Robotic dross removal is the future

The current production process for galvanizing entails pulling a preheated plate of steel through a 400-500°C zinc bath. Operators must wear uncomfortable protective clothing, while manually scooping the dross from the bath in an extremely hot environment. It is a daily occurring and definitely unsafe situation, with all the risks it entails.Tebulo Industrial Robotics has developed a robotic dross system specifically for such production environments, with smart tools that allow for easy implementation in any existing production process for galvanizing steel, even in limited space.

Author: Henriëtte van Norel
Tebulo Industrial Robotics

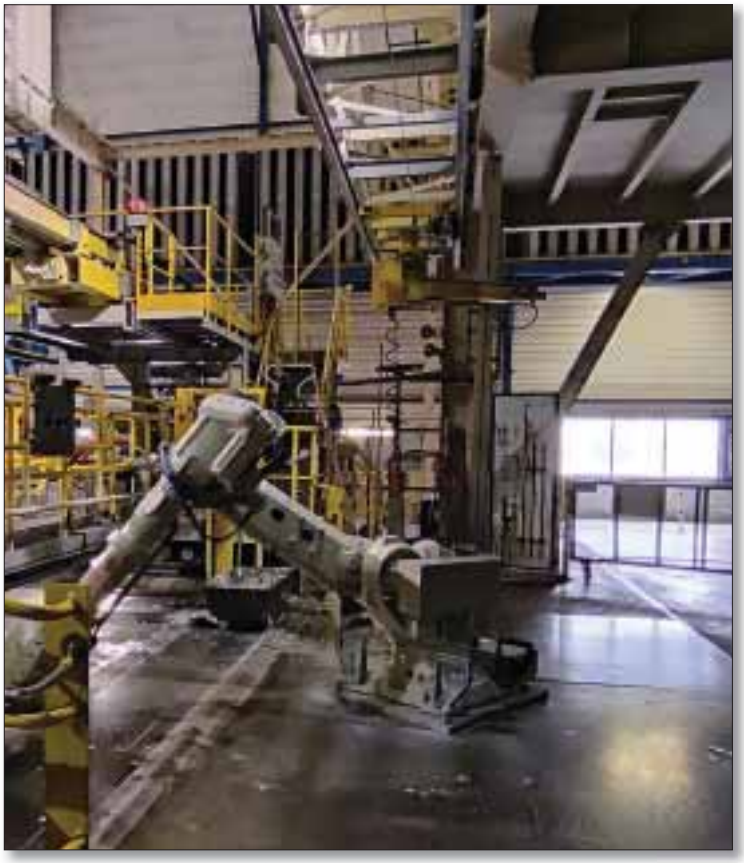


Fig 1 **Front robot**

"To provide 24/7 dross removal from both sides of a steel plate to prevent any contamination, while increasing the operators' safety and ease, and ensuring a continuous, high quality of galvanized steel plates." These were the main instructions for Tebulo Industrial Robotics regarding the development of the recently introduced dross-robotic system. This solution stands out since it may be integrated into any existing production process, in spite of tight space constraints. With the new installation, there is no longer any human interference. The manufacturer opted for an 'out of the box' solution with a front robot and a V-side robot, smart, user-friendly control software and a patented tool changer.

PROCESS

In the continuous galvanizing process, a steel plate is fed through an inert nitrogen environment furnace minimizing exposure to oxygen and dipped directly into a zinc bath. The deflector roll submerged in the zinc bath deflects the plate, which is covered in a thin zinc layer on both sides. As the plate leaves the bath, air knives blow off excess zinc, leaving a wafer-thin zinc coating, of a constant thickness. During zinc application, the steel plate is kept as stable as possible by means of stabilizers, correction rollers and stabilizing magnets. Under extreme conditions, operators must manually scoop the dross from the zinc bath during every shift.

Hans Spaans, Technology Director with Tebulo Industrial Robotics explains: "Often this takes place just too late, causing dross accumulation and contamination on the steel plate. This compromises the steel plate's corrosion resistance and negatively affects the finished product's appearance, not to mention that it causes unsafe working conditions for the employees."

NUMBER OF ROBOTS

Dross removal may be carried out with one, two or more robots. The number of robots used is dependent on various factors, such as the available space surrounding the steel plate, the desired end result, the process in the zinc bath

and the available investment budget. In existing zinc baths the installation of two robots is quite a challenge, as space is limited. Such a situation requires a creative and safe solution, so that the existing installation remains fully intact, while the use of robots allows for the most optimized processing. This was realized by suspending a V-side robot from an overhead rail system over the zinc bath. It was equipped with various tools and programmed to co-operate with the front-side robot (*Figures 1 & 2*).

The track from which the V-side robot was suspended was attached to the existing steel structure of the furnace, allowing it to move from left to right and vice versa. To ensure the required rigidity in this construction, an additional gantry was added to support the track. The V-side robot works with two types of rakes on the steel plate's rear (V-side) and ensures that the dross is offered in a controlled way to the front-side robot's operational area, so that the latter can handle the dross-removal process from there. Both robots operate with an in-house designed tool changer to ensure a maximum flexibility to select the tool made to measure for each individual project application to accomplish an optimized dross removal process. There are two types of rakes for the V-side robot and a total of four types of rakes and shovels for the front robot. It is important that the zinc bath be disturbed as little as possible.

TOOL CHANGER

Of particularly note is the fully mechanically operated, patented tool changer system. This system consists of a tool station with individual rakes and shovels as well as a robot actuated tool changer (EOAT – End of Arm Tooling) with an ingenious attachment system, as shown in *Figure 3*. The entire tool changer system is suitable for the harsh environment. Most of the tool changers on the market are pneumatically, or electrically driven and therefore less suitable for use in heavy-duty environments contaminated by zinc dust. This is what prompted the idea to develop a suitable tool changing system, where the robot with a robust gripper can fetch, return and secure the tools by itself. Thanks to the use of robotic movements additional cylinders and electric actuators are now superfluous. The result is a patented robust solution called the robot-actuated tool changer. The tool station is set up within the robot's reach. As soon as the robot removes a tool, it is mechanically locked in place with the robust coupling mechanism, measured and calibrated.

After use, the tool is replaced and unlocked, which is done via a unique pick-up and parking spot or a kind of key system, based on the Japanese poka-yoke system. The key system is secure, such that each tool has a pick-up point with its own design. This makes it impossible for tools to end up in the wrong place during changing. ▷

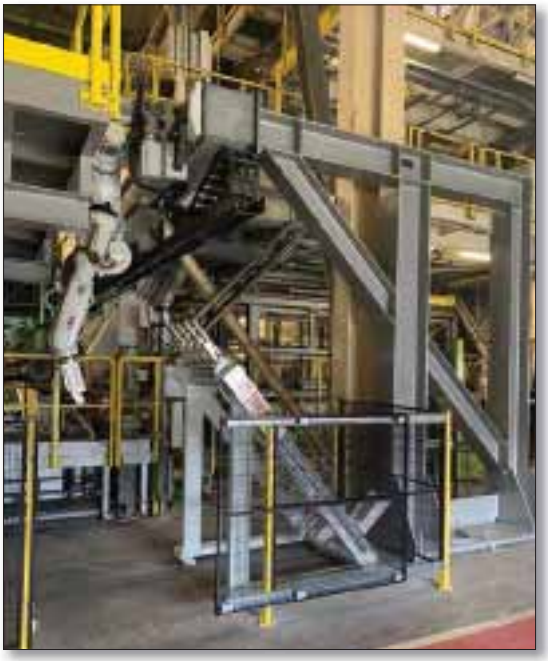


Fig 2 V-side robot on a track with the tool station

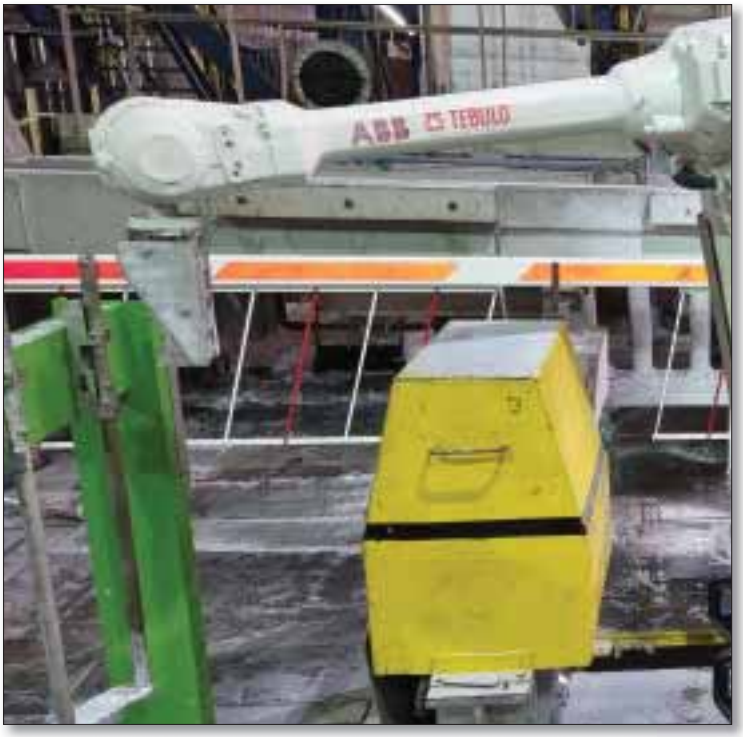


Fig 3 Front robot changing tool

Fig 6 **Front robot filling the dross bin**

all dross scooped from the zinc ends up. Once the empty dross bin is put in its place, the robot is able to detect and confirm its correct position and monitor the fill level, with a sensor integrated into the robot arm (*Figure 6*). When the dross bin is almost full, the sensor reports this to the HMI, so that the operator can replace the bin in time. Moreover, the dross bin tray's level is displayed on the HMI (*Figure 7*).

Fig 7 **Dross bin status**

REMOVABLE FRONT ROBOT

In cases where the steel plate breaks, or if the operator needs more space during a stoppage, the front robot may simply be removed from its spot by a forklift. This creates a completely even, flush floor area, free of trip hazards. An optional winch drive may be set up in the free space to haul the steel plate back into position. Moreover, the free space may be utilised to safely perform necessary tasks for the zinc bath. There is an ingenious robot fastening construction, which allows for continuous positioning accuracy, particularly when considering removing or returning the robot.

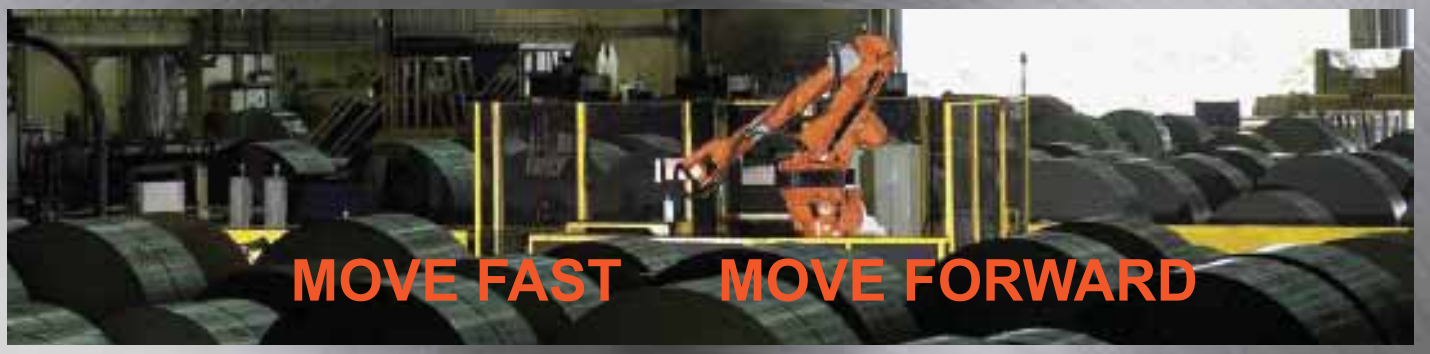
CONCLUSION

The introduction of the aforementioned robotic dross removal system, has substantially improved operator working conditions, as well as the zinc plate quality. This development is extremely interesting for types of industry where continuous high product quality and operator safety are absolute requirements. **MS**

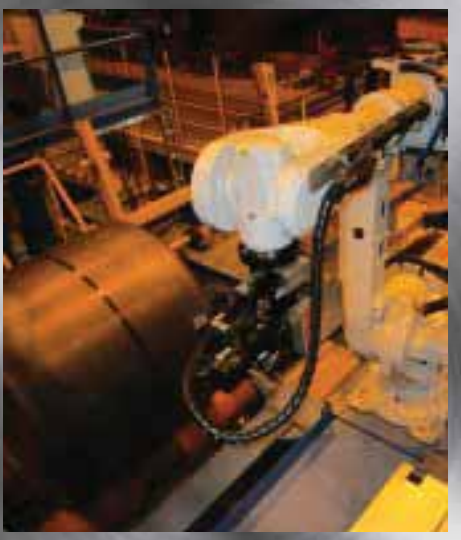
Henriëtte van Norel is Director of van Norel Management Consultancy, based in The Netherlands, working here on behalf of Tebulo Industrial Robotics.

CONTACT: henriëtte@vannorel.com

TEBULO
INDUSTRIAL ROBOTICS



Marking & Labelling
Coils & Slabs

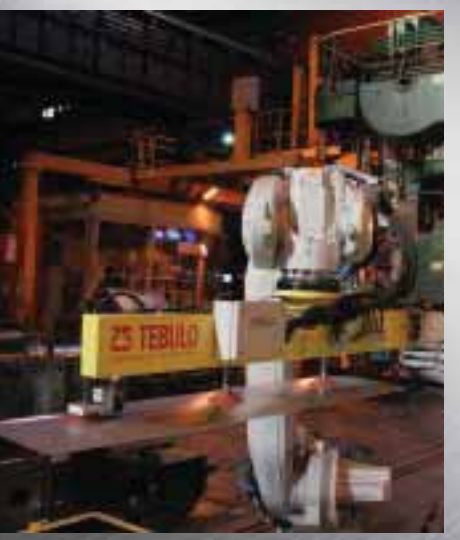


Destrapping of
High Strength Steel Straps

Product Handling &
Specials

Dross Removing

Eye Strapping



Sample Plate Handling

www.tebulorobotics.com