Properties of the Sintered Compact

1. Dimensional change during sintering

Dimensional change is always occurring when a green compact is given a sintering operation. It is of special importance in the carbide industry where this change is of the order of 25%. It is determined by taking the measurement of dimensions of a standard specimen before and after sintering under standard conditions. It is customary to express the shrinkage (or growth) as a percentage of sintered length (particularly in the carbide industry).

$$\text{Shrinkage (or growth) \%} = \frac{\text{Change in length}}{\text{Sintered length}} X\ 100$$

or it is defined as the percentage of unsintered length

$$\text{Shrinkage (or growth) \%} = \frac{\text{Change in length}}{\text{unsintered length}} X\ 100$$

A rectangular specimen or hollow cylindrical specimen is used for performing a test on dimensional directions as this change may differ considerably in the two directions.

2. Sintered Density

The methods used for determination of sintered density are similar to those which have already been used for the determination of green density. The property facilitates rendering of information on porosity of the finished product. The mechanical properties, in general, increase with the decrease in porosity of the sintered compact.

3. Porosity

The presence of porosity has a much greater influence on the elongation, and impact and fatigue strength and a rapid increase in these values is obtained with the density approaching the theoretical.

Porosity acts as a stress raiser and sintered component does not indicate truly elastic behavior, rather it appears to function in a similar manner as graphite in cast iron. It is interesting to note here that the fatigue ratio of sintered alloys and of cast iron is about 0.4, as compared to the values of 0.5, for wrought steel.

It is very difficult to produce P/M parts without any porosity remaining after sintering. The total porosity present in the sintered part may be calculated from the following relationship.

$$P = \frac{pv}{ps}$$

Where P is the fractional porosity, Pv the density of the sintered and Ps the density of the solid materials.

4. Mechanical Properties of Sintered Parts

It is customary to obtain the required mechanical properties of the finished part by using either one or a combination of the following processes: a. Double pressing and sintering b. Coining c. Infiltration d. Alloying e. Heat treatment

The radial crushing strength test is widely used particularly in the sintered bearing industry. In this test the specimen is compressed between two flat surfaces in the direction normal to the longitudinal axis of the specimen. The point at which drop in loading observed because of the first crack determines the crushing which can be expressed by means of the following formula:

$$W = KLT^2 / (D-T)$$

Where W is the radial crushing strength (Ibs), K the strength constant (Ibs/in^2), L, T and D the length, wall thickness and outside diameter of the cylinder respectively, all expressed in inches. The value of K varies between about 17500 and 40000 Ibs/in^2 depending upon the density and composition of the porous part.