

Vacuum Furnaces for Sintering

Adam Adamek, Vacuum Sales Manager, SECO/WARWICK S.A., A.Adamek@secowarwick.com.pl

Sintering is a method for manufacturing parts from powder, by heating the material until its particles adhere to each other. Sintering temperature does not exceed a melting point of the sintered base material. Sintering is traditionally used for making parts from different materials like: pure metals produced in vacuum, steels (constructional, stainless, tool, etc.), ceramic, cermet and has also found uses in such fields as powder metallurgy. Powder metallurgy is used along with other metal forming processes such as casting, cold/hot working and machining.

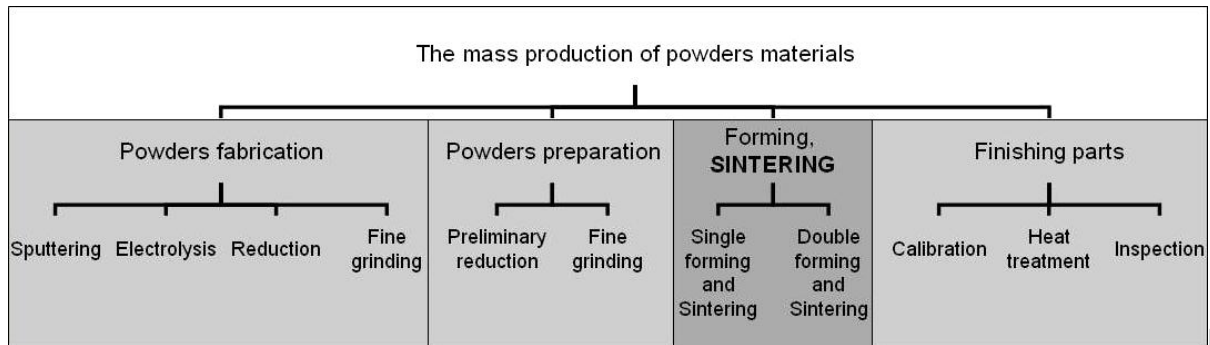


Fig.

1 The mass production of powders materials.

Sintering, with subsequent reworking, can produce a great range of material properties. Changes in density, alloying, or heat treatments can alter the physical characteristics of various products. For instance, the tensile strength E_n of sintered iron powders is insensitive to sintering time, alloying, or particle size in the original powder, but depends upon the density (D) of the final product according to $E_n/E = (D/d)^{3.4}$, where E is Young's modulus and d is the maximum density of iron.

Sintering has a number of advantages:

1. The parts produced have an excellent surface finish, and good dimensional accuracy,
2. The possibility of very high purity for the starting materials and their great uniformity,
3. Absence of inclusions (as often occurs in melt processes),
4. Preservation of purity due to fewer subsequent fabrication steps,
5. The porosity inherent in sintered components is useful for specialised application such as filters and bearings,
6. Stabilization of the details of repetitive operations by control of grain size in the input stages,
7. Refractory materials which are impossible to shape using other methods can be fabricated by sintering with metals of lower melting points,
8. A wide range of parts with special electrical and magnetic properties can be produced.

Vacuum Furnaces for Sintering

Control over heating rate, time, temperature and atmosphere is required for reproducible results. SECO/WARWICK offers different types of vacuum furnaces designed for different applications including: Dewaxing and vacuum sintering; High pressure vacuum sintering; Metal injection molding (MIM); and Outgassing.



Fig.2 Dewaxing and vacuum sintering furnace



Fig. 3 "60 bar" overpressure vacuum, sintering furnace



Fig. 4 Dewaxing/MIM vacuum furnace

A large majority of vacuum sintering furnaces are designed as a cold wall, front loading devices equipped with a vacuum pumping system, and equipped with an optional dewaxing system and gas cooling feature. Strong graphite insulation and heating elements provide long, reliable service in this heavy-duty furnaces designed for the industrial work place. Flat heating elements surrounding the load from all sides assure excellent temperature uniformity. The pumping system, power supply, cooling systems and dewaxing system are generously sized for sintering processes. The heater arrangement optimises temperature uniformity within the furnace hot zone. The cooling gas recirculation system includes a multi-nozzle gas feed arrangement to optimise the uniformity and rate of cooling of the load during quenching. The equipment is designed for easy maintenance and service operation. Users can reduce the cycle time to a minimum and save production costs.

Vacuum Furnaces for Sintering

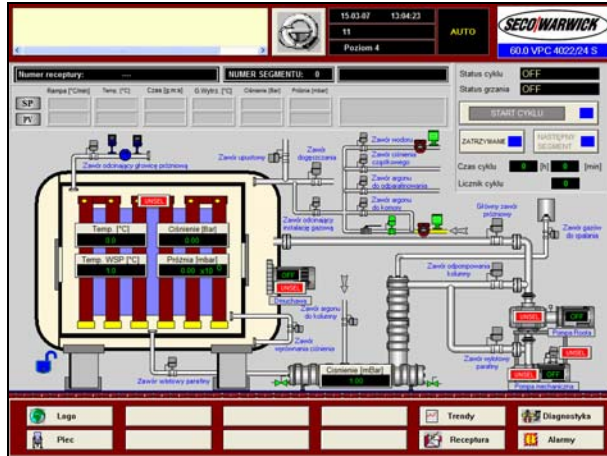


Fig. 5 Operator interface from a high pressure vacuum sintering furnace

The vacuum furnace control system is composed of the control cabinet complete with measuring/control equipment provided with the human-machine interface (HMI) for the operator. The user-friendly control system makes this furnace simple to operate while producing repeatable results.

For more information, contact the Vacuum Team at 814-332-8400.