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American Foundry Society

Wonders of Technology

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We went to see what it was all about and what I learned really opened my eyes to the opportunities new technology offers.

Just a few months ago we had a chance to work on a project for the Ford Motor Company's Engine Manufacturing Development (EMDO) Group in Dearborn, MI. making sand cores and molds for casting metals directly from CAD drawings. EMDO selected the "sand printing" machines for this process as designed and built by Prometal Co., a division of ExtrudeHone Corp., of Irwin, PA and the purpose of our visit to Prometal was to become better acquainted with the requirements and functions of the process. Before settling in to discuss the purpose of our visit we were given a quick tour of Prometal's facilities and their activities.

Fig.1

Now, let me ask you something. If you were given the assignment to make the small casting shown in Fig.1, how would you make it? Impossible, you say? Well, it may be impossible to cast by conventional methods but state of the art technology today makes it possible to produce this part in it's finished state in just a few hours using only a CAD drawing file, powdered metal and a sintering furnace.

Originally developed and licensed from the Massachusetts Institute of Technology, the process utilizes a 3D printing concept. The 3D CAD model is transferred to the Prometal machine which spreads a smooth layer of metal powder over a platen. An ink-jet type print head then prints a slice of the CAD image, depositing millions of minute droplets of binder per second. The binder quickly dries and another layer of metal powder is deposited onto the binder layer. The process is then repeated until the full 3D part is completed.

Once completed, the "green" part is placed into a furnace and sintered. The binder is burned away leaving a structure with approximately 60 percent density. A second furnace operation then infiltrates the part with filler metal such as molten bronze or stainless steel via capillary action allowing the part to achieve full density ready for further use as a model or finished part.

Now, rapid prototyping in general, as demonstrated by Prometal's RCT (Rapid Casting Technology) in a certain way, is nothing new since the technology has been around since the early seventies when prototype castings of all sizes were made without tooling. However the introduction of computer aided drawings (CAD) and the development of various CAD-driven pattern and mold-making methods in the nineties dramatically changed the way castings were made without tooling.

Coming back to the original purpose of our visit we learned that Prometal's recently introduced RCT is actually a systems approach developed to manufacture sand cores and molds without needing a pattern or a series of patterns. Using only the 3D CAD printing technology, some foundry sand, binder and an activator you can now "print" (produce) complicated sand molds and cores in a flask-like job box in only a few hours. For a sample core package made by this process see Fig. 2 below.

Measuring approximately 36"x30"x60" the job box can hold a number of various cores at the same time, in fact, the entire core package for a motor block easily fits into the space with room to spare.

And here's how it works.

Fig. 2

The equipment consists of a sand printing machine, a sand delivery system, a mixer to coat the sand with activator, a vacuum system to remove the loose sand and a job box conveyor system to index the job box in and out of the printing machine and to position it to the unloading station. The sand molds, cores or core packages are built in layer-wise fashion. The 3D CAD models of the parts to be made are uploaded into the machine's computer and the empty job box is positioned. The machine then deposits layers of sand and binder added in sequence. A thin layer (approx. 30 microns thick) of pre-mixed sand coated with activator is spread across the entire bottom surface of the job box. The sand is mixed with activator just before spreading.

Next, a layer of millions of minute droplets of binder is spread on top of the sand layer with the droplets of binder placed selectively onto the sand layer to match the outline of the particular layer of the 3D CAD model. The process is similar to an inkjet printer with the printhead dispensing the binder onto the layer of sand. The binder and activator on the sand grains then react chemically and harden to form the 3D shape of the parts to be made. This process of a layer of sand across the entire job box followed by a layer of selective binder droplet location continues until the entire part is completed. A job box full of cores, molds or core packages can be completed in about 15 hours. The process is automatic and does not require operator intervention.

After the printing for a job is completed the job box is moved to the unloading station where the loose filler sand - sand that was not covered with binder - is removed with a vacuum wand, exposing the completed core or core package. Inspecting the surfaces of the finished cores it was amazing how perfectly smooth the surfaces are, edges and corners are sharp and there is no indication of layering, at least with the naked eye.
Talking about flexibility in core design - if you need to make changes, just revise your CAD model and 15 hours later you are ready to pour.

Faster, cheaper ,better - is the battle cry in the marketplace today and the RCT process certainly is a novel way of using technology towards that goal.

After you have settled on a core design and no more changes are necessary to start production you can then concentrate on the tooling design to make the parts your customer ordered. And if you are interested to find out more about CAD for Cold Box Tooling Design you should mark your calendar for our next AFS meeting on Thursday, March 17, 2005 and come hear what Mark Adamovits of Ashland Casting Solutions has to say about the subject. Mark is an expert in his topic and even if you get just one tip or idea that you can use in your work it will be well worth your time. For meeting details check our website, click here http://www.afscentralohio.org and make your reservations.

Do it now!

PS: Isn't technology just amazing. Maybe in the not too distant future all we have to do is think about something and it will materialize in front of us. The idea is probably no more absurd today than if the idea of RCT technology would have been presented when the first cannons were cast in the civil war. Wasn't it Napoleon Hill who said "What the mind of man can conceive, he can achieve"!? It's Wonders of Technology.

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