# Selecting vacuum heat treatment process parameters

Through a variety of materials, a variety of artifacts, multi-batch processing, vacuum heat treatment process to identify common parameters, and explore some empirical formulas, and achieved good results in actual production.

Keywords vacuum heat treatment process parameters empirical formula

Explore the development of vacuum heat treatment process main content one pair of vacuum heat treatment process parameters are: to determine the heating system (temperature, time and manner), decided to vacuum and pressure regulator, and a choice of cooling medium ···. This paper discusses heat treatment system.

1.1 heating temperature

There are two main characteristics of vacuum heating, one in a very thin atmosphere, for example, H13 aluminum extrusion die, we used 1 030 oC heating temperature to meet the requirements of life; while W6Mo5Cr4V2 steel hot extrusion punch you the process uses a 1 180 ℃ heating quenching and tempering 560 oC and 4O0 oC twice tempered, strength and toughness to meet the requirements of the workpiece, which meet or exceed the import life mold life; for vacuum annealing, we used 720 oC (the original use of 910 oC) insulation technology for low-carbon steel ferrule annealing annealing improves the quality and significantly reduce costs.

1.2 Holding time

The length of the holding time, depending on the number and amount of stove size and shape of the workpiece. General information presented in the traditional heating holding time

T determined as follows:

T] = 30 + (· 5-2) D 1

T2 = 30 + (1.0-1.5) D} (1)

T3: 20+ (0.25-0.5) DJ

Where: D is the effective thickness of the workpiece (mm); Tl for the first warm-up time (min); T2 is the second warm-up time (min); T3 for the final holding time (min).

In fact, often in an oven at the same time with a number of different shape and size of the workpiece, which need to be considered. We follow the workpiece size, shape, manner and place installed furnace capacity to determine the holding time, while also taking into account, mainly by vacuum heating to high temperatures, low temperature heating (6oo ℃ or less) of the workpiece temperature rise very slowly, this time in deformation of the workpiece no special requirements, should make the first warm-up and the second warm-up time as short as possible, and to improve the preheating temperature, because the low temperature thermal longer and, after warming to reach the central portion of the workpiece surface temperature still need some time. The vacuum heating principle, to improve the preheating temperature, the temperature difference between inside and outside the workpiece can be reduced, so that the preheating time is shortened, and the final holding time should be extended, so that the carbide steel sufficiently dissolved [2]. This

Thus, both to ensure the quality, but also improve work efficiency.

The length of the holding time also with the following factors:

① installed furnace capacity

Workpiece dimensions identical fashion furnace capacity, the time should be extended through the burning; on the contrary, it should be shortened.

② work platform in the form of

Because of the vacuum furnace is radiant heating, in general, the same as if the shape of the workpiece, the workpiece should be placed neatly avoid blocking heat radiation, and put aside a certain gap (<D), in order to ensure that the workpiece can be subjected to maximum heat radiation; for different parts of the same installed a furnace, in addition to calculating the maximum workpiece holding time, but also to increase through the burning time. When placed in the gap

<D, the resulting empirical formula is:

TI = T2 = T3 = 0.4G + D (2)

Where G is installed furnace capacity (kg), meaning the rest of the symbols have the same. In addition, for small parts (the effective thickness D≤20 coffee), or placed in the gap between the workpiece ≥D holding time can be reduced:

TI = 1 "2 = 0.1 G + D (3)

T3 = 0.3 G + D (4)

For large workpieces (effective thickness D≥100 mn-i), and finally the holding time can be reduced:

TI = 1 "2 = T3 = 0.4G + 0.6D (5)

③ heating temperature

High heating temperature, holding time can be shortened. For example: right, /, DC53 punch 20 when heated at 1 030 ℃ according to equation (3) (4) to calculate the holding time, and for, /, M2 high speed steel when heated at 20 1 200 oC press following formula to calculate the holding time is reasonable: TI = T2 according to the formula

(3), T3 = O. 07G + D.

1.3 Cooling time

① Precooling

After small parts for high-temperature quenching, also noted by the hot room into the cold room, whether pre-cooling before quenching, will affect the deformation hardening. Its rule is: When the hot room into the cold room, directly or air-cooled oil cooler, will lead to dimensional change; if appropriate pre-cooling, you can keep the heat in front of the same size; but if the pre-cooling time is too long, workpiece size will cause swelling. The general rule is that, for the effective thickness of 60 m 2o a workpiece, pre-cooling time is 0.5-3 min.

According to analysis, this is because when the pre-cooling and direct quenching without internal stresses in the part to the thermal stress based, so volume shrinkage occurs, and in the pre-cooling over a longer time after quenching, the internal stress in the part in order to stress the main phase transition, which appears volume expansion, only after an appropriate time during the pre-cooling, the thermal stress and the role of stress equilibrium phase transition, in order to achieve the same size of the workpiece [.

② air cooling

We use vacuum furnace can pass into the 2 bar less pressurized nitrogen gas quenching, cooling to below 100 ℃ baked. AACS empirical formula to calculate the time as follows:

1 "4 = 0.2G + 0.3D (6)

Where: T4 time for air-cooled (mi, 0.

③ oil cooling

Quenching oil temperature control in 6o a 80 ℃, tool and die of the oil temperature is usually controlled 100-200 oC. Oil cooling time is calculated empirical formula is as follows:

T5 = O. 02G + 0.1D (7)

Where: T5 for oil cooling time (min). Then the workpiece baked
Temperature is generally about 150 oC.

2 Conclusion

The resulting empirical formula of this article summarized as follows:

① Considering the amount of stove and put the gap <D, the holding time according to equation (2) to determine;

② For small parts (effective thickness D≤20 rain, and put the gap ≥D), the holding time according to equation (3), (4) to determine;

③ large workpieces (effective thickness D≥100 mm) for the holding time according to equation (5) is determined;

④ air cooling time according to equation (6) is determined;

⑤ oil cooling time according to equation (7) OK.