August 4, 2004

ICI 52nd Technical Conference & Equipment Expo
September 19-22, 2004

Casting Yields are generated in the Wax Room

The pressures on foundries today to maintain a competitive edge in the world market is staggering. Countries with lower operating costs have taken away many high volume jobs, and they are doing them with equal quality and lower prices. How are we going to regain a competitive advantage? By operating differently. We need to step back and look at the whole foundry operation from a different vantage point. Two areas that will gain significant casting yields are:

1. Decreasing, or even eliminating rework in every step of your operation.
2. Pour less metal to create the same amount of castings.

The only way to take a significant step in eliminating rework, and reduce the amount of metal poured, is to improve the process control at the front end of your foundry.

Take the shell room as an example. Many foundries have installed automation in the shell room so that the shell coverage is uniform coat after coat. This is a great concept and the dipping operation is extremely repeatable. But is the shell coating itself really uniform from pattern to pattern? When you look at your shell, is it really uniformly covered over every single pattern that is on your assembly? Look carefully, the answer is no. When you analyze what is causing the differences, you can see that it is the variability in the placement of the patterns on the runner. If the wax assembly is not uniform going into the automated shell room, the finished shell coming out of the shell room is not, and cannot, be uniform from pattern to pattern.

Stand back for a moment, and look at your wax assembly. For example, if you presently have a spacing of .400" (10mm) between all of your patterns ask yourself what is the reason for that particular spacing? Is the reason to accommodate for variability in the assembly process? Does that variability prevent the shells from being uniform? Does that variability cause an increase in rework and scrap? Does an increase in rework and scrap cost money? Of course it does, which we have documented during our testing.

Now ask yourself "Is it necessary to build into my process a variable which prevents the down stream process from being consistent?" The variable I'm talking about is irregular pattern spacing caused by manual assembly. This variable, at the beginning of the Investment Casting Process, reduces the uniformity of the rest of the process.

If you improve the process by eliminating the variables in manual assembly, you reduce rework, reduce scrap, and therefore increase yields. What would happen if you reduced the spacing from .400" to .100" (10mm to 2.5mm)? How many more parts could you fit on your runner? Before you say it can't be done, think about the benefits of doing it.

Imagine the yield gains that can be achieved throughout the entire investment casting process. With identical assemblies, automation in the shell room has the ability to be a repeatable process that is in control. It's the first time that every wax pattern, mounted onto a runner, is at the exact same angle, with the exact same spacing and with a perfect weld. The pattern assembly is as accurate as if the entire assembly were injected in a single cavity die. Every wax pattern will be able to meet the slurry at the same angle. You will have the same coverage, the same drainage, and repeatability assembly after assembly and pattern to pattern.

Picture what this means to the rest of your process – In de-wax the drainage will be exactly the same for every pattern. No variation. Metal pour will be repeatable assembly after assembly. Metal solidification will be uniform from pattern to pattern. Envision what this means to your cut off operation. You'll not only be able to cut off automatically, but you'll be able to cut off with accuracy pattern after pattern. Control of the process will allow you to eliminate many secondary and finishing operations. Rework, for the first time, has the possibility of being non-existent.

How can I be so confident? Lets analyze it. With the elimination of the variability that has been entering the front end of your process, you will have the foundation on which to build improved down stream process control that can eliminate rework. Have you ever considered your foundry operating with this much accuracy?

Is it really possible for the wax pattern assembly process to have such a large effect in every single step of the investment casting process? The answer is yes. Ask the question this way. Is it possible to have a downstream step in your process under control, if the first step in the process is out of control? The answer of course is no. Unless the first step of a process is in control, you cannot expect your end product to be repeatable and in control.

Now lets go back to the question I asked earlier. What would happen if you reduced the pattern spacing on your runner from .400" to .100" (10mm to 2.5mm)? I know what some of you are thinking, no way, that's too tight. We can't shell parts that close. But what would you say if I asked you to cast a single part with the same configuration and part features as an assembly with spacing of .100" (2.5mm). You'd say no sweat. It's time to start thinking of the assembly as a single casting. It can be done. Our approach is to create an assembly so accurate that it could have been injected as a single injection. Single injections, which incorporate the patterns on the runner, have and are being done on some high volume parts, and this is extremely efficient.

If you can't build your tools this way or its not cost effective the next step is to automate the pattern assembly process. This can be incorporated using two entirely different approaches.

1. Robotics can be added to your existing assembly operation allowing you to use as much of your existing tooling and components as possible. For example not having to modify your runner. On the surface this sounds like the cleanest and least expensive way, but maximum foundry gains may not be realized. The way this is incorporated can greatly effect the down stream operation and needs to be carefully studied in order to achieve maximum gains.
2. A second approach is to evaluate the inconsistencies of each step of your entire foundry operation from part cut off and finishing forward to the wax room. Carefully evaluate each foundry operation. Some examples of the thought process might be.
    a. Finishing: What type of finishing work is performed on each job and why?
    b. Cutoff: Why is there so much gate material left after cutoff? Why is there weld repair after cut off?

c. Knockout: Why are some castings cleaner after knockout than others?

d. Casting: Why are there some trees that have a higher yield than other trees of the same part? What is causing casting inclusions?

e. Dewax: Why is there more ash in some cavities than in others?

f. Shelling: Why are the wax patterns not uniformly coated and the holes filled identical from pattern to pattern if the wax assembly is dipped robotically each and every time?

g. Pattern assembly: Why do wax assemblies vary from assembly to assembly? Why do you have pattern break off?

Every one of these examples can have a direct link to pattern assembly and the correct approach to pattern assembly can impact positively the yield gains in each department.

MPI is offering a version of automated pattern assembly that considers the yield gains in each and every department of the Investment Casting Foundry.

Please visit MPI in booth 501 and see automated pattern assembly in action.

Thank You.