

Fabrication of Powder Metallurgy Components by Rapid Prototyping Technique

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1. Introduction

With the outbreak of industrial revolution the trend in large scale production for domestic as well as foreign market has set in. Developed countries can invest huge money in design and R&D to develop their products, but due to trade liberalization the competition becomes stiffer and under developed countries are facing lot of problems to meet the standards for global markets.

In the process of product development working prototypes play a vital role for proving the function of new technology. Traditionally metallic parts are machined from the stock or near net casting process are used to produce the desired shapes. Both these options require skilled manpower and are very costly and time-consuming operations.

During last decade plastics are finding more and more application in almost all industries Rapid prototyping is a new technology in which a physical three dimensional plastic model is created using CAD file data through special sintering, layering or deposition techniques, without creating actual mould.

This technology offers tremendous advantages in terms of lower cost of prototyping, shorter lead times and improved total product quality. This process not only saves time and money but also gives a competitive edge at the crucial stage of product development. The potential of this process is enormous and newer avenues are being explored everyday.

2. About the Process

Rapid Prototyping (RP) is a process to fabricate quickly a complex shaped component directly from CAD models. RP systems are based upon a layered manufacturing paradigm. In this method a solid 3D CAD model of the object is first decomposed into cross sectional layer representation in the process planner. The planner then generates trajectories for guiding material additive process to physically build up these layers in an automated fabrication machine to form the object. RP can rapidly and automatically be planned and executed independent of part shape.

RP system can be classified as under :

Liquid based process : Liquid based RP system begins with their material in a liquid state. Through a process commonly known as curing, the liquid is converted into a solid state.

Solid based process : The materials in this process are in the form of a wire, a roll, laminates and pallets.

Powder based Process : Powder in form of grain is used as basic material.

One such Rapid Prototyping (RP) process has been developed by Manufacturer Solution, Inc and Rensselaer Polytechnique Inst. New York State Centre for Advance Technology in Automtion, Robotics and Manufacturing used to fabricate P/M components without hard tooling. The RP process has been demonstrated using a variety of metal powders including copper, iron,

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nickel, stainless steel and titanium¹. The process replaces the hard tooling associated with conventional press and sinter P/M with "soft tooling", which reduces cost and lead-time, associated with P/M component manufacturing and makes it available option for small lot size application. By selectively arranging these different powders within confined volume, it is possible to create a part whose geometry is defined by the interface between powder that consolidate at prescribed condition and powder which does not. Powder which consolidate at these same condition is termed as tool powder. Fig 1 below illustrate such an arrangement for a simple open ended tube by showing a cut away view of powder matrix and a part which results after processing². Tool powder serves both to define shape in conjunction with the part powder and to support part powder. It is soft tooling which replaces the

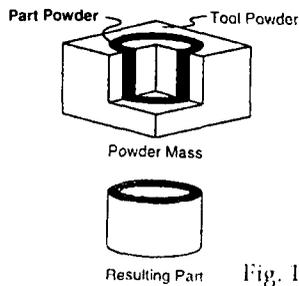


Fig. 1

hard tooling used in many conventional P/M operations. After the part powder component has been created sintering or hot iso-static pressing is required to give sufficient strength in

the component. The tool powder generally remains loose during processing so it is easily separable and can be reused.

3. Conclusion

RP process is very much applicable to the rapid fabrication of P/M components where hard tooling is either cost effective or feasible for small lot size component manufacturing. Although several technical challenges remain, the precision, accuracy and speed with which a powder mass can be created must be improved.

References

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"The basic structure of research consists of dreams into which the threads of reasoning, measurement and calculations are woven ."

- Albert Szent György