COMPONENTS FROM POWDER METALLURGY

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Abstract

A much wider range of products can be obtained from powder processes than from direct alloying of fused materials. In melting operations the "phase rule" applies to all pure and combined elements and strictly dictates the distribution of liquid and solid phases which can exist for specific compositions. In addition, whole body melting of starting materials is required for alloying, thus imposing unwelcome chemical, thermal, and containment constraints on manufacturing.

Key words: Powder metallurgy, Process, Product, Technology

INTRODUCTION

Powder metallurgy, or PM, is a process for forming metal parts by heating compacted metal powders to just below their melting points. Although the process has existed for more than 100 years, over the past quarter century it has become widely recognized as a superior way of producing high-quality parts for a variety of important applications.

This success is due to the advantages the process offers over other metal forming technologies such as forging and metal casting, advantages in material utilization, shape complexity, near-net-shape dimensional control, among others. [1]

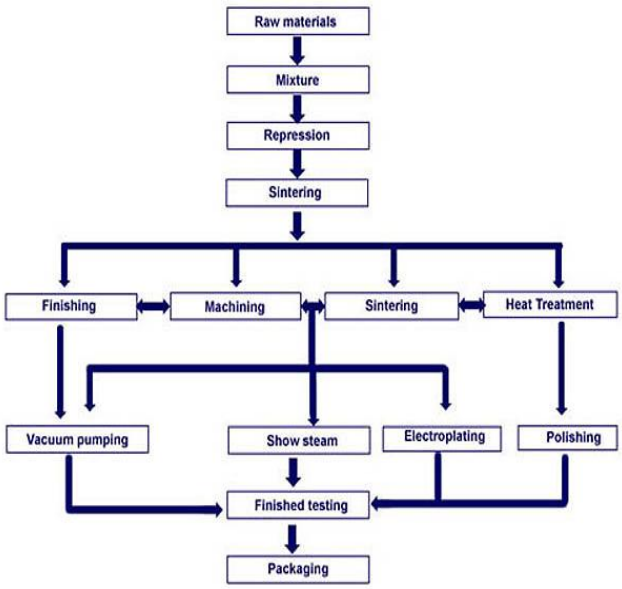

Fig. 1 Principle of powder metallurgy process [4, edited and supplemented by author]

Most PM parts weigh less than 5 pounds (2.27 kg), although parts weighing as much as 35 pounds (15.89 kg) can be fabricated in conventional PM equipment. While many of the early PM parts, such as bushings and bearings, were very simple shapes, today's sophisticated PM process produces components with complex contours and multiple levels and does so quite economically. [3]

ADVANTAGES/USAGE OF THE POWDER METALLURGY

The PM process provides a host of advantages over competing metalworking technologies. These all add up to cost effectiveness, shape and material flexibility, application versatility, and part-to-part uniformity for improved product quality.

Advantages of the powder metallurgy process:

- Eliminates or minimizes machining by producing parts at, or close to, final dimensions,
- Eliminates or minimizes scrap losses by typically using more than 97% of the starting raw material in the finished part,
- Permits a wide variety of alloy systems,
- Produces good surface finish,
- Provides materials which may be heat treated for increased strength or increased wear resistance,
- Provides controlled porosity for self lubrication or filtration,

- Facilitates manufacture of complex or unique shapes which would be impractical or impossible with other metalworking processes,
- Is suited to moderate- to high-volume component production requirements,
- Offers long-term performance reliability in critical applications,
- Is cost effective. [2]

Usage of the powder metallurgy products:
The applications for PM components fall into two main groups. First are components that are difficult to manufacture by any other method, such as those made from tungsten, molybdenum, or tungsten carbide. In addition, porous bearings, filters, and many types of hard and soft magnetic components are made exclusively using PM. The second group consists of PM components that offer a cost-effective alternative to machined components, castings, and forgings. Automotive clutch plates, connecting rods, camshafts, and planetary gear carriers are just some examples of these. [4]

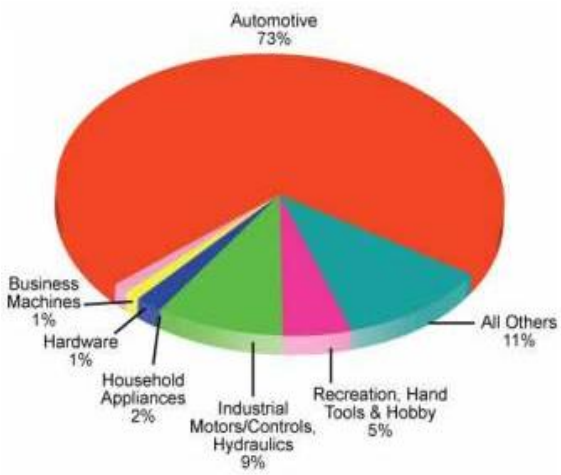

Fig. 2 Powder metallurgy structural components markets [4, edited and supplemented by author]

PM components are used in a variety of markets, with the automotive industry being the predominant one, consuming approximately 70% of the ferrous products the industry produces annually.

Other important markets include recreation, hand tools, and hobby products; household appliances; industrial motors and controls; hardware; and business machines. And, as designers increasingly learn about the superior performance, cost savings, and unmatched tolerances the PM process can offer, the trend indicates that PM components are continuing to expand into previously untapped markets. [4]

CONCLUSION

Metal powder technology has the power to open up a world of possibilities. The inherent properties of metal powders provide unique possibilities to tailor solutions to match the requirements of engineering industry.

Powder metallurgy is being applied far beyond its traditional role in the production of components for vehicles. Iron powder is used in food fortification to combat anaemia. Nickel powders are vital ingredients in valve coatings to enhance wear resistance. Specially formulated iron-based powders offer new solutions for high-temperature brazing. Soft magnetic composites with 3D magnetic properties are opening the way for innovative electric motors. In fact, metal powder technology generates virtually endless possibilities.

Using many of PM processing techniques, as well as other processes such as spray forming, roll compaction, rapid solidification, and others, components are also produced today from particulate materials other than metal powders. These include cermets, intermetallic compounds, metal matrix composites, nanostructured materials, high-speed steels, etc.

References

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