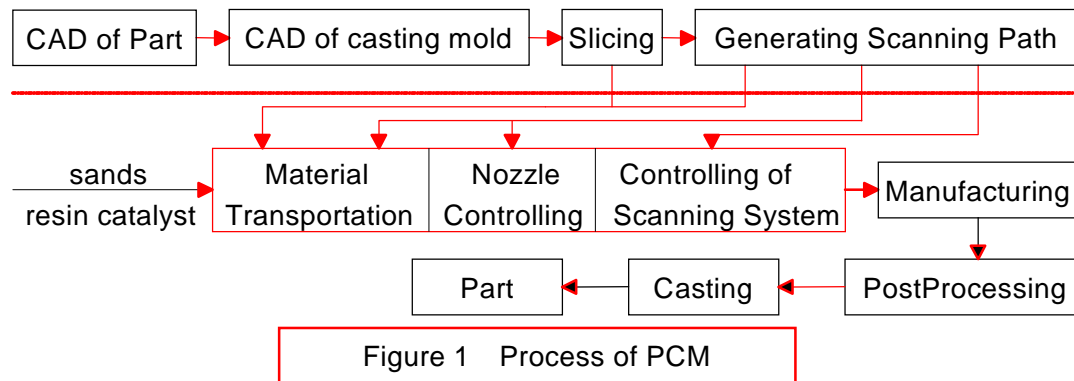


## Introduction of PCM Modeling Process

The PCM (Patternless Casting Modeling) process is also based on the disperse/deposit forming principle of RP technology, and it is a kind of new modeling method that is different from the traditional ones. In one word, the modeling process of PCM can be illustrated by figure 1. In every layer of sand, the first nozzle scans along a given path and deposits resin, then the other also scans along the same path and deposits catalyst. On the profile of the cross section of a mold, resin and catalyst interacts with each other and the relation between them binds the sands together. Where there is no liquids, the sand is still loose and can be cleaned easily. After all layers are finished building, the mold is complete. After loose sand is taken out, the mold is covered by dope and is ready to casting.



On the one hand, resin and catalyst must bind sands rapidly during the modeling process. On the other hand, the casting mold is not only need to have a curtain shape, but also need to meet the requirement of strength, heat transfer, mass transfer, and so on. It is the basis that implements the process and the key which determines the final quality of casting mold.

During the modeling process, each parameter must match the others. These process parameters include the scanning velocity, liquid flux, sand granularity, slicing thickness, and so on. It is not the single corresponding relationship between those parameters. They are interrelated, interactive and restrict each other. If some parameters are determined, there is certain functional relationship between others.

Many factors can influence the modeling process, such as the physics property of sands, physics and chemist property of resin and catalyst, the distance between nozzle and sands, injecting flux, scanning velocity, the inner construction of nozzle, working pressure, the resistance and pressure loss of liquid tube, and so on. To some extent, the surrounding temperature and humidity can effect this process.

By abundant experiments, it is found that the dimension tolerance of casting mold can be within 0.5~1.0 mm, and the precision will not change when the dimension of casting mold becomes larger and larger. This fact indicates that it is feasible to manufacture large-scale casting mold with PCM.

To illustrate the modeling process, we take the impeller casting mold for example. Figure 2 shows the machining process along profile of the cross section. Figure 3 shows the cross section that is finished machining. Figure 4 is the whole casting mold that is finished manufacturing.

Not only casting mold, but also large-scale prototype can be manufactured by PCM. Figure 5 and figure 6 shows the casting molds of solenoid and sleeve respectively. Figure 7 shows the prototype of impeller.

The casting mold that is finished manufacturing must be post-processed to pour. This post-process include the following steps, such as cleaning up the loose sands, brushing dope on the surface, mould closing, assembling and so on.

Dope can not only improve surface roughness of casting mold, but also can influence many casting properties to some extent, such as gas forming property, gas permeability, refractability and so on. It is directly referred to pourability of the mould and the final quality of the cast.

For the future, the research mainly focuses on the commercialization of PCM modeling machine. In addition, there are several problems to be solved. The first primary issue encountered in research is injection technique and it is the most urgent problem to be solved. The second one is the principle follow which that liquid diffuses and permeates between the grains of sands. The last difficult problem focuses on the research in property of dope. So future efforts of research will be put in the three aspects mentioned above so as to improve this process.

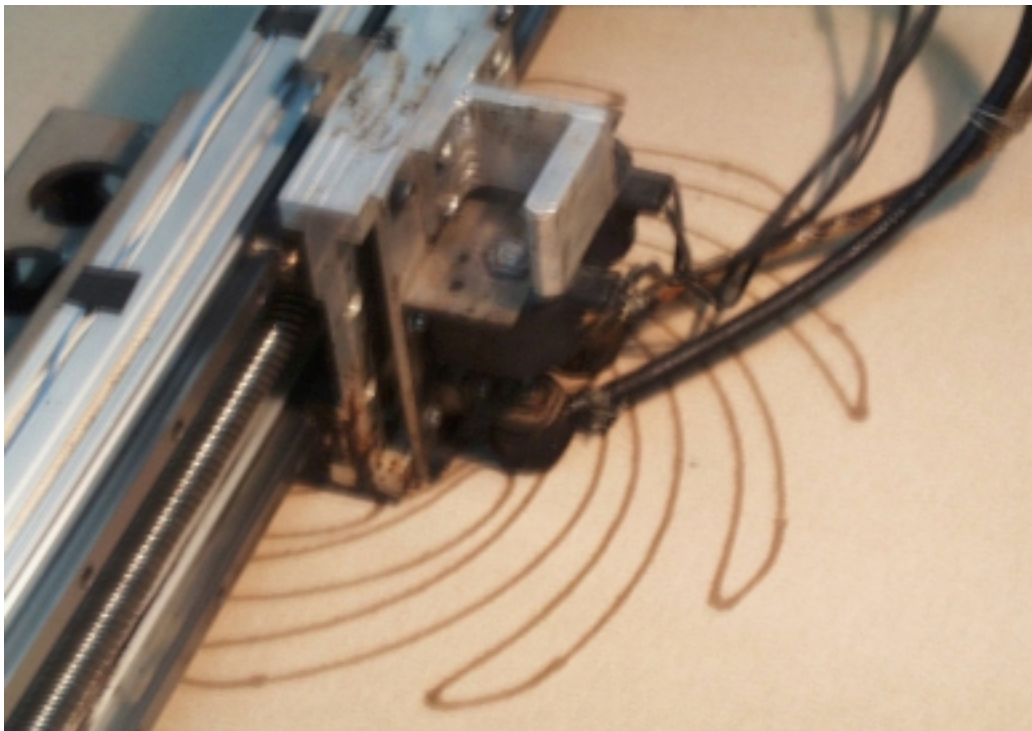


Figure 2 The machining process along profile of the cross section



Figure 3 The cross section that is finished

machining



Figure 4 The whole impeller casting mold that is finished manufacturing



Figure 5 The casting mold of solenoid



Figure 6 The casting mold of sleeve