

## **Powder metallurgy**

Metals and alloys can be fabricated into any desired shape by hot working process, during which the metal remains in the liquid state or in the solid state. A new technique called powder metallurgy (PMA) has been developed for fabricating metallic objects from metal powder.

Powder metallurgy (P/M) is the art and science of manufacturing fine metal powders (i. e, raw materials), consolidating them and fabricating into desired shape of the products with little or no melting.

### **Advantages of powder metallurgy**

- Rate of production is high.
- Highly complicated products can be manufactured.
- It is highly cleaner and quieter operations and longer life.
- Mechanical operations are not required because the object passes very good dimensional accuracy and good surface finishing.
- Life of component parts is longer.
- Metals as well as non-metals can be mixed in any proportion.
- The products are more uniform and free from defects such as blow holes, voids, etc.
- No material is wasted.

### **Disadvantages of powder metallurgy**

- It is unprofitable to manufacture products in very small quantities because of the great expense of tools and equipment.
- Since high pressure is required to compact the powder into desired shape. Only limited product is manufactured.
- The products has poor plasticity, elongation, etc, which limit their use in many applications.
- High investment is needed in heavy process for making larger products.
- Porous products are liable to oxidize at the surface as well as throughout the whole body due to its porosity.

❖ Powder metallurgy involves the following steps

1. Preparation of metal/alloy powder.
2. Mixing and blending.
3. Hot pressing.
4. Sintering.
5. Secondary operations.

#### **1. Preparation of metal / alloy powder :**

The particle size of metal powder should be in the range of 10 to 100 microns. The degree of purity, particle size and shape of the metal powders largely depend on the method of manufacture. The metal or alloy powders are prepared by the following methods:

- Chemical methods;

Chemical methods like reduction, decomposition and condensations are used to produce metal powders.

- Electrolytic deposition;

The principle involved in this method is similar to that of electroplating or electrolysis, during which a powdery deposit is obtained on the cathode. The deposited powders is scrapped, washed, dried and then pulverized further to get fine powder of desired size.

- Mechanical pulverization or comminution;

It is done by using mechanical pulverize such as counter rotating blades, rapidly moving hammers. Due to mechanical forces, it disintegrates the metal particles into fine powder. Pulverization, is usually, followed by milling. Brittle metals and alloys can be powdered, by this method to a size of 0.001mm.

## **2. Mixing and blending:**

Mixing and blending of metal powders in desired proportions are uniformly mixed in order to get uniform and very good results especially when an alloy is to be manufactured. The time of mixing may vary from a few minutes to several days depending upon results desired.

## **3. Hot pressing:**

In this method the powder is placed into die pressure and temperature is applied simultaneously. Molding and sintering take place at the same time, which results in higher densities and greater productions.

## **4. Sintering:**

Sintering is defined as the heating of loose or compacted aggregate of metal powders below the melting point of the base metal with or without the application of external pressure in order to transform it to a more dense material by inter particle bonding.

### **Applications of powder metallurgy**

- ❖ **Lamp industry;** tungsten has very high melting point (3300°c) and is very difficult to cost.
- ❖ **Diamond tools;** there are made by blending 30% diamond dust with iron powder. These tools are used for cutting porcelain, glass and other materials.
- ❖ **Refractory metal composites;** the metal powder having high melting point can be mixed with ceramic oxides to form refractory composites using P/M technique.
- ❖ **Porous products;** porous products like filters, bearings are manufactured by this process.

**Plasma sprayed coatings;** this is another important applications of P/M technique. It involves production of rapidly solidified coatings and powders on objectd.