3D Printed Sand Molds: HOW DOES THIS HELP YOU?

TRIDENT ALLOYS

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INTRODUCTION TO 3D SAND PRINTING

When it comes to the foundry industry and the technology that has been utilized to create prototypes and production castings there have been minimal changes. The technology of the foundry industry is one of the most researched areas within the respective engineering discipline and therefor it beckons the phrase "If it isn't broke don't fix it". 3D printing is beginning to change that line of thought by introducing new ways of looking at a job. 3D printing is bringing new advantages to the foundry industry for parts buyers to take advantage of and there are 2 that make the biggest impact, shorter lead times and reduced cost.

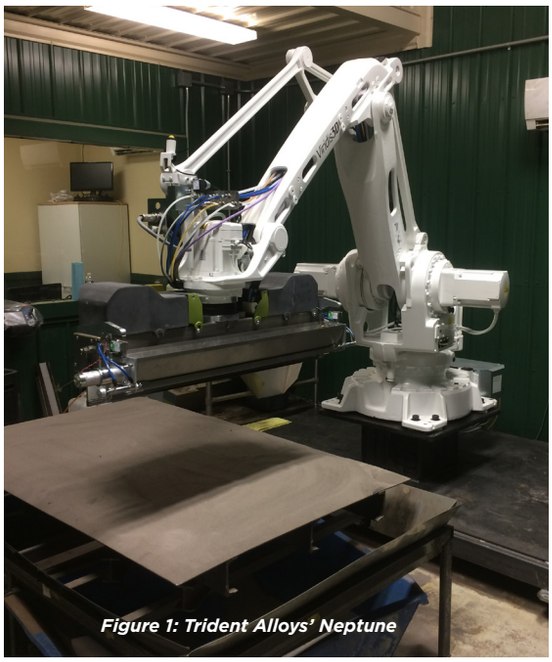

Figure 1: Trident Alloys' Neptune

THE PROCESS

To most people they are still unsure what 3D sand printing is and how it relates to molding. In its simplicity Viridis3D's sand printer, as seen in Figure 1, is similar to the modern inkjet printer in homes today. Each print pass can be seen as the next piece of paper that was printed and the binder can be seen as the ink that prints the words on the paper. To go a little more in-depth the sand printer uses binder jetting technology in which furan binder is deposited in specific patterns to bond individual layers together to create the mold. This mold is comparable to existing no-bake technology in strength and surface finish all without the need for an expensive wooden/metal/polymer pattern.

The process flow for 3D sand printing is very similar to traditional mold making so any large production orders can be transitioned flawlessly if the need arises. The part begins as a 3D model or 2D drawing provided by the customer, once a satisfactory casting model is achieved (i.e., machine stock added, fillets added) solidification analysis can begin using SolidCast. Running solidification analysis the foundry engineer can design and redesign the rigging (gating and risering) system quickly and efficiently. The major advantage to this is that when the part goes to the foundry floor there is a high confidence that the casting will be sound as the solidification software has predicted/shown where risering was needed and a proper gating system calculated based on known theories.

With a final rigging system designed and verified, through solidification analysis, mold design can begin after the material shrinkage is added to the casting model. At this point the foundry engineer must envision what the mold is going to look like when printed. It is up to the engineer to create this mold as separate pieces, traditionally known as the cope/drag. Unlike traditional molding however, 3D printing is not limited to this thinking. With 3D modeling the foundry engineer can create what works best for

that particular casting by cutting the mold into several sections to allow for easier cleaning and handling or even removing mold material in areas that are unneeded to reduce cost and weight on the final mold. Once a final mold package is designed and assembled into a build file printing can begin.

Printing is simple, with the slicing software provided with the computer doing all of the hard labor this part of the process is plug and play. The build file is imported into the software and centered on the build table, once centered printing can start. The 3D printer can run autonomously with very limited outside action needed by an operator. The operator is limited to occasional maintenance and cleaning on the print heads, as well as ensuring the sand is properly supported as the build progresses in height. With Viridis3D's current printer technology the rate of printing is at 2.25in/hr on average and a curing time of 30 minutes to 2 hours depending on the size of the mold printed. It is typical to print a mold and pour it the next day with the time in between utilized by the operator, during another print cycle, to clean all the non-printed sand from the mold and add a mold wash to the casting cavity. This mold wash that is applied increases the quality of the surface finish. The unprinted sand can be easily removed by vacuum or hand without worry of disrupting the mold surface. The clean and washed mold can be assembled the same as existing foundry

Figure 2: Partially assembled 3D printed mold

molds. If the foundry engineer designed the mold right rebar can be utilized to aid in lifting the pieces and in closing the mold. Figure 2 shows a partly assembled mold, in the picture internal riser sleeves can be seen as well as an intricate core.

THE ADVANTAGES

This technology in regards to sand casting gives several advantages to the foundry that are passed along to the customer. The biggest advantage to 3D printing is reduced lead times. 3D printing was created with rapid prototyping in mind and printing with sand is no different. The foundry can utilize 3D printing to produce a casting in the time it would take to even receive the pattern. The foundry is looking to print low volume orders for prototyping or replacement parts. The low volume orders translate to cost savings for the foundry and customer as no expensive pattern or major rework are needed. The rapid prototyping nature of 3D printing allows quick modification to any design or casting material changes with no downtime since there is no pattern that needs to be worked on for what may amount to several days. The modifications can be implemented within minutes of the results from the previous mold being seen, however with the utilization of solidification analysis there is a 90% confidence in the first iteration. Lastly, there is an abundance of cost savings for the customer as there is no hard tooling, no need for storage, and no repair/upkeep. Everything can be stored on a flash drive to be used again in short notice if that particular casting is needed within a couple weeks.

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