Vulcan Aluminum Mill Doubles Capacity with the Furnace on the Hill

By Andrea Svendsen, Managing Editor

Vulcan Inc., headed by president and ceo Tommy Lee (Figure 1), is one of the largest sign makers in the country and the only sign manufacturer to have its own aluminum rolling mill. Over the past year, the company has worked on improving and expanding its aluminum rolling mill, including the installation of a new furnace and associated equipment, along with the rebuild of an existing furnace and the upgrade of its mill. The project significantly expands Vulcan's production of aluminum coil and sheet. The completion of phase one of the project this year will increase capacity from 50 million lbs per year to an estimated 125 million lbs per year.

Figure 1. Tommy Lee, president and ceo, standing on the cooling tower of the mill expansion.

Company Overview

Vulcan began in 1935 as a small traffic sign manufacturer in Birmingham, AL, which became Vulcan Signs and Stampings, Inc. in 1966. Five individuals, looking to chart their own future, purchased two manufacturing plants (one aluminum and one steel) from Vulcan Materials Co. The company later moved its aluminum division to Foley in 1968, with the steel division following shortly thereafter in 1975.

In that same year, Vulcan became the first Alabama corporation to implement an Employee Stock Ownership Plan (ESOP), which gave ownership of the company to its employees. The company has a profit sharing plan that rewards all of the employees at the end of each year and the board of directors approves a stock contribution to each employee's ESOP account. The company currently has almost 300 workers on staff. "All of Vulcan's employees know that they are working for themselves and collectively for the success of the company," said Lee. "Our employees work hard, very hard. They know that if the company is successful, they will be successful for themselves and their families."

In 1982, the name changed to Vulcan, Inc. and the company has continued to grow since it first moved to Foley. It currently has five divisions—Vulcan Aluminum Mill (production of sheet and coil for internal use and external sale), Vulcan Aluminum (fabrication of sign blanks and sheet for the traffic industry), Vulcan Metal Stampings (fabrication, stamping, laser cutting, and assembly of a variety of metals for heavy truck, electronic, construction, and other industries), Vulcan Signs (manufacture and screen printing of traffic control and other signs), and Vulcan Utility Signs (production of signs and markers for a variety of industries). In addition, the company has a Technology Center and an Engineering, Maintenance, and Compliance department.

Vulcan Aluminum Mill: The rolling mill was built in 1986 in order to meet the company's demand for aluminum for its highway sign production needs. The mill included a single production line with a melting furnace (used to both melt and cast from), a Hazelett strip caster (bought used), and a Nash single stand rolling mill (also bought used). Since 5052-H38 is the alloy specified by all 50 states in the U.S. for use in traffic signs on highways, this was the sole alloy produced. "Our leadership consisted of men with great vision who wanted to control their own destiny as much as possible," said Lee. "Not having to depend on other aluminum producers for our needs was one factor for building the mill, and the second was our belief that we could produce 5052 cheaper than the larger mills and effectively take control of the traffic sign blank market."

Since being built, the Vulcan Aluminum Mill has undergone many changes and upgrades over the years. The company runs the rolling mill as both a cold and hot mill by switching out parts between rolls when needed. It produces coil in four widths, 34, 40, 46, and 52 inches. The furnace, which melts both ingot and in-house scrap, has also been upgraded several times, including the addition of an electromagnetic pumping (EMP) system in 2007. Upgrades have also been performed on the caster. In addition, the company has added new equipment, including a BK slitter (bought used), two annealing ovens from SECO/Warwick (the first purchased ten years ago, the second purchased in 2012), and other processing capabilities.

The company still produces only 5052 coil and sheet (Figure 2), which being a versatile alloy, can be used in a variety of applications outside of traffic signs. "In the beginning, all of the rolling mill's output was consumed internally for our traffic sign needs. But as we continued to expand our production output, we needed to look for additional sales avenues to supply our coil and sheet into," said Lee. Today, the majority of the company's stock of coil and sheet capacity is sold to companies in the automotive, irrigation, home and garden, construction, and marine application sectors.

Figure 2. Coil in storage.

Expansion Project

In order to increase capacity and improve quality of its product, Vulcan embarked on a new expansion and modernization project for its aluminum rolling mill in 2012, the first stage of which was completed in October. The expansion includes the installation of a new melting furnace, a rebuild of the old melting furnace (known as "Ole Betsy"), and upgrades to its rolling mill. "We had successfully sold out our capacity and needed to continue to grow," said Lee. "The new equipment will more than double our previous capacity and will be much more efficient."

Construction started on the building that would house the new melting furnace in November 2012, and installation of the furnace was completed ten months later in August 2013. The new building was constructed as an attachment to the existing aluminum mill building, making them adjoining areas for easy flow of metal from the melter through to the caster and mill.

Planning was essential in preparing for the project, and careful consideration was given to the selection of equipment and the installation process. Vulcan had to ensure that the installation and modernization work would be done quickly, and that the equipment would function well in the existing layout once completed. "With only a single production line, downtime is a big deal. It means a stop in operation," said Jim Morris, general manager of Engineering, Maintenance & Compliance. "We had to be sure of the engineering before shutting down the furnace to make the change."

In preparing to choose a new furnace, one of the many aspects Vulcan was concerned with was the selection of the stirrer, knowing the importance of the movement of metal in achieving a fast melt rate and a good, homogenous metal quality. "When you build a melter, circulation is key. You can put burners in as big as you want, but you need stirring to improve melt rate," said Morris. "Burner behavior changes without the stirrer. The burner runs a long time, so the top of the melt is hot, while the bottom is cool, until they slowly equalize. Then the burner turns off and slowly the top of the melt cools, while the bottom remains hot. Eventually the burner has to kick on again, and there is lot of irregularity. Stirrers even out the temperature in the melt."

Due to Vulcan's installation of the EMP stirrer on Ole Betsy, the company also understood the magnetic stirring method, which required no moving parts in the melt. This understanding led the company to consider Zmag America's permanent magnet stirring technology. Following discussions about the equipment and a visit to a Kobe Aluminum plant in Bowling Green, KY, to see the stirrer in action, Vulcan chose a MagStir™ Series II canal stirrer for its furnace.

The furnace was built around the choice of the stirrer. The company selected Gillespie & Powers (G&P) to provide the new melting furnace and its installation, as well as the rebuild of Ole Betsy. One of the key reasons why G&P was selected for this project was because they had installed a Zmag canal-type stirrer before. They had already worked out the challenges of how to build the canal and how to optimize the stirrer for the furnace. For example, in a previous installation, the bridge members of the canal were thinner and were showing signs of cracking, so G&P was able to widen the members, making them thicker and more brick-like for better integration into the canal. The design for the furnace with side mounted stirrer was demonstrated on a water model by G&P, which allowed the company to see how the melt rate was affected and if there were any dead spots.

"G&P is a great company to work with. They're family owned and have been in the furnace industry for years.

Figure 3. New 220,000 lb G&P furnace.

It's great to have someone with that many years of experience," said Morris. "They're very hands on, even their management will be down in the plant, getting their hands dirty to make sure the work is done right. That sets them apart."

G&P installed a 220,000 lb furnace with regenerative burners (Figure 3), provided by Bloom Engineering. Nicknamed "the furnace on the hill," because it is located at a higher elevation than the rest of the aluminum mill, the new furnace has an average metal depth of 34 inches with a 36,000 lb per hour melt rate and a 100,000 lb per hour transfer rate. The company installed a transfer trough system for delivery of metal to Ole Betsy, as well as an emergency tundish drain trough and catch cart, an autotapper, and a leak detection system.

The Zmag MagStir Series II stirrer was built into the sidewall of the furnace with construction of the canal completed by G&P (Figure 4). MagStir uses a patented permanent magnet circuit to create a magnetic field that creates circulation of aluminum. It is fitted in the center of the canal, which allows the aluminum to flow around the stirrer and provides speed and direction control, without the stirrer having to come into contact with the metal. The stirrer canal was designed with tapered openings that allow the flow of the stirred metal to be directed where needed. For example, the metal can be directed toward the opening of the furnace, where the cold ingot and additions are added, providing an improved melt

Figure 4. MagStir Series II stirrer with covers opened to show flow of metal through the canal.

rate. The stirrer also provides good temperature uniformity, another contributing factor for melt rate, and Vulcan has noted a less than a 0-5°F temperature difference between the top and the bottom of the melt.

The improved melt rate allows the company to keep the furnace door closed for longer. "We're able to load the furnace and let it run," said Roger Payton, general manager of the Vulcan Aluminum Mill. "The more times you open the door, the more oxides you create. Leaving the door closed for longer means less aluminum oxide generation." This canal-type stirrer also provides easy and safe access to the melt, allowing operators to take samples and ensure the chemical composition is homogenous.

The four Bloom low NOx 1150 series burners include modular controls to maximize the productivity of the system, while minimizing utility costs and reducing emissions (Figure 5). Maintaining the pressure in the furnace is important, as too much outward pressure results in heat waste, and too little pressure causes the furnace to suck in air, resulting in aluminum oxide generation. Regenerative burners, in which the burners cycle every 40-50 seconds (one burner firing, while the other exhausts furnace gases into a media case), offer advantages in terms of heat recovery, low fuel usage, and temperature uniformity. However, they provide challenges in terms of maintaining pressure, which is upset every time the cycle reverses. The modular system provided by Bloom controls all pressure parameters within an acceptable envelope. It controls each burner independently to avoid major control changes when switching from one burner to the other. Bloom also installed and wrote the program for the Allen Bradley PLC system for the burner controls on the furnace and G&P wrote the program for the stirrer to integrate the controls with the PLC system.

Figure 5. Close-up of one of the four Bloom regenerative burners.

Both G&P and Bloom engineers were on site through the entire installation and startup of the new furnace, and a Zmag engineer was onsite during the stirrer installation. "We've just started up with the new equipment and we're already seeing great results. Between the new furnace and the stirrer, it's all very fast. We have a really high melt rate," said Payton. "We feel we have an excellent melter."

G&P also performed a rebuild of the old melter, Ole Betsy. This included replacement of the southwest wall steel, replacement of the EMP connection (allowing it to be put back on wheels), design and installation of a new heavy duty sill system, relining of the door (after three months of service life), replacement of all burner tiles and tubes, and relining of the entire furnace. A metal receiving port was also installed on Ole Betsy, along with modification of the combustion piping and mezzanine, and installation of a receiving blister from the new furnace.

All of this work on the furnaces has been in preparation to be able to increase the speed of the Hazelett caster. "The Hazelett caster can run just about at any speed, if you have the equipment to support it," said Payton. Before the furnace improvements, Vulcan could run a 160,000 lb cast before the furnace ran out of metal, requiring the operator to stop and reset the machine in order to start over. The new furnace is able to feed aluminum to Ole Betsy. While Ole Betsy feeds metal to the caster during casting, the new furnace on the hill can be charged and begin a new melt, allowing the company to maintain a longer cast than they could do before. With these existing changes, Vulcan can cast up to 40,000 lbs per hour and has more than doubled the size of their cast capacity to 340,000 lbs. The company's longest run to date took about 12-14 hours and produced 600,000 lbs of strip.

In addition to the furnace work, Vulcan performed an upgrade to its single stand rolling mill in September. This included the installation of a new Rockwell PLC system with new screens, two new SES belt wrappers (Figure 6), and a new Mayfran vertical conveyor for trimmings. Installation of the PLC system required the company gut all existing wiring and electronics in the mill and replace them. In addition, the company will install a new bridle section on the entry side of the mill in October. These upgrades will provide better gauge and tension control, enabling the company to provide higher quality coil and sheet products.

Figure 6. The upgraded aluminum mill shown with new belt wrappers.

Ongoing Upgrades

Vulcan does not intend to rest following the current upgrades and expansion, and plans to continue its expansion program, which will be ongoing through 2016. In phase two, the company plans to implement upgrades on its Hazelett caster and to install an additional melting furnace with a capacity of 220,000 lbs. When the melting furnace is installed in late 2015 to early 2016, Vulcan will also retire Ole Betsy, which will be replaced with a new tilting, holding furnace.

"We will continue to be successful by giving our employee owners the tools and resources they need to be successful, empowering them to continue to strive to be their best," said Lee. "We will also work harder and smarter for our customers, providing them with on-time quality products."

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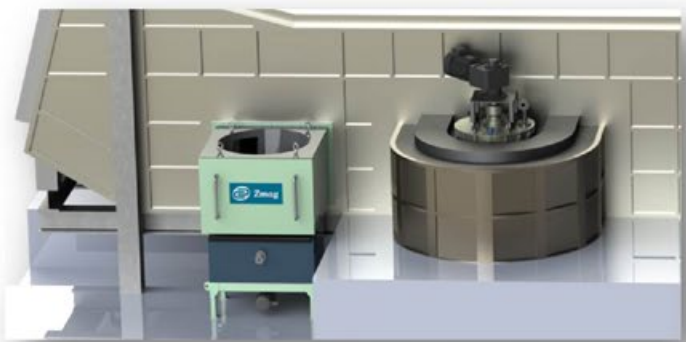

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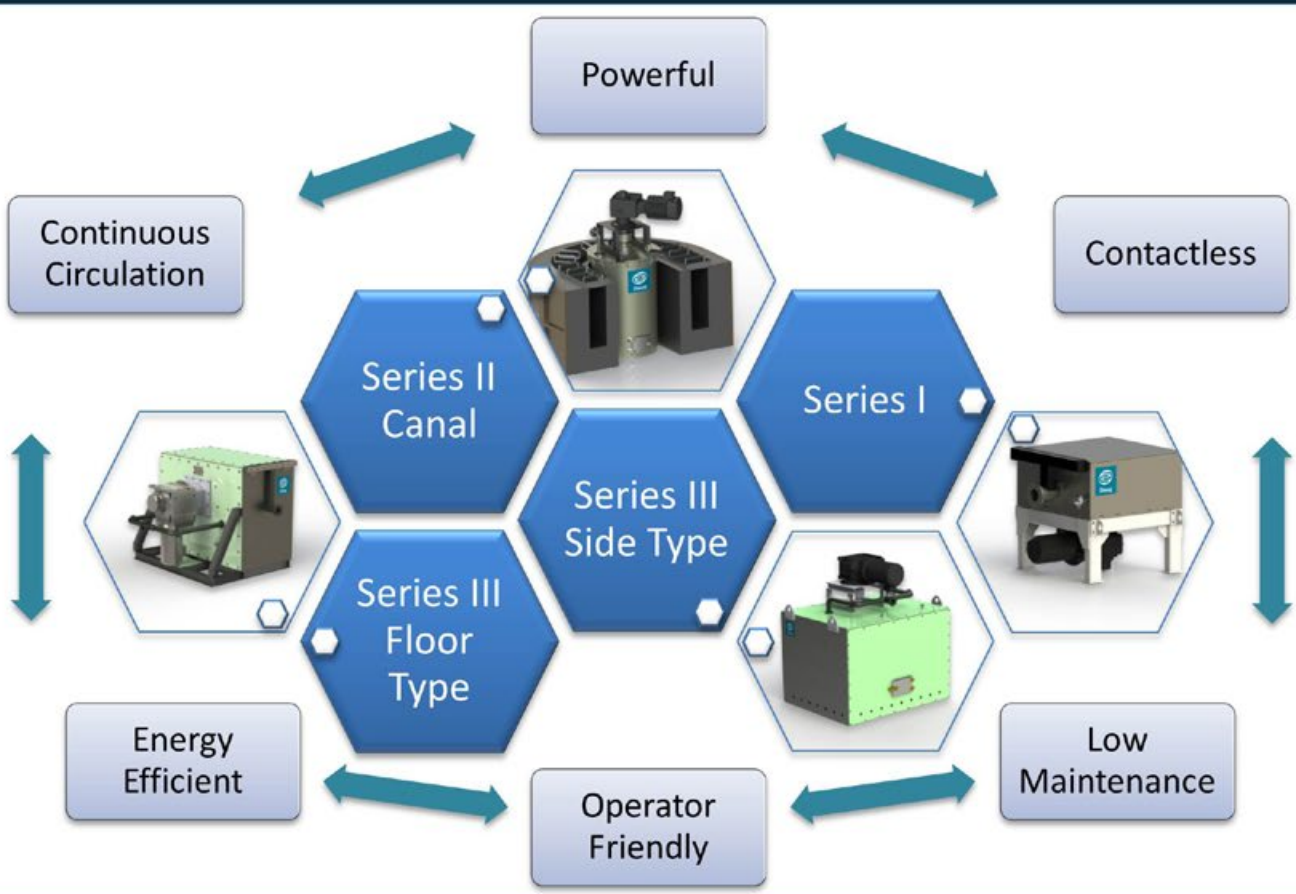

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