Increasing Capacity – A Contrarian View

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Outside his world of heat treating, Ron Di Salvio hears music in his head and transforms those notes into jazz. As an accomplished composer and pianist, Di Salvio elegantly transitions his personal interests to his professional helm as president of Trojan Heat Treat (THT) in Homer, Mich.

With 30 years of experience in the heat treating of gray-iron castings, Di Salvio is considered an expert by many foundries. Working in partnership with Grede Foundries, Dalton Foundry, Calhoun Foundry and Metal Technologies, to name a few, the high expectations for excellence in managing processes, flow of material, transportation and on-time deliveries is required and critical for castings. At the foundry, gray-iron castings are most frequently and economically formed from green-sand and shell molding. Typically, THT processes castings ranging from ½ pound up to 750 pounds.

The properties of gray iron are resistance to wear, hardness, strength and ductility. Well known for its excellent performance in applications involving sliding surfaces such as machine tools, cylinder bores and pistons, its performance in internal-combustion engines and machine tools is remarkable when one considers the ease of machining this material (Fig. 1).

As one of the oldest cast ferrous products, gray iron is the most easily cast of all metals in the foundry offering the lowest pouring temperature of the ferrous metals, high fluidity to be cast into intricate shapes, excellent machining qualities and excellent wear characteristics.

The mechanical properties of gray iron are not only determined by composition but also greatly influenced by foundry practice, particularly cooling rate in the casting. All of the carbon in gray iron, other than that combined with iron to form pearlite in the matrix, is present as graphite in the form of flakes of varying size and shape. It is the presence of these flakes – formed on solidification – that characterizes gray iron.

In search for sustainability early on, Di Salvio convinced Grede Foundries' Vassar operations not only to close their in-house heat treat and allow THT to be their sole heat-treat source, but also to 100% visually inspect all castings leaving the THT facility. This led to a 10-year relationship that proved to be a win–win situation for both businesses. THT set up a 20-station inspection facility and visually inspected non-heat-treated as well as heat-treated small castings, wheel cylinders, EGR valves, etc. with a volume of 20 million castings a year.

In March 2005, THT was acquired by Heat Treating Services Corporation of America (HTS) with corporate headquarters in Pontiac, Mich. The choice to sell their business was part of an exit strategy plan already in place. Chairman of the Board George Petredean started THT in 1959 as a captive shop for their other family business, Calhoun Foundry. He was preparing for retirement along with Thomas Petredean, who was involved in THT operations for 25 years. They entertained quite a few potential buyers but settled on Heat Treat Services, which in Di Salvio's words "has proven to be the right choice."

In 2007, an economic downturn forced THT to shut down a 10,000-square-foot inspection facility. Much of the inspection work handled was transferred to other states or brought back in-house to the

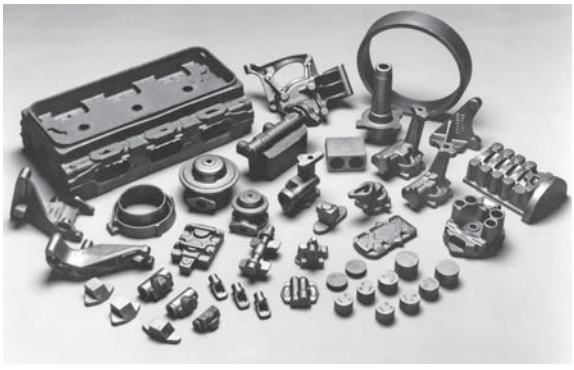


Fig. 1. Parts made from gray-iron castings

Fig. 2. Front view of tip-up furnace

foundry to help reduce escalating foundry costs. Although THT still inspects castings, it's now a smaller part of their transformed and enlarged heat-treat operation, which specializes in all the annealing processes and normalizing.

Moving Forward

Today, THT excels through strategic partnerships with its customers and works together to operate more effectively by understanding the bigger picture. By running larger loads, reducing personnel and improving efficiencies, they have maintained competitive pricing and have been able to absorb much of their increased energy and alloy costs.

During this recent time of economic slowing, Di Salvio has taken a contrarian view by increasing THT's capacity with the addition of a new furnace line from BeaverMatic. The tip-up-type furnace at a size of 40 feet L x 8 feet W x 8 feet H with a 90,000-pound load capability was the answer to Di Salvio's vision for efficiency (Fig. 2). The project began in November 2007 and was on line by mid-February 2008. With an investment of $1.4 million for purchase and installation, THT feels that this state-of-the-art furnace will keep them out in front as a competitive solution to the ongoing rising costs that the foundry industry is subject to.

In just three and a half months from installation, over 7 million pounds have been annealed with a substantial improvement seen in work flow and throughput by stacking and configuring baskets, trays and castings to process daily, back-to-back loads weighing 70,000–90,000 pounds.

Tip-Up Furnace

Simplistic in appearance and operation since there are no internal transfer mechanisms, this BeaverMatic tip-up furnace has three distinct design features, which, when combined, make this furnace highly effective in achieving temperature uniformity of +/-5°F:

- Fan assemblies
- Combustion system
- Opening mechanism

Fan Assemblies

To achieve ±5°F (actual tests indicated ±2°F) temperature uniformity, high-velocity centrifugal fans with diffusers are mounted in the base of the furnace and accessible via the pit. Using a diffuser under each load gives uniformity with consistent and even laminar airflow (Fig. 3). The success of this forced-convection heat application is due to the volume of air circulation and velocity down through the load – required for heat transfer and temperature uniformity. Each of six loads average 15,000 pounds for a maximum load of 90,000 pounds per cycle.

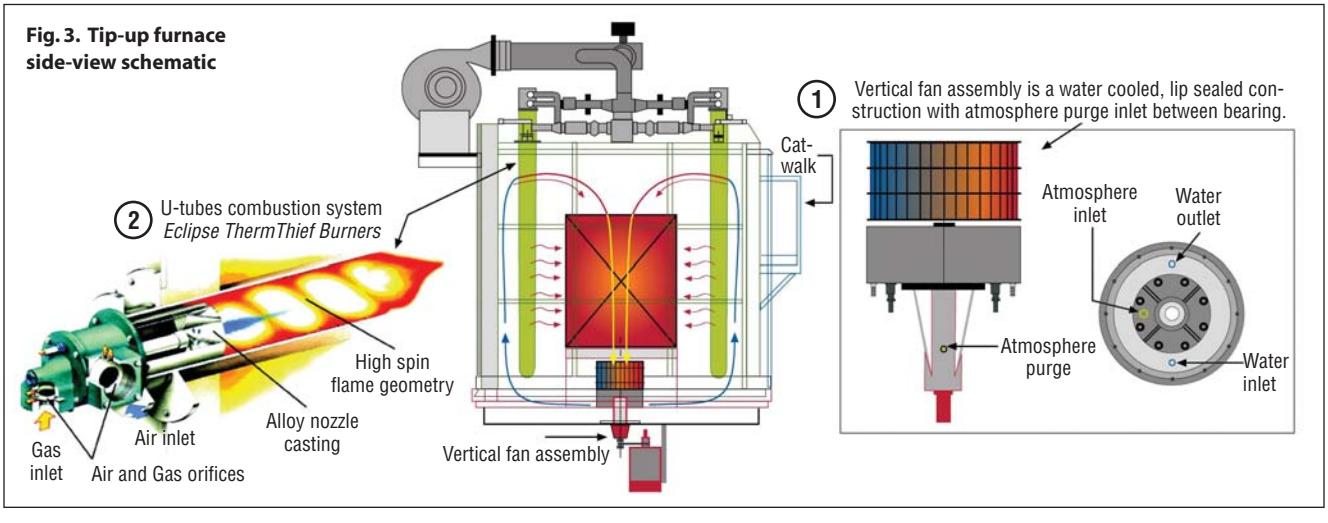
This vertical fan assembly is a multi-blade "squirrel-cage"-type fan specifically for large volumes of flow against low-to-medium static pressures. The performance of each of six base-mounted fans is 13,000 cfm @ 3 inch WC static pressure. Consistency of circulation is critical for stability in annealing large, heavy loads. As a heat-treating process, annealing of castings relieves any internal stresses at temperature ranges of 1000°-1100°F. According to Di Salvio, a slow, uniform stress-relieving cycle ensures the removal of residual stresses without adverse effects on hardness.

Combustion System

First manufactured in 1999, the BeaverMatic tip-up furnace was designed using Eclipse ThermThief burners, which are ideal for indirect heating of tubes where tube temperature uniformity ensures uniform product processing. ThermThief's unique nozzle creates an intense and adjustable-length flame with a vigorous spinning action to remove the gas-film boundary layer and increase heat-transfer effectiveness. The furnace, designed to process 92,000 pounds per hour, has 20 U-tube burners configured into two zones of control for flexibility and product consistency. These burners are gap fired using a radiant tube that is 8 inches ID in the firing leg reducing to 7 inches ID in the return (exhaust) leg with an effective tube length of approximately 103 inches for each leg.

Using natural gas as fuel at 10 PSI, the

Fig. 3. Tip-up furnace side-view schematic



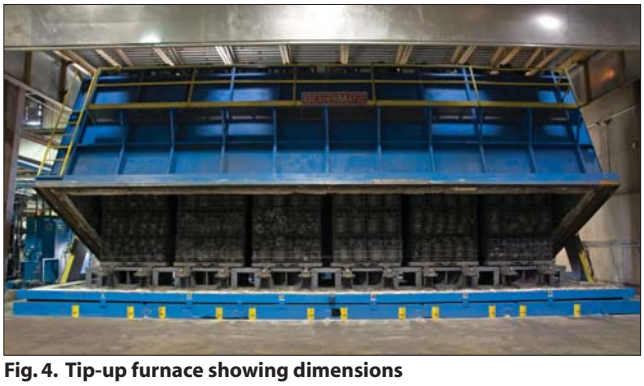


Fig. 4. Tip-up furnace showing dimensions

gross heat input is 7,200,000 Btu/hour with a net of 4,600,000 Btu/hour. Estimated efficiency is 64% with gross input of 360,000 Btu/hour for each of the 20 burners. The combustion system has an exterior-bypass burner system with a 50-HP blower that allows high volumes of air to be used to remove latent heat via the 8-inch U-tubes. The cooling tube takes heat away, reversing the heating tube to shorten cycle time. All U-tubes are positioned and designed to allow for desirable air movement and prevent heat impingement. A typical annealing cycle at THT ranges six hours for 60,000 to 90,000 pounds. Four loads are processed daily.

Opening Mechanism

A tip-up furnace looks like a rectangular, steel box and opens 90 degrees on one horizontal axis. Loading and unloading is easily accessible only from the front using either a forklift or load cart. Its internal work area is 31 feet L x 8.5 feet W x 8.5 feet H, which allows for flexible racking of smaller and larger castings to be arranged for optimum processing. A hinge torque tube with two hydraulic cylinders lift and pivot the furnace shell to allow for loading/unloading (Fig. 4). Opening and closing is speed controlled to minimize sand loss required for a positive seal. The furnace lifts out of its atmosphere seals before tipping open, serving to protect the seals and simplify routine maintenance. Temposonic Linear Encoders are used to control hydraulic-cylinder speeds.

Expectations Met

BeaverMatic Inc. has manufactured thermal-processing equipment for over 40 years, 22 of which have been in Rockford, Ill. BeaverMatic's proven equipment has surpassed Di Salvio's expectations. Based on the furnace's performance and Di Salvio's strategic in-house decisions, THT has recognized significant improvements in all company measures, including financial.

Understanding the foundry expectations well, THT along with its parent company, HTS, provides additional features such as total backup lines for all their equipment, the ability to handle customer surge volumes and rapid turnaround time. The three Pontiac HTS facilities serve the forging industry as well as the foundry industry, and together the four plants have a combined monthly processing capacity of 62 million pounds – equivalent to 23,956 Ford Focuses at curb weight. With eight complete lines and three 22-cubic-feet Wheelabrators available at just the THT facility, it has the versatility to handle subcritical annealing at 1350°F, stress relieving at 1050°F, normalizing at 1700°F and shot blasting. Large, high-volume orders and smaller orders can now be processed together thanks to the recent tip-up furnace installation. **IH**

Reference:

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