Take Control of Your Wax Room

Four investment casting facilities took different approaches to making their wax rooms more efficient.

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Improving process control helps reduce labor and improve the efficiency of your facility. By controlling the variations of a process, metalcasters control the outcome. The control comes from knowing how the variations affect the end product, monitoring key parameters that affect individual operations and using equipment capable of maintaining consistent performance.

Four investment casting facilities took control of their process variations to reduce costs, improve quality, increase yields and increase productivity, while also increasing profitability. Each investment caster had its own approach to implementation, which fit its operations and specialties.

While process control can come through automation, the investment casters understood that automation is more than merely mechanizing a manual operation to reduce labor cost. They saw it is an adaption of changes to existing processes to eliminate variations and increase productivity by maximizing the use of automated equipment.

Dolphin Precision Investment Castings

Dolphin Precision Investment Castings, Phoenix, produces golf club irons for Ping Golf Inc. and is the only remaining major caster of irons in the U.S. The company also casts some commercial products. One of the challenges Dolphin faces is the cyclic nature of its business. Each year, the requirement for golf clubs ranges from 3,000 per day to 12,000 per day. Dolphin opted to build an automated casting facility that could turn capacity on and off to meet demand without hiring and training temporary personnel to be skilled operators.

Dolphin first looked at automating its casting cut-off due to the high labor content. However, the manual process of pattern assembly could not provide the accuracy and consistency to support cost effective automatic cutoff.

To achieve the necessary consistency, the investment caster worked with a supplier of wax room automation equipment to design a system that automated pattern assembly, increased the number of patterns per assembly, used one set of quick change tooling for the complete range of clubs and provided accuracy and consistency for automated cutoff.

Eventually, the automated wax assembly became part of Dolphin's entire automated operations, which include paste wax injection (cuts pattern cycle time in half), automated pattern assembly, robotic dipping in the shell room, a manipulator for metal pouring and automated casting cutoff.

Using an automated pattern assembly system, Dolphin can rapid changeover parts eight to 10 times per day. The system runs 24 hours a day during peak demand.

In pattern assembly, one operator runs two automated systems to make 18 assemblies per hour, compared to four assemblies previously made per hour by one worker. Scrap from inclusions associated with assembly decreased to near zero.

The automated pattern assembly system runs 24 hours a day during peak demand, with rapid changeover eight to 10 times a day. All operations in the investment casting facility are matched for the same flow, so inventory does not build up.

Pine Tree Castings

Pine Tree Castings, Newport, N.H., a division of Sturm Ruger, is in the process of implementing lean manufacturing throughout its operations. The casting facility used three different processes with three operators to produce wax assemblies. It opted to completely automate its wax pattern area to reduce man hours needed and speed up the process.

The existing process started with one operator running a semi-automatic wax injector for patterns. The operator also inspected the patterns, placed the patterns in trays and trimmed off the runner. Time for this step for a 40-pattern assembly took 10:55 minutes.

The second step involved another operator making runners for assemblies. This took one minute.

Pine Tree Castings compared the time to piece together this 40-pattern assembly when using the original manual process versus a completely automated wax cell.

Finally, a third operation ran an automated pattern assembly system that welded the 40 patterns to the assembly, taking up 6:27 minutes. The total labor time to make one assembly of 40 patterns was 18:22 minutes.

Pine Tree researched the time that would be saved with a completely automated wax cell, which consisted of a fully automatic wax injector for injecting patterns, a semiautomatic wax injector to inject runners and an automated pattern assembly to weld the patterns to the runner. The automated wax cell would require one operator to inject patterns and runners and trim, inspect and load the wax patterns onto the pattern assembly system. The same operator then could remove the finished assemblies and place them for transfer to the shell room. Total labor time for the automated wax cell to produce the same 40-pattern assembly was reduced to 6:27 minutes. Additionally, two operators were freed up to perform other tasks.

"The pattern spacing on the runner is at a higher density, with more patterns per runner," said Adam Kuper, process engineer. "One part has recently been increased from a density of 56 pieces per assembly to a 112-piece assembly. The spacing between the patterns was decreased from 0.3 in. (7.5 mm) to 0.12 in. (3 mm). That's a 100% increase in yield per assembly, and this yield flows downstream to increases in shelling and pouring."

Invest Cast

Commercial metalcasting facility Invest Cast, Minneapolis, also wanted to automate its pattern assembly, with the idea that how an assembly is made can affect throughput for the entire operation, from the wax room through cutoff and finishing. This would usually mean fitting more patterns on an assembly, but in some cases, fewer patterns on an assembly also could improve total operation throughput.

To maximize throughput, Invest Cast needed to tighten pattern spacing on the assemblies, which was not possible when done manually. An automated system allowed it to achieve close pattern spacing to load more patterns on an assembly. For one part, the firm now is able to produce 300 patterns an hour using the automated system, compared to 175 patterns per hour when done manually. Invest Cast decreased the number of patterns on an assembly (from 36 to 16) for another part, but through automation, the company still increased the number of patterns assembled per hour by 144%.

A third part was losing money when it was assembled manually at 60 patterns per assembly. By automating the process, Invest Cast now fits 76 patterns on one assembly and yields a positive profit margin on the part.

Wisconsin Precision Casting measures its wax temperature as it leaves the nozzle twice per shift.

Wisconsin Precision Casting Corp.

Wisconsin Precision Casting Corp., East Troy, Wis., specializes in short run, high value castings. Its goal was to redesign its operation to be more efficient in handling its products, so small quantity orders could be turned around quickly and efficiently, with each department producing 100% yields.

In order to achieve the 100% yield goal, the investment caster decided to implement flow manufacturing and a process control system designed to deliver orders throughout the company's stages of operation with no scrap.

After a comprehensive review of all operations, management found that a key issue was the willingness of employees to embrace change and accept accountability for their jobs. Some personnel changes were made so the right people were in place to manage the changes.

"You can buy all the sophisticated high-tech equipment," said Cliff Fischer, vice president of operations, "but if you do not change the attitude of your people and have them working for the same goal, it will not work."

To help change the culture at the plant, process control became a continual driving force that reinforced the company's goals. Wisconsin Precision also made sure its personnel were fully trained and held accountable for their actions.

The firm's wax room became the first department to implement flow manufacturing and process control because it was the first step in the process, making its impact on the entire downstream operation critical.

A review of the wax room showed that no process control systems were in place. The process was not consistent, and procedures were performed based on memory. Each wax injector was considered unique, so setup cards were specific to every wax injector. No measurements were taken or monitored.

To bring the wax room

process under control, the first item to tackle was the wax. Wisconsin Precision selected a wax that was suitable for both large bulky parts and thin-walled parts. The company uses 60% reclaimed wax and 40% virgin wax for all products.

Wisconsin Precision also recognized that wax temperature was the key process variable for making repeatable wax patterns, so it decided to run every wax injector at the same wax temperature for all products. Controlling wax temperature was considered more productive than adjusting the temperature to reduce cycle time. A constant wax temperature reduces the variability in the injection process, reduces the wait time for wax temperature to change and promotes flow manufacturing.

With a constant wax temperature, fewer adjustments were required during setup, and part changeover problems were eliminated. Supervisors now visually monitor the process from a distance because the wax temperatures on all injectors are identical.

To maintain process control, Wisconsin Precision implemented the following procedures:

- Wax temperature as it comes out of the nozzle is measured twice per shift;
- Wax patterns and castings are measured weekly to make sure the process is not drifting;
- Limits are set for wax flow and pressure, and changes can be made only by a master technician or supervisor;
- The wax supplier must provide test results for each wax shipment, which includes a batch-to-batch historical trend from the wax supplier to see if the wax properties are drifting;
- Operators receive continuous training;
- Each job has an order/process sheet that is followed and monitored throughout the casting process;
- Once a week process review meetings are held to identify and eliminate process problems;
- Every wax injection is counted, and scrap is identified as being made while setting up the job and during production;
- Operators are accountable for scrap, which is logged into an information system that creates an efficiency rating for each operator.

Wisconsin Precision utilized a graphing unit that monitors process control from one wax injector to another, so that a job can run on any of the machines. The graphing unit also allows personnel to move a wax die to multiple injectors with the same quality results and calibrate the injectors.

The investment caster's effort to control its wax room has led to less setup time, pattern rework and effort to supply quality castings to the customer. Dimensional accuracy has improved, and customers return fewer castings. Scrap was reduced from 17% to 3%, and sales increased 72% without adding employees. **MC**

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For More Information

"Improving Investment Castings Through Innovations," *L. Swenson, MODERN CASTING, January 2002, p. 32-34.*