Optimising Efficiency in Aluminum Recycling: Delacquering Furnaces

The global energy crisis, rising costs, and the Green Deal's requirements push manufacturers to adapt, and industries with energy-intensive processes must evolve more quickly than others. In February 2019, a consortium of 18 companies and research centers around Europe proposed a HORIZON project under the coordination of CIRCE, a technology center from Spain, to enable the use of an increasingly variable, bio-based, and circular feedstock in process industries through retroftting core equipment. Accepting the consortium's proposal, the European Commission decided in October 2019 to fund the Retrofeed project for 48 months with a 9.9 million Euro budget. A member of the consortium and the core equipment provider for the aluminum industry, Sistem Teknik R&D center has been dedicated to the project for the past four years with the goal of increasing material and energy effciency in the aluminum recycling process.

Although aluminum can be recycled infnitely, organic and inorganic components hinder the process by dramatically reducing metal yield. For better melting quality, scrap should be shredded and scrubbed from these components before being charged into the melting furnace. As a part of the Retrofeed project, Sistem Teknik designed and developed a delacquering drum furnace to reduce annual energy consumption on heating and melting processes by increasing the use of scrap aluminum.

Organic compounds are eliminated at high temperatures; meanwhile, inorganic compounds are removed from the surface of the materials when they strike each other during the delacquering process.

Post-consumer scrap is shredded with a double-shaft shredder and collected in the bunker section. Then, it is transferred to the rotary drum furnace by the loading conveyor. The circulation fan system directs hot air into the drum and de-coating occurs as the scrap surface contacts this hot air. Air enters the radiant tube heaters at 800°C and is transferred to the cyclone at 600°C as it passes through the material. Then, the heat from the cyclone is transferred into the afterburner by the circulation fan and the volatile organic components are burned with the heat and used as fuel.

The after-burner's flame prompts the organic materials to burn, generating heat that is then partially transferred to the melting furnace and partially expelled through the exhaust. The exhaust gas is only released through the chimney after going through a heat exchanger. At this point, the combustion air reaches the required temperature. This thermal cycle provides energy savings by not only providing preheating but also using volatile organic compounds as fuel in the process.

The rotational movement of the drum puts the blades inside the furnace body into motion, making chips hit one another and generating friction to scrape the inorganic components from the scrap surface. The residence time of scrap in the drum furnace is adjusted by determining the rotation speed. The scrap that is eliminated from the lacquer and paint on the surface is transferred to the vortex of the melting furnace through the vibrating conveyor.

The advantages of the delacquering furnace developed by the Sistem Teknik R&D Team are not limited to these. Preheating the material before melting speeds up the melting process. The de- coating process, which eliminates the scrap from the paint, increases the metal yield. In other words, even though dross formation will result in some metal loss, this process virtually negates that loss. Waste heat recovery, which benefits both the economy and the environment, is made possible by the use of waste heat from melting furnaces in the de-coating process. Post-consumer scraps are also allowed to participate in the recycling process. As a result, signifcant energy savings and reduction of large amounts of carbon emissions are both achieved.

The products which are developed for Retrofeed Project by Sistem Teknik are focused on lowering total raw material costs, increasing the amount of available raw materials supplied to the furnace, and improving the energy effciency of the facility's main process in order to reduce primary aluminum consumption. In this context, Sistem Teknik continues its research, adheres to the idea of demonstrating environmental awareness while preserving the continuity of the industry, and works in this direction.