Hydro’s new cast house in Cassopolis, Michigan

The aluminium company Hydro has awarded Sistem Teknik (ST) a turnkey contract for the melting line in its recycling development project in Cassopolis, Michigan, USA. The contract includes a melting furnace with a capacity of 50 metric tonnes, specially named as the Supermelter, two holding furnaces with a capacity of 54 metric tonnes, and other items such as a fully automated scrap charging car, an AI-aided dross skimming robot, and an acoustic room for prolonged equipment lifetime.

Despite that Sistem Teknik has previously delivered many furnaces to Hydro around Europe, this contract brings ST’s next-generation low-carbon recycling technology to the USA. Hydro’s decision to work with ST is based on proven capability, e.g. in reducing the environmental impact of aluminium recycling.

Hydro is currently building a new plant in Cassopolis, Michigan, USA ready for operation in 2023 with annual capacity of 120,000 metric tonnes of recycling-based aluminium billet.

Differing from typical melting furnaces with a single pair of burners, the ST Supermelter can melt at least 10 (in this project, 16) tonnes of aluminium per hour. ST Supermelter was initially designed in 2015 as a specific solution that meets the high capacity and speed that are needed by one of the global industry’s greatest players. To address Hydro’s high quality and efficiency expectations, Sistem Teknik has improved the ST Supermelter within the years and turned it into a standard product. The company received the trademark for ST Supermelter in 2021 as the demand for the product has grown significantly especially among large scale producers. While the ST Supermelter relies on an expanded bath surface area and two pairs of high-efficiency regenerative burners for such superior melting rates, the integration of a special-design process control system customized by ST automation team is instrumental for increasing energy efficiency and metal recovery in shortened melting cycles.

A fully automated scrap charging car feeds the furnace in an area that allows no human presence for achieving maximum safety. The car moves towards the furnace on a rail system after the scrap is loaded into the trolley‘s loading conveyor by an operator in the safety zone separated from the melting process. When the car reaches the desired distance to the furnace, the PLC control system designed by the Sistem Teknik automation team sends a signal to the furnace, and the furnace door automatically opens. Following that, the car gradually moves into the furnace, charging the scrap to the furnace bath.

A display is integrated to the safety zone to show information such as the total weight of the charged material, the time remaining for the completion of the melting cycle, the next charging time, and cycle times to allow easier tracking. Operators can track production efficiency for the entire melting and casting processes through these parameters. In addition to enhanced control mechanisms it provides, the fully automated scrap charging car is also beneficial in terms of shortening production cycles and reducing energy consumption in the aluminium recycling process.

Oxidization and dross formation are common problems in aluminium melting plants and significant obstacles against the reduction of the carbon footprint of aluminium recycling. Dross is located at the highest level of molten metal and has a low thermal conductivity. Dross is also undesirable because it causes casting impurities. This inclusion has the potential to reduce cast aluminium quality, increase the oxide patch during billet casting and clog the ceramic foam filter. Conventionally, the dross skimming process is carried out manually by an operator to prevent the results mentioned above.

Sistem Teknik has designed an AI-aided dross skimming robot to provide better qual-

The ST melting line for Hydro Cassopolis, schematic

ity products while consuming less energy. Image processing helps in detecting dross position. After the precise coordinates of the dross which must be skimmed are determined by image processing, the dross is skimmed from the surface of aluminium bath automatically through a telescopic lever, which has been designed to maximize maneuverability and prevent refractory damage. The telescopic arm adjusts operation angle and position according to the angle of the furnace floor.

Image processing is carried out by cameras integrated into the robot. These cameras communicate with the PLC system designed by the Sistem Teknik automation team. The skimmer moves automatically toward the rail system, and the distance between the skimmer and the furnace door is measured by scanning the entire field with the PLC system. It sends a signal to the furnace to open the door when it reaches the optimal distance predicted by machine learning. The camera is activated when the furnace door is opened, taking a photo of the molten aluminum surface and detecting the dross position, which is then transmitted to the PLC system. Following that, the process works and therefore the dross skimming process becomes safer, easier, and faster, without any human intervention.

The project also includes two holding furnaces. The holding furnaces are specifically designed to tilt sideways in contrast to conventional tilting of the furnaces due to the plant layout. The molten aluminum is transferred to the holding furnace which has a lower heating capacity provided by cold air burners that keep the molten aluminium in the liquid phase. The molten metal is transferred to the holding furnace's tap-in module by a launder system. After the necessary alloying and skimming have been completed, the holding furnace is tilted for metal transfer to the casting machine by a heated launder system, which eliminates heat loss. Thus, liquid metal flow is provided.

The molten metal exits the holding furnace at 750°C and flows into the casting machine at approximately 720°C or higher. To achieve the best alloying quality, it is crucial to prevent the molten aluminium from getting colder than the specified value. To that end, electrical or gas-fired heating systems are implemented to launders. A gas-fired heated launder system is used to keep the liquid metal temperature constant during casting. Multiple layers of insulating materials, including porous plugs, are used to ensure quality and safety by minimizing thermal losses to the greatest degree possible. The pneumatic actuation system used for the covers allows for the easy cleaning of the launders.

Last but not the least, Sistem Teknik will be implementing an acoustic chamber to the melting line. The frequency of noise-related hearing loss was found to be 23% in casting industries, where the risks of occupational accidents are very high. As a result, particularly industries engaged in casting operations with high risks require a solution to reduce this risk ratio and eliminate the area occupied by fan systems and the noise caused by them. Hydro has invested in acoustic rooms in its new facility to prevent the health risks that high noise from the fans may cause in the long term. The acoustic chamber also increases equipment lifetime due to the elimination of metal dust and provides maneuverability in installation and maintenance operations.