

Metalcaster of the Year: U.S. Pipe Turns on Tradition

U.S. Pipe engineered a new kind of ductile iron pipe facility and now is taking the plant to even greater heights.

Shea Gibbs, Senior Editor

The major players in the ductile iron pipe casting industry make products that go into the ground for more than a half century. So it's an appropriate coincidence that for more than 50 years, not a single new ductile iron pipe casting plant was engineered on U.S. soil.

But when U.S. Pipe, Birmingham, Ala., finally completed a new automated ductile iron pipe manufacturing operation in September 2008, it stepped outside of 100 years of tradition.

"We adopted to the iron pipe industry a model we saw become tremendously successful in the steel industry,"

said U.S. Pipe President Roy Torok.

The steel plants he's referring to are designed to run fewer part numbers than their predecessors, and they offer another significant break from traditional steelmaking facilities—they rely on a highly flexible workforce capable of performing a variety of jobs.



The Marvel City Mini Mill, as U.S. Pipe's new operation was dubbed, is the sports car of ductile iron pipe casting facilities. Where the traditional plant (the sport utility vehicle of the industry) produces a variety of pipe types with varying diameters and wall thicknesses, the Mini Mill was designed to perform long and fast production runs of only a few types of pipe.

"This is very people-focused," Torok said. "Anyone can buy the equipment we bought and arrange it. What will distinguish us over time is how successful we are with our workforce."

Since the facility's commissioning, that notion has been put to the test by changing economic conditions. U.S. Pipe's new facility recently was asked to produce more pipe and more part numbers than it was originally intended to make. Fortunately, it has been up to the challenge, in part because

it is able to crank out pipe with half the man hours per ton required at more traditional operations.

Market Forces and Beyond

According to John Pensec, director of communications for U.S. Pipe parent company Mueller Water Products Inc., Atlanta, the health of the company's end markets is based on activity in three industries—residential construction, non-residential construction and municipal spending (repair and replacement of water infrastructure). Pensec said U.S. Pipe's operations specifically are most affected by residential construction and municipal spending.

"We are seeing signs that residential construction may have hit bottom," Pensec said. "Housing starts have rebounded slightly from historic lows. We are also seeing greater attention being paid to the need to repair or replace aging municipal water infrastructure systems."

Remember the housing boom? It had been going strong for nearly a decade when it came to a screeching halt several years ago. "Housing starts declined almost 80% between 2006 and April 2009, when they were the lowest of any month for which data has been collected," Pensec said.

So when U.S. Pipe decided to build a new ductile iron pipe plant to capitalize on some untapped resources

in 2006, it was actually behind the economic growth curve, according to Steven Boyd, the company's director of engineering services.

"It was something we had been wanting to do for a while," Boyd said. "But we needed the right management to push it through." The formation of Mueller Water Products Inc. as a standalone company in 2006 helped drive the initiative.

The strategy was simple—U.S. Pipe was running furnaces at a variety of locations around the country for only 12 hours a day. But the giant cupolas each plant operates run most efficiently when they melt iron 24 hours a day. Why not pair up a new plant with an old plant and use that continuous capacity to feed ductile iron pipe casting lines in both facilities? The new facility would increase the efficiency of the plant on which it would piggyback, and it would allow U.S. Pipe to consolidate some of its less efficient operations, specifically the Burlington, N.J., facility, which was closed in February 2008. (U.S. Pipe has maintained a distribution center in Burlington.)

In late 2006, the search began for a site on which to build the new generation of ductile iron pipe plant. The site that eventually won out was a brownfield location adjacent to U.S. Pipe's existing facility in Bessemer,



Steven Boyd (inset) led the team that engineered the new U.S. Pipe metalcasting facility with the help of consulting firm EC&S. The facility was awarded Metalcaster of the Year honors for building the most advanced ductile pipe plant in the country.

U.S. Pipe Named Metalcaster of the Year

MODERN CASTING selects its Metalcaster of the Year based on the recipient of the annual American Foundry Society Plant Engineering Committee's Plant Engineering Award. The award is presented annually to a North American metalcaster that has demonstrated engineering expertise to advance the capabilities of the industry. U.S. Pipe's Marvel City Mini Mill, Bessemer, Ala., was chosen for its "creative design of a new facility and its equipment, along with

its unique operational strategy [which] has created the most technologically advanced ductile iron pressure pipe manufacturing plant in North America."

Past winners include Blackhawk de Mexico, S.A. de C.V., Santa Catarina, Nuevo Leon, Mexico, Signicast, Hartford, Wis., General Motors' Saginaw Metal Casting Operations, Saginaw, Mich., Dotson Iron Castings, Makato, Minn., John Deere Foundry, Waterloo, Iowa, and International Truck and Engine Corp.'s Waukesha Manufacturing Facility, Waukesha, Wis.

Ala., which produces large diameter ductile iron pipe. The site was a former bridge fabrication facility and perfectly suited U.S. Pipe's needs. Only one challenge faced the plant engineers—the selected location was in a 100-year floodplain. That would come to be a driving force behind several of the engineering decisions the

company implemented in developing the plant layout.

Engineering Marvel

Boyd is a focused foundryman. He is not a job shop jack-of-all-trades, but he knows pipe casting. So when he was called on to lead the engineering team for the 115-employee Marvel

City Mini Mill, he was able to draw on his wealth of industry experience (as well as that of engineering consulting firm EC&S, Birmingham).

The new plant was intended to reduce usage in three areas of U.S. Pipe's existing operations—energy, resources and labor. The improved cupola utilization represented a reduction in energy

Making Pipe Step-By-Step

Ductile iron pipe making is one of the better known metalcasting processes. It's the first to make it to those "how things are made" shows on cable TV, and it produces some

of the highest weights of castings in the industry. But how exactly does the Marvel City Mini Mill operate? Following is a look at the process from start to finish.

1 Metal enters the facility from a neighboring plant on one of two railcars.



2 The metal is held in two furnaces with 195-ton holding (135-ton usable) capacity.

3 Metal is transferred automatically to pouring ladles in one transfer, which preserves energy/temperature. "Every time you pour iron, you lose 50-100 degrees," said Steven Boyd, director of engineering services.

4 Pouring ladles feed two horizontal centrifugal pipe casting machines. The high speed machines are 60% faster than the typical U.S. Pipe machines.



5 Once solidified, the pipes immediately are transferred automatically from the pouring machines to the heat treat lines. Cranes that transfer the pipe are operated by a person in other plants.

use. Resource reduction was more complicated (and proprietary). According to Boyd, the new plant was outfitted with process controls that would allow it to increase its yield. What's more, the capabilities of the machines purchased (which are among the fastest horizontal centrifugal casting machines in the industry) allowed the new plant to produce pipe with thinner walls than could previously be made.

"[Pipe has a] metal thickness standard—a minimum and maximum—but we now have improved control of metal thickness to operate comfortably within standards," Boyd said. "And the closer you can come to the minimum, you are saving metal."

The labor reduction was the most important improvement made at the new plant, according to Boyd, and it was a twofold effort. The first stage of the reduction involved working with the employees' union to allow cross-

training. According to traditional union practices, workers are expected to do their contracted job and nothing else. But in order for the Marvel City Mini Mill to exhibit the flexibility of workforce necessary to match that of the steel industry, the workers had to be willing to adapt to multiple job definitions. According to Pensec, the people employed at the Mini Mill are all classified according to one job definition and are trained (at their own expense) to go from job to job throughout the manufacturing process before they are qualified to be hired. And the training process is no easy road—to date, only 47% of the people who have gone through the training have been hired.

"The people here are far different from anything I'm used to," said Plant Manager Paul Pereira. "We have only one job classification. In most union shops, there are lots of classifications by area."

The second effort was to automate several areas of the plant that were previously manual, including the transfer of metal from the holding furnaces to the pouring ladles and movement of solidifying pipe from the pouring lines to the heat treating furnace.

The plant also was built above ground, essentially on stilts. This was done to avoid equipment ruination in the event of flooding, but it had the added benefit of making the plant easier to maintain, as the inner workings of the equipment can be accessed without descending into pits, which are often built into the floor of other facilities. The Marvel City Mini Mill also operates a high efficiency annealing furnace, which uses heat recovery and special burners to reduce energy consumption and emissions.

Finally, because the new plant has more space to work with, U.S. Pipe now can produce products to the in-

6 Pipe enters the heat treat ovens. Special burners at the front of the furnace and consistent spacing allow the oven to achieve greater capacity.

7 Pipe exits the oven and descends to an extended conveyor in an elevator. The long conveyor allows the pipe to cool, as opposed to using air or water.



8 Ductility and pressure testing and a physical inspection are performed as the pipe moves down the conveyor.

9 The pipe is filled with concrete in a process similar to casting.

10 The pipe is coated with water-based paint.

11 A stripe showing how the pipe should be assembled is painted on each piece.

12 Inspection for final packaging is performed automatically.



13 The pipe bundles are staged and shipped.



The Marvel City Mini Mill's efficient heat treat furnace has helped the facility produce more pipe than the engineers initially thought it could.

dusty standard of 20-ft. lengths, rather than being limited to the 18-ft. pieces the company previously made, an 11% improvement in efficiency. The sum of the efforts has been a facility that has exceeded the expectations of its designers.

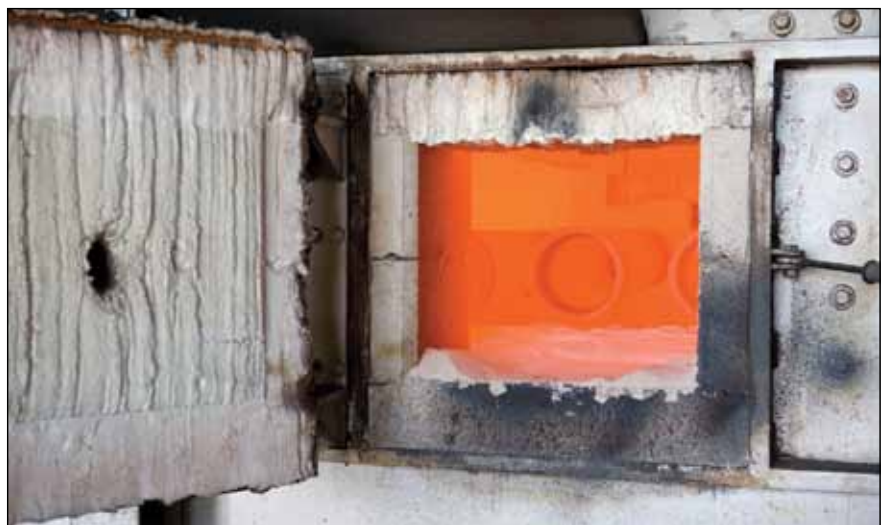
"We wanted the transition from our Burlington plant to the Mini Mill be seamless for our customers," Torok said. "It wasn't seamless. The quality and consistency of the product made in the Mini Mill is greater."

Lean Steps In

Geoff Maffett, director of operational excellence for Mueller Water Products, said that while it may seem counter-intuitive, lean processes are as viable in jobbing environments as they are in high production facilities.

So when the Marvel City Mini Mill was charged with the task of adding products to its daily runs to meet market needs, a team of lean specialists was brought in to allow the plant to continue to produce pipe at levels above the company's original expectations.

The Marvel City Mini Mill makes pipe in four diameters—6-in., 8 in., 10



in. and 12 in.. Each requires different casting machine settings. To produce more part numbers, those settings must be changed more frequently.

Changing among the two smaller diameters or the two larger diameters is what the operators call a minor change, which requires only mold swapping. Going to one of the smaller diameters to one of the larger diameters is a major change. Here, in addition to changing the mold out, several other parts have to be changed. This process can be lengthy. In fact, when the mill first started operating, it took nearly 10 hours to perform a major changeover. Enter the lean team.

"The first thing you do in any [quick changeover project] is separate the internal and external events," Maffett

said. "The team identifies those activities (called 'internal' events) that can only be done with the machine down. Every remaining activity is an 'external' event and must be done while the machine is running, such as staging things line-side so that as soon as the machine goes down, you are ready to fix it." (Maffett suggests imagining a racing pit crew. An internal event would be changing the tires on the car. The external events involve having the new tires and equipment needed to install them in place prior to pulling the car into the pit.)

To lean the process of changing between pipe sizes, Maffett and the lean team videotaped everything in the process, separated the internal and external events and determined where

they could be improved by better preparation. Eventually, they reduced the major change time to 1.5 hours.

Other goals of the lean team have been to perform failure analysis, optimize the number of people required to perform the internal and external tasks and make operators more consistent.

“The flexible workforce is a cornerstone of the whole process,” Pereira said. “When you have these dividing lines between jobs, you can’t serve the customer faster. Everything builds up in a pile.”

The lean team has more to do before it is finished making the Marvel City Mini Mill more flexible. The plant has been ramped up to twice its original production, with plans to take it further due to the consolidation of other facilities. To do so, the lean team will be involved in projects to allow the facility to run the equipment harder without increased downtime and operate both of its casting lines simultaneously.

“We originally designed [the facility] to run one machine at a time with a dividing wall between the two to allow for concurrent maintenance activities, but we can run them both if needed,” Boyd said.

Mini Stepping Back to Prosperity

U.S. Pipe has consolidated capacity—more capacity than it anticipated when it first conceived of the Marvel

City Mini Mill. In addition to the Burlington plant the mill was intended to replace, the company recently closed its flagship North Birmingham, Ala., pipe casting shop due to excess capacity caused by the economic downturn.

But the company’s executives aren’t wary of talking about the hard times; after all, it’s been an industry-wide epidemic. Nearly all of the company’s major competitors also have consolidated capacity.

And most of the execs see reasons to be optimistic about the future. The anticipated rebound in residential construction should start to grow the company back to its previous levels of production, and the greater awareness of the need to replace aging water infrastructure has resulted in some additional funding, according to Pensac. They also say that when and if that bounceback happens, the Marvel City Mini Mill will play a significant role in meeting the demands of U.S. Pipe’s customers.

“As the volume increases, we have the ability to add capacity to the Mini Mill and grow it,” Torok said.

According to Torok, that might mean making further changes to the layout of the plant, adding another pipe machine and tapping into the efficiency of the annealing oven to handle a 50% increase in pipe production. But he hopes it won’t require further consolidation.



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“We have a nice plant, and [our company has] a neat structure,” he said. “We have a plant in California that handles the business on the west coast, the Mini Mill handles small diameter pipe, and the remaining Bessemer plant does large diameter pipe. There is very little product overlap between the three facilities. I don’t see the footprint changing.”

That doesn’t mean the company sees no challenges in its future. Currently, the ductile iron pipe market has escaped much of the pressure other segments of the metal manufacturing markets have felt from low cost countries. That could change, but Torok expects the Marvel City Mini Mill to help U.S. Pipe hold off the competition.

“I believe the culture of the Mini Mill, as its success becomes more evident, will spread to the rest of U.S. Pipe,” he said. “The Mini Mill is the future of pipe. It is the low cost supplier of product in this market, and we are ready to take on all competitors.”

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After exiting the heat treat furnace, pipe produced at the facility moves down a long conveyor to cool and go through inspection.





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**EC&S Congratulates U.P. Pipe
Bessemer, Alabama For
“The Foundry of the Year Award”**

EC&S is proud to have been part of the Design/Build of the U.S Pipe new Pipe Mill. EC&S can Modernize Your Foundry, Increase Production, Reduce Emissions.

