

General Extrusions' New Energy Efficient Induction Heater

General Extrusions International (GEI), which came under new ownership at the end of 2023, operates a 225,000 sq ft extrusion plant in Youngstown, OH. The plant houses two press lines, including a 1,675 ton, 7 inch Youngstown press and a new 25 MN, 8 inch SMS press (installed in 2022). The 7 inch press line produces profiles with tight tolerances, requiring strict isothermal controls to ensure a quality product. However, it was heating billet with an older conventional induction furnace (which used a capacitor bank for power factor correction). Due to the aging technology, GEI was experiencing production stoppages and higher temperature variability than desired. Therefore, the extruder decided to upgrade the line with a new induction heating furnace (Figure 1) from extrutec GmbH, based in Germany.



Figure 1. The new induction heating furnace improves efficiency and reliability.

Planning and Installation

The furnace replacement project had several clear objectives—significantly improve process reliability, provide accurate temperature uniformity, and ensure high energy efficiency. In addition, the furnace needed to be installed during GEI's 2024 Christmas shutdown.

Several furnace concepts were investigated during the course of the project. GEI's preferred method, from a process control perspective, would have been to retain and modify the induction coil of the original furnace and also add a new induction furnace to apply a temperature taper to the billet. In this scenario, the original coil would be used to apply the base temperature, while the new furnace would be responsible for accurately tapering the billet.

Unfortunately, this concept proved to be impractical for several reasons, including space limitations, economic considerations (due to complicated billet handling), and finally from a lead time perspective. These constraints led to the development of the state-of-the-art induction furnace concept. GEI awarded the contract to extrutec in

August of 2024, which created a very short timeframe to complete the project during the holiday shutdown. Nevertheless, the project was successfully completed by the required deadline.

"The installation process involved both the GEI and extrutec teams, along with some engineering support services to integrate the new furnace into the existing equipment footprint without requiring a lot of field modifications upon arrival," noted Jason Andre, director of engineering at GEI. "This was critical for it to fit within our shutdown schedule. The installation went smoothly and was completed ahead of schedule, allowing for more pre-production testing and operator training."

New Induction Heater

The state-of-the-art induction furnace has a high throughput (up to 50 billets per hour) and provides a significant space reduction compared to the previous furnace. It includes an energy management system for reduced energy consumption and simplified billet handling compared to the earlier base and taper heater concept.

The new furnace features five multi-layer coils (zones) and a combination of preheat and taper sections in one furnace. The five coils have a total length of 60 inches with a specific design that enables the taper and preheat sections to operate at different power densities. The first two zones (each 15.2 inches long) provide the base heating, while the last three zones (each 9.85 inches long) are responsible for applying the precise temperature profile to the billet. The taper temperature is continuously adjustable, providing either a linear or non-linear taper.

The power to each coil is controlled by a 5 output insulated gate bipolar transistor (IGBT), which uses the latest converter technology (Figure 2). The IGBT converter is equipped with an unregulated diode rectifier to achieve a constant power factor of 0.95 or better in every load condition. A major advantage of this system is that it operates as a direct converter without a resonant circuit to reduce inter-sectional interference.



Figure 2. The IGBT converter allows for better temperature control in the furnace.

The IGBT converter allows continuous adjustment of the power density in each coil section with a combined power and current control. This level of control, combined with the feedback from the thermocouples, results in an excellent temperature accuracy. Billets in an order are repeatedly exposed to the same conditions from entry to exit (Figure 3), stabilizing the process and resulting in less scrap. With billet lengths ranging from 15 to 28 inches, it is necessary to have a field extender at the furnace inlet to compensate for hot spots during the preheat cycle.

In addition, the IGBT converter is equipped with data collection and analysis software for condition monitoring. Each billet can have a data package containing information, such as set temperature, measured temperatures, time in the furnace, energy applied, etc. This helps to define the process parameters through customizable recipes using the five zones in the heater.

“The ability to control the recipe for every billet is a great benefit of this new furnace,” said Andre. “This provides GEI the ability to provide better service and ensure high quality products to meet the needs of our customers.”

It’s important to note that the IGBT converter is “future proof.” When GEI decides to upgrade the press line, then the converter can be used with a future five-coil taper furnace.

Conclusion

The installation of the new induction furnace is an important step in ensuring the efficient production and delivery of high quality aluminum extrusions. With this

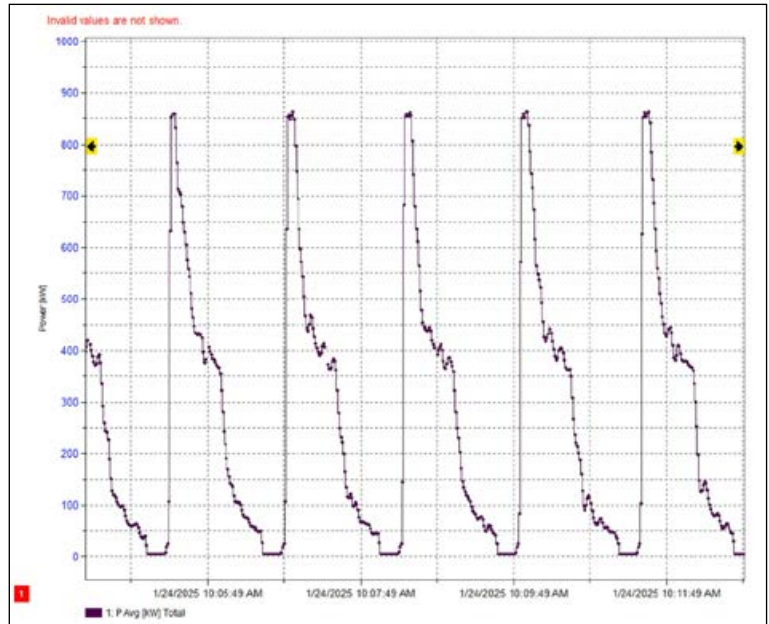


Figure 3. RMS power curve shows the perfect heating of several billets during production.

project completed, General Extrusions plans to continue in the improvement of its operation, through the installation of a new press and additional equipment to increase its extrusion and fabrication capacity. “We are developing and adding to our team to enhance our technical capabilities to meet the requirements of current and future customers,” noted Andre. “We are also working with customers to develop solutions that meet their demands.” ■



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