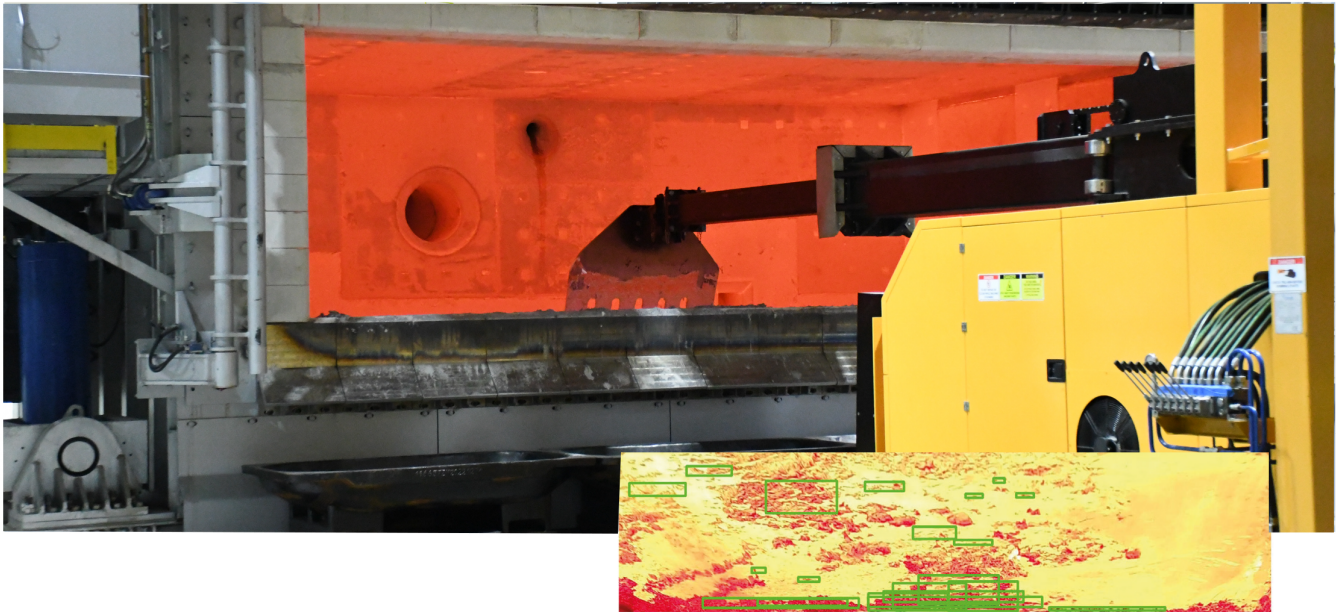# Robotisation of aluminium cast houses

Aluminium is a strategic material for many high-tech industries because of its lightness, flexibility, conductivity, and above all, its 96 percent recyclability. When a disproportionate rise in material consumption and environmental change are combined with an ever-increasing world population, serious concerns about the future of our planet have been raised. As a result, global demand for secondary aluminium production is increasing daily because it requires 95 percent less energy when compared to primary aluminium production.

When aluminium comes into contact with air during the melting process, it oxidizes easily, resulting in dross formation. The dross formed on the surface of the aluminium bath is cleaned by an operator using a manual lever to improve the quality of aluminium alloys by ensuring temperature homogeneity. Sistem Teknik, one of the largest providers of foundry technology, has been improving its capabilities with cast house innovations. These improvements are primarily intended to provide maximum alloy quality while reducing the environmental impact of aluminium recycling.

The fully automated dross skimming robot is one of Sistem Teknik's most important innovations for the aluminium recycling industry. The robot moves towards the furnace on a rail system. When the furnace door is opened, it gradually moves forward along the chassis it is mounted on. The dross is detected with high-temperature resistant cameras integrated into the robot and cleaned from the surface of the aluminium bath with a telescopic lever.

Machine learning is provided by image processing. The digital image captured by industrial cameras is made up of a series of real numbers that are represented by a limited number of bits in computer language. By analysing data collected from machines, learning algorithms are created in large data sets, and industrial operations are optimised with industrial IoT solutions required for digital transformation. Machines become unmanned as a result of this artificial intelligence assistance.

In addition to image processing, the automation team designed a PLC system to provide automated control of the robots. Heat-resistant industrial cameras are also used to collaborate with this PLC system. The distance between the skimmer and the furnace door is measured by scanning the entire field with the PLC system. When it reaches the standard distance determined by machine learning, it sends a signal to the furnace to open the door. When the furnace door is opened, the camera is activated, taking a photo of the molten aluminium surface and detecting the dross position, which is then transmitted to the PLC system.

The industrial cameras ignore the tolerable amount of dross during the image processing to gather the optimal dross level possible in one skimming cycle. After the precise coordinates of the dross which must be skimmed are determined by image processing, it is skimmed at an angle (due to the angled bottom of the melting furnace) into the dross pan located in front of the furnace door. The telescopic lever has been designed to maximise maneuverability and prevent refractory damage.

In addition, Sistem Teknik has developed electromagnetic stirrers to remove the dross from areas that are inaccessible even by the telescopic arm. The electromagnetic stirrer, which is located beneath the aluminium melting or holding furnaces, is lifted to the niche beneath the furnace. Inductors generate a magnetic field, and the stirring process occurs without the need for human intervention or door openings. The aluminium bath is stirred by this magnetic field, ensuring temperature homogeneity and reducing metal loss. When used in combination with the skimmer, the stirrer repositions the dross in the molten aluminium, allowing for a more convenient dross removal process.

To conclude, the fully automatic dross removal process reduces the amount of time the furnace door remains open and eliminates the possibility of occupational accidents and refractory damage. Tests conducted in a 30-ton capacity furnace designed by Sistem Teknik and installed at a customer site demonstrated that the fully automatic dross skimming robot provides approximately 320 tons more annual production because it is faster than manual dross removal. The addition of other solutions such as electromagnetic stirrers further increase efficiency in aluminium cast houses by reducing melting time and metal loss. ∎