Discussion on the Material Characteristics and Processing Technology of Metal Parts

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[Abstract] In recent years, due to the vigorous development of China's industry, especially the metal manufacturing process has made great progress compared with the past. In order to adapt to the requirements of social development and seek for their own development and survival, all the manufacturing companies of metal materials have carried out relevant reforms and optimized the structure, management model and resource allocation. Through this series of transformations, we hope to maximize the economic and social benefits of the company. The paper gives a general overview of most of the material properties, and then specifically explains the characteristics and processing techniques of metal materials. It aims to provide valuable reference suggestions for the development of metal manufacturing and processing industry in China, and also serves as a reference for relevant business units.
[Keywords] Material properties; Metal materials; Processing technology

1. Analysis of the Characteristics of Common Materials

1.1 The Inherent Properties of the Materials

Generally, ordinary materials have inherent characteristics, which are characteristics and performances exhibited at the time of use, and are usually determined by the material composition of the material itself, that is, the physical and chemical characteristics of the material. Therefore, most of their shape design when processing products is determined by the inherent characteristics of the materials. In view of this, we require that the inherent properties of the material should be able to meet the basic functional and structural requirements of the product, while meeting the safety requirements of the product as well as the operational requirements and environmental protection requirements in a specific environment.

1.2 The Sensory Properties of the Materials

The so-called sensory characteristic is the comprehensive impression that the consumer left on the material through vision and touch, and is reflected by the psychological and physiological effects of the person. Therefore different materials will exhibit different sensory characteristics. For example, rough wood gives a natural and intimate feeling, and metal gives the impression of being cold and hard, but also infiltrating the modern atmosphere. If it is a geologically soft plastic, it gives a light and elegant feel. Another example is the common glass, which gives a smooth and

transparent feeling, while the soft leather gives a warm and romantic feeling. Therefore, the sensory characteristics of the material in the form design can communicate and transmit emotionally with people, showing the differentiation of different products.

1.3 The Process Properties of the Materials

The process characteristics of a material are a comprehensive reflection of the inherent properties of the material and represent the ability of the material to be well adapted to the requirements of multiple processes. Because different materials have different process characteristics, for example, metals are suitable for construction methods such as forging, welding, and casting; for wood, sawing, throwing, and assembling methods can be used. The glass can be completed by pressing, blowing, and drawing. Therefore, you should understand the characteristics of various materials and then select the appropriate processing technology according to the actual situation. Sometimes, some materials have the same shape and composition, but if you use different processing techniques, you will get an unexpected difference in morphology. In the same way, if the shape is the same, the composition of the material and the process used are different, the visual difference in appearance can also be achieved, thereby creating a special visual effect to attract consumers.

2. The Overview of Metal materials

The advent of the industrial revolution indicates that humanity has entered the steam era of metal machines. With the continuous advancement of society and the continuous innovation of science and technology, metal materials have begun to occupy an important position in the development of human society, whether it is construction or machining. Since the era of bronze and iron in China, metal materials have been widely used in society. This is a symbolic era in which metal materials begin to enter people's lives. For now, all kinds of infrastructure are inseparable from metal products. The so-called metal material is essentially a general term for various materials which are composed of a single pure metal element or a mixture of multiple metal elements, and which also exhibit certain metal characteristics. Pure metals and special metals and metal compounds are all in the range of metal materials, but metal oxides are not included in the range of metal materials.

3. Metal material Characteristics Analysis

3.1 Forging

When stamping and forging metal materials, metal materials can increase their load carrying capacity due to plastic deformation. (The ability of a metal material to plastically deform into a forged or stamped part when forging is performed).

3.2 Castability

After the metal material is melted to form a liquid state, it can be cast into a specific shape, which is the castability of the metal material. In general, the mold filling conditions, the chemical composition of the alloy itself and the casting temperature have an effect on the properties of the metal material.

3.3 Machinability

This feature refers to the difficulty of cutting metal materials. This property is related to the internal structure of the metal material, its hardness and thermal conductivity.

3.4 Weldability

It means that under certain conditions, the metal material can be welded into the corresponding components according to the design requirements, and the expected service life of the components can be realized. Generally, materials with small shrinkage and good thermal conductivity have good weldability.

4. Metal Material Processing Yechnology

4.1 Metal Material Welding Process

(1) Stainless steel welding. Pre-heat treatment of the welding material at a temperature of 200 °C ~ 400 °C before welding, heat treatment after the completion of welding, first heat it to a temperature range of 730 °C ~ 790 °C, until it slowly cools to 540 °C After the air is cold.

(2) Non-ferrous metal welding process. Titanium is welded by automatic welding, which has high requirements on the surface of the material. Since copper has poor weldability, it is suitable for welding by brazing.

(3) Low alloy steel and low carbon steel have good welding properties. When welding medium-high alloy steel and carbon steel, the pressure is preheated before welding, and heat treatment is performed after the welding is completed, thereby improving the material structure and eliminating the welding stress.

4.2 Heat Treatment Process

4.2.1 Classification of Heat Treatment

In general, heat treatment can be generally divided into annealing, normalizing, quenching, tempering, quenching and tempering treatment, aging treatment, surface quenching and chemical heat treatment (carburizing, nitriding, cyanidation, metallizing). When selecting the heat treatment system for the craftsman, it is

necessary to fully consider the requirements of the parts and the composition, structure and hardenability of the metal materials, and also consider whether the metal materials have brittle areas. After heat treatment, the tensile test and hardness test of the heat-treated parts or test pieces can be carried out to ensure that the performance of the parts after heat treatment meets the requirements. For non-critical parts or parts that are not demanding, it is also possible to control only the hardness or conductivity to avoid damage to parts or test pieces.

4.2.2 Heat Treatment Process

The heat treatment process for metal materials consists mainly of three joints, namely heating, holding and cooling. These links are interlinked and ongoing. The ceramic heat exchanger can be used to heat the metal material during heating, because the ceramic heat exchanger has good oxidation resistance and thermal conductivity, and is easy to operate, high temperature resistance and good heat recovery performance.

(1) For the heat treatment of metal materials, various heating methods can be used, such as using conventional coal and charcoal as heat sources, using gas and liquid as fuel, and using the most used electricity as heat source, etc., and these heat sources can be directly utilized.

(2) Reasonable selection and maintenance of the heating temperature is the prerequisite for ensuring the quality of the heat treatment process. When the metal material reaches the design heating temperature, it is usually necessary to stabilize the temperature for a certain period of time, creating a consistent internal and external temperature, and completely transforming the internal microstructure of the workpiece. This period of time is the holding time.

(3) Cooling methods are often different due to different processes, but the main purpose is to effectively control the cooling rate. In general, the quenching cooling rate is the fastest, the annealing cooling rate is the slowest, and the normalizing cooling rate is between the two.

5. Conclusion

In summary, we know that if companies want to further improve the effective use of metal materials, and achieve economic and social benefits for enterprises, then relevant enterprise units, especially those related to metal materials, must do a good job in controlling the quality of materials, and at the same time establish relevant management and supervision systems to supervise the manufacture and production of products and testing. Metal materials are different from other common materials. If the characteristics of various metals are not studied beforehand, it is impossible to optimize the allocation of resources, which not only causes a large investment in costs, but also causes waste of national resources. In addition, in the processing technology of metal materials, it is also necessary to continuously absorb new technologies and methods, cultivate relevant professionals, improve the level of construction technology, and optimize the structural composition of products, which has greatly promoted the development of the enterprises.

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