**Sintering Atmosphere:**

The choice of a suitable furnace atmosphere which is governet by the characteristics of the materials and to some extent by the properties desired in the sintered prodect, is of almost importance in practically all sintering processes.

It has been felt that reaction of :-

1. the constituents of atmosphere amongst each other at the sintering temp ( e . g water gas reaction).
2. The atmosphere with the material to be sintered ( e . g reduction of oxides or decarburization).
3. The atmosphere with furnace refractions will lead to different in composition of the atom – sphere before its introduction. This chang affects the properties of the work being sintered.

Thus controlled atmosphere are highly desirable during sintering otherwise the atmosphere will give rise to a large scrap loss and inconsistencies.

In the quality of the end product.

For any case of sintering the functions of sintering atmosphere are :-

1. it must prevent oxidation on the metal surface at the sintering temperature otherwise it would inhibit or interfere with the sintering process.
2. It must a void carburizing and decarburizing reactions and nitriding condition in certain metals.
3. It must have the tendency of reduce surface films such as oxides on powder particles, If they are present, and remove or replace absorbed gases and.
4. It must not contaminate the metal powder compact at the sintering temperature.

The atmosphere which prevails in the various types of sintering furuaces are considered to fall into three groups :-

1. Reducting atmosphere.
2. Neutral atmosphere.
3. Oxidising atmosphere.

H2 cracked NH3 atmosphere are often employed, but carbon monoxide, hydrocarbons, partially combusted hydrocarbon gases, and lithium containing atmosphere may also be used in some cases as the reducing atmosphere. The choice of a reducing atom – sphere is made depending upon the articles to be sintered, the initial and operating cost of the atmosphere generator.

Vacuum sintering is costly and therefore employed, on a small scale in very special cases where it is essential or for research work.

Vacuum, helium and argon are employed for sintering reactive metals at elevated temperature.

Inert atmosphere can not reduce oxides or surface films present on the compacted powders when they are introduced into the furnace.

They can't burn up and eliminate air which is generally carried into the furnace door during the charging of the load into the furnace. Also inert atmosphere free from traces of oxygen, water vapour and other undesirable constituents is costlier. Thus, they are not commercailly in P / M because of these reasons. Nitrogen, usually employed as a purging gas for furnaces, may be used for sintering iron and copper only at elevated temperature, as it forms nitrides with others.

**Table 17. Controlled Atmospheres for Common Materials.**

|  |  |
| --- | --- |
| Material | Atmospheres |
| Iron | Hydrogen, Argon, Exothermic gas, Endothermic gas. |
| Nickel | Hydrogen, Argon, Exothermic gas, Endothermic gas. |
| Copper, Brass, Bronze | Hydrogen, Argon, Exothermic gas, Endothermic gas. |
| Cobalt, Tungsten carbide | Hydrogen, Vacuum. |
| Tungsten | Hydrogen, Argon, Vacuum. |
| Stainless steel | Hydrogen, Argon, Vacuum. |
| Molybdenum | Hydrogen. |
| Alnico magnets | Hydrogen. |
| Aluminium | Vacuum. |
| Chromium | Vacuum. |
| Tantalum | Vacuum, Argon, Helium. |
| Vanadium | Vacuum. |
| Gold | Air. |
| Platinum | Air. |
| Silver | Air, Hydrogen. |

1. Hydrogen :-

Pure dry hydrogen is frequently used Sintering atmosphere especially in small furnaces and where very powerful reducing agent free from N2 is required.

It is wide applications in the industry in the sintering of steel, stainless steel, or any alloy containing over 1 % carbon or high cost, it has got the advantage of possessing a large sintering powder.

1. Dissociated or cracked Ammonia:-

Dissociated ammonia is a mixture of 75 % hydrogen and 25% nitrogen by volume, which is equally effective, more economical and more convenient as regards the simplicily and reltability of operation than hydrogen atmosphere, For many purposes, it is possible to substitue this atmosphere for hydrogen. An added advantage is that it is free from oxygen and moisture and there is no danger of explosion.

1. Exothermic gas :-

The most widely employed reducing sintering atmosphere is produced by the combustion of fuel gases such as paraffin, methane, butane, propane, natural gas, coal gas or coke – oven gas with pre – mixed air in cortain ratios, which hase adew point averaging – 70 ° F ( - 57 ° c).

Burning occurs in an electrically heated or gas fired chamber filled with catalysts. The gas contains various amount of hydrogen, carbon monoxide, methane carbon dioxide, nitrogen and water vapours and this gas may be reducing, carburizing, inert, dccarburizing or even oxidizing depending upon its composition.

1. Endothermic gas :-

it is produced in the same way as the exothermic type protective atmosphere except that a mixture of hydrocarbon gas and air ( low air – gas ratio) is heated over catalyst externally by gas or electricity for cracking the richer mixture or supporting the reaction.

1. Argon & Helium Inert gases:-

Particularly argon and helium, are used to limited extent, because of their relatively high cost and lack of reducing potential. They are used advan – tageously for sintering of most reactive metals due to their inertness.

Vaccum sintering :-

We have already discussed earlier about the vaccum furnace and vaccum sintering. The chamber in which the compacts are heated and cooled is connected to vaccum pump by means of which the chamber is usually pumped down to the desired pressure level prior to and during heating.