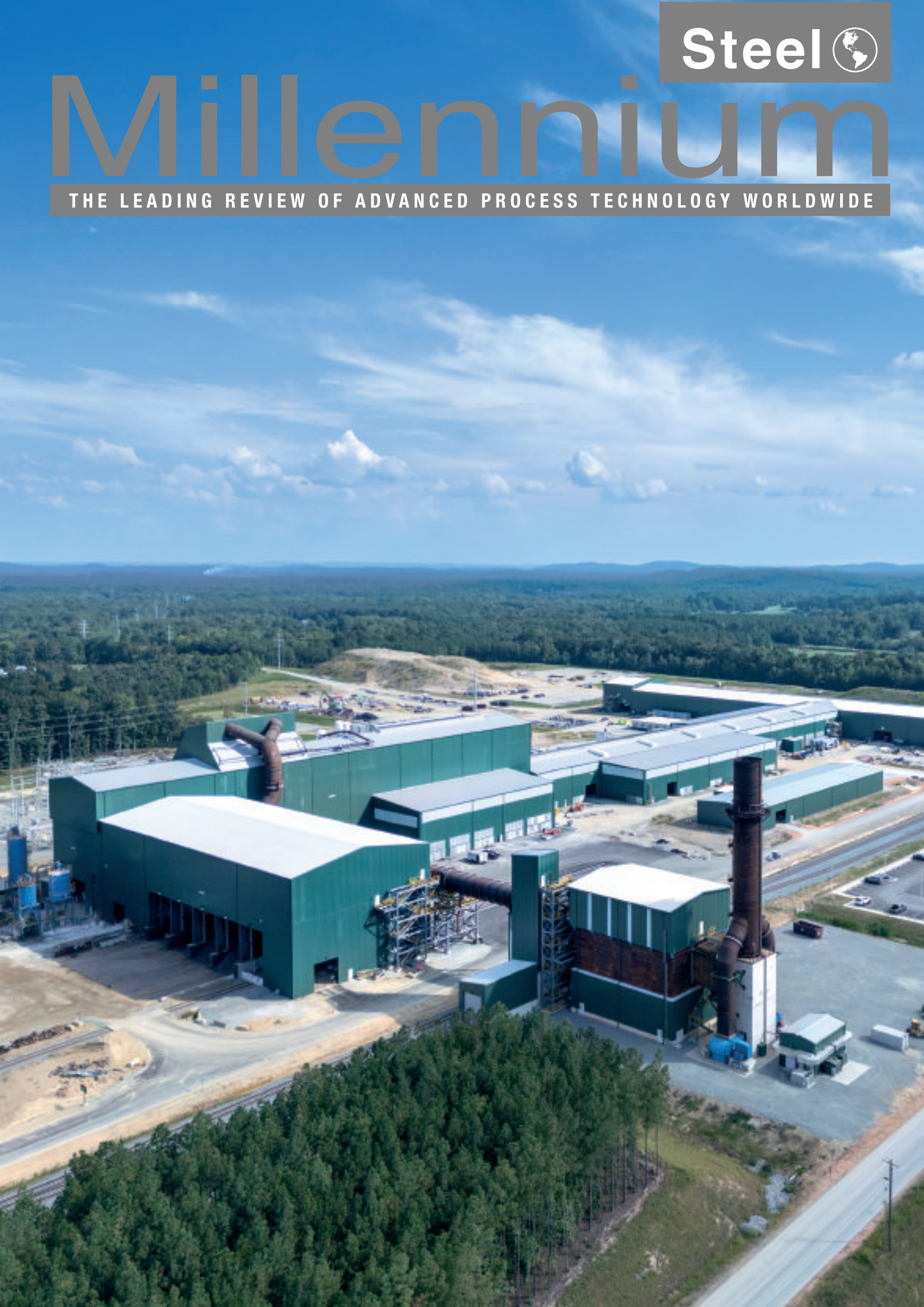


Steel 

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Tata Steel uses robotics to improve the safety and efficiency of galvanizing lines

A recent safety investigation among steel companies into the way (high-strength) steel coils are strapped for transport to third parties, prompted Tata Steel Netherlands to significantly improve the safety of galvanizing line DVL1. Two robotic strapping machines using 19mm x 0.8mm steel strapping were purchased and safety zoning was adjusted. Not only does the line now once again comply with the applicable packaging standard, but the physical safety of operators has also been greatly improved.

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CPR (Tata Steel Netherlands) has housed three galvanizing lines for decades: DVL1, DVL2, and DVL3. DVL1 is the oldest of the three and has been operational for about 27 years. Until recently, this line still used two traditional strapping machines to strap the coated steel coils with 19mm x 0.6mm steel bands before shipping. However, this conventional solution no longer met the current packaging standard. Replacement was necessary.

PRODUCTION PROCESS

All three lines operate 24 hours a day, 7 days a week. They receive steel coils from the hot or cold rolling mills, in various grades, widths, and thicknesses, to be coated with zinc or zinc and paint depending on customer requirements. After processing, the coils are shipped to manufacturers for producing, for example, cars, white goods, or cladding panels. Roos explains: "The production process is continuous. The input coils are welded together to create an endless strip, which is later cut back into individual coils at the end of the process." On average, each galvanizing line has about 7-8 hours of material queued for processing. Annually, about 1,500 kilotons of steel are coated on these lines.

LOGISTICS

All process steps in this logistical chain, starting with casting, were programmed well in advance by the Logistics Department. They are thoroughly familiar with the programming rules and determine which materials may or may not be welded together to keep the process running

continuously. This logistical planning is sent to the SCADA systems at the galvanizing lines, allowing the operators to see which coil enters the process and which one is next.

CUSTOMER REQUIREMENTS

Spaans states: "When I was consulted for advice about new strapping machines for DVL1, the question was whether I could supply a conventional strapping machine with added functionalities for applying seal pads and coil ID labels. I had to decline because adding extra functionality to an existing installation always reduces its reliability. However, I was able to offer a more efficient solution in the form of two strapping robots. A strapping robot with integrated seal pad and label application functionality, all operated from a single, safe location within the production process. The benefit of such a setup is that operators no longer need to cross the coil transport line to replace seal pads, nor do they need to enter the coil transport area for maintenance on the strapping head. This is a significant improvement both ergonomically and in terms of safety. By choosing a robotic solution, the need to thread labels is eliminated. Labels can now be applied directly to the steel strapping by the robot. After applying the label, the barcode is also scanned for verification in the line control system."

ADAPTING AN EXISTING PROCESS

Roos notes: "The biggest challenge in adapting an existing process is integrating the new technology into the existing layout. Older

installations always have physical imperfections that operators have learned to work around over time. For instance, at DVL1, the strapping frame was slightly misaligned. Moreover, space to add new technology is always limited.”

Spaans adds: “At DVL1, we had 8.5m² of space for the first strapping robot and 10m² for the second. In a brownfield project, it’s also important to change as little as possible to the existing installation. Every change can potentially lead to a malfunction, or worse, and that must be avoided. Therefore, we chose not to alter the coil car and positioning saddles.”

SAFETY INTERFACING

Only the strictly necessary safety zones were adjusted to accommodate the two robotic strapping machines. This was due to safety issues that did not exist in the previous setup. Spaans illustrates: “Robots must always be fully enclosed and comply with performance level D. Since the existing safety system wasn’t designed for that, we first had to upgrade the safety interfacing. To exchange more data, the number of I/Os had to be significantly expanded, and the old Profibus system was replaced by Profinet with ProfiSafe. Additionally, existing safety fencing and light curtains were modified, and the zoning layout was updated. This safety interface revision was completed during a yearly shutdown in under a week.”

SAFE WORKING ENVIRONMENT

The new zoning layout consists of four safety zones. Zones 1, 2, and 3 are located within the coil transport area, while zone 4 houses the robotic strapping machines. All activities associated with these machines (changing the strapping, replenishing labels and seal pads, and maintaining the robot heads) now take place exclusively in zone 4, a designated safe working area for operators. There is no longer a need to enter the coil car area. The door to zone 4 can only be opened once the entire system has been brought to a safe and de-energized state.

The pit in which the coil car moves is now fully separated from the area where the robotic machines operate, eliminating the tripping hazards in the old setup. Roos adds: “Even though these optimizations are a significant improvement, we naturally also encountered real challenges. Because the distances between humans and robots are very small, we had



Fig 1 Coil positioned ready for strapping

to take additional measures to meet safety standards. This was solved by installing light curtains with a height of 2.20m and a spacing of 1cm between beams. In that case, different standards apply, allowing work to be performed with a minimum distance of 50cm.”

A view of straps being applied is shown in *Figures 1* and *2*, while *Figure 3* shows a strapped coil.

INDUSTRY 4.0

“It is interesting to note that the entire installation is now prepared for Industry 4.0,” says Spaans. “Because the robot’s strapping head is driven by servo motors and the robot performs →



Fig 2 Robot applying strap to coil

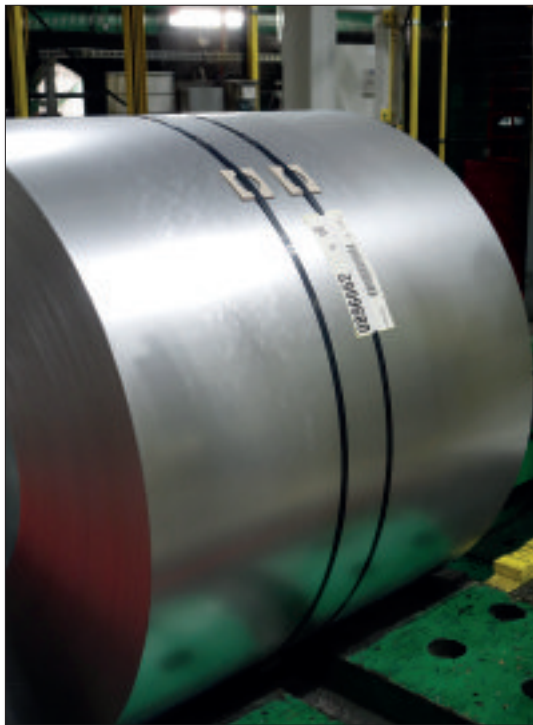


Fig 3 Fully strapped coil

a welding process, various data are continuously collected and can all be logged. With the rise of AI, this offers great potential. For example, it becomes relatively easy to verify whether the correct tensile strength is being achieved or to make maintenance predictions. These kinds of functions are standard but not yet in use.”

Roos explains: “The biggest challenge here is not collecting data, but collecting the right data. We first need to define the goal of data collection and only then can we determine which data need to be logged. With the advent of AI, I foresee a lot of possibilities in this area. These new robots already operate using around 200 different parameters. If a program is developed to monitor those parameters and perform trend analyses, it could certainly contribute to further process optimization in the future. For now, that remains something for the future.”

TRAINING

Finally, a few words about the commissioning. Since the installation of the robots had to take place during a scheduled shutdown, this activity was brought forward in the planning. The additional time created was used to train all shift workers at Tata Steel who work on this galvanizing line. Tebulo Robotics conducted six training sessions in Warmenhuizen, The Netherlands with more than 65 employees from production, maintenance, and day shifts at Tata Steel. During the training, participants learned how to operate the robots, resolve malfunctions, and replace labels and strapping. “The mutual enthusiasm increased significantly during these trainings, and a nice side effect was the high level of acceptance, which resulted in the robots being very positively received when installed on site,” Spaans concludes.

IN CONCLUSION

Although this process optimization involved quite a bit of effort, in hindsight operator safety has improved considerably, as has galvanizing line efficiency. And this is just the beginning. With the arrival of AI, many more exciting projects are on the horizon. **MS**

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