

Rational Selection and Application of Materials in Mechanical Design

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ABSTRACT. *As we all know, whether the material is selected reasonably and scientifically is directly related to the performance and quality of mechanical products. At the same time, in the face of such fierce competition in the market environment, in order to improve the performance-price ratio of mechanical products, mechanical manufacturing enterprises must pay attention to the selection and application of materials, in order to enhance the competitive advantage of the designed mechanical products. With the prosperity and development of socialist market economy, the level of mechanical design in our country has been continuously improved, which puts forward higher standard requirements for the selection of scarce materials in mechanical manufacturing, with a view to increasing the utilization rate of materials, saving costs and creating conditions for optimizing the design of mechanical structures.*

KEYWORDS: *Heavy Industry Machinery Design; Material Selection; Standard Requirements*

1. Introduction

In recent years, with the improvement of scientific and technological level and innovation in the field, China's mechanical design technology has made unprecedented breakthroughs, and the front-line mechanical technology research team has gradually grown, laying a solid human resources and technical foundation for the progress of heavy industry. However, in the actual development process, excessive consumption of mechanical manufacturing materials not only makes scarce materials insufficient, but also runs counter to the concept of sustainable development. In view of this, this paper focuses on the selection and application of materials in mechanical design.

2. Value Reflection of Rational Selection of Mechanical Design Materials

The impact of the global economic integration storm is unstoppable, which intensifies the economic competition pressure of various countries. In order to achieve the grand strategic goal of sustainable development, the development of

modern city construction is very important. In the process of promoting and expanding urban construction, mechanical design plays an irreplaceable positive role. The vigorous development of machinery manufacturing industry and heavy industry has created tremendous economic benefits for our country, and further improved the gross national product. As we all know, the field of mechanical design will involve many types of raw materials. At this stage, the production and processing of many scarce materials can no longer meet the actual needs of mechanical design, and seriously restrict the development of the industry. Therefore, based on the perspective of sustainable development, we should deeply analyze the substantive causes of material shortage, improve the environmental protection and economic practicability of material selection, reduce the negative impact on the ecological environment, and promote the stable operation of the national economy. According to the relevant research results of professionals, the reasonable selection of materials plays an important role in the process of mechanical design. First of all, we should combine the actual needs, adhering to the principle of sustainable development concept, as far as possible to improve the utilization rate of materials, reduce the excessive consumption of resources. Secondly, starting from the overall situation, comprehensive evaluation of the advantages of mechanical structure design and functional integrity, selection of mechanical design materials with strong applicability. Finally, the selection of mechanical design materials should focus on the macro perspective, start with the details, pay close attention to the key content of the practical application process, in order to ensure the rapid and stable development of the mechanical manufacturing industry.

3. Basic Principles for Selection of Materials in Mechanical Design

3.1 Selection of materials to meet design requirements

In the process of selecting and applying materials for mechanical design, the basic design principles and specific requirements should be fully complied with, starting with the properties and uses of materials. Different components play different roles in the field of mechanical design, so the characteristics of materials are essentially different. Based on this, it is necessary to select materials according to the standard requirements of mechanical design for the performance of components[1].

3.2 Selection of materials with high load levels

With the prolongation of mechanical operation time, some components will lose their original functions. The fundamental reason is that the load level of some materials is low, which leads to the loss of basic functions of mechanical components. In view of this, the load level of materials should be ensured to meet the standard requirements. In the process of reviewing mechanical design, more

attention should be paid to the evaluation of material load level. At the same time, load limit standards should be raised for materials with high frequency of application. One of the most common cases is the carburizing process of low carbon steel. In order to ensure that the quality of steel meets the factory standard, it is necessary to test and unify the material[2].

3.3 Choose non-toxic materials as far as possible

In the early planning process of mechanical design, many types of materials will be involved. At the same time, radioactive elements will appear in some specific industrial production and processing links. Non-pollution treatment can not only avoid irreversible harm to the ecological environment, but also protect the lives of residents in the region, which has a very important practical significance[3].

3.4 Preferential selection of recyclable materials

At present, the materials used in mechanical design are mainly metal materials, but due to the differences in production process requirements, there will be special requirements for materials. In order to further strengthen the specific functions of metals, comprehensive treatment of various metals will also be carried out. The selection and application of alloy materials can meet the needs of mechanical materials to the greatest extent. In the process of mechanical design, it is necessary to plan the life cycle of components and various types of materials reasonably, and focus on the control and recycling. The recycling of materials can not only improve the economic efficiency, but also improve the utilization rate of resources and protect the ecological environment. For example, in the process of selecting metal materials, there should be limited selection of alloy materials with single composition[4].

3.5 Selection of Low Energy Consumption and Light Pollution Materials

In fact, the principle of selecting materials with low energy consumption and light pollution should also run through the whole material life cycle planning process. This advantage should also be guaranteed in the stage of recycling and reuse. From the material itself, it is the most basic principle to preferentially select economical, low energy consumption and light pollution materials. In this process, once the difficulty factor of production and processing increases, the short-term production cost increases sharply, it will affect the decision-making of the whole project. Therefore, the selection of materials requires scientific and rational planning, and comprehensive consideration of the entire material life cycle[5].

4. Material selection in mechanical engineering design

4.1 Emphasis is placed on the economic applicability of controlled materials

In the process of selecting materials for mechanical design, the economic applicability of materials should be considered. Mechanical designers should strictly control the production and processing technology, welding technology, assembly technology and casting technology involved in the design process. And on the basis of meeting the design requirements, we should give priority to the selection of raw materials with high price ratio, so as to ensure the maximum value of material utilization and optimize and improve the mechanical design. For example, in the process of mechanical casting, the fluidity, shrinkage, suction and segregation of mechanical materials should be strengthened; in the process of welding, the practicability and sensitivity of materials should be guaranteed; in the process of casting, the cold shrinkage, impact strength and plasticity of materials should be increased. In addition, the performance difference of mechanical materials determines the direction of material selection in mechanical design. It can be further optimized to understand the characteristics of different types of materials. On the premise of ensuring the applicability of mechanical design, we should synthesize the economy of calorific materials, not only to make their quality standards meet the requirements, but also to save costs as much as possible. For recyclable materials, appropriate secondary treatment can be adopted to improve the utilization rate of resources, reduce design costs and stabilize economic benefits[6].

4.2 Increasing Consideration of Energy Conservation and Environmental Protection of Materials

With the deepening of implementing the concept of sustainable development in an all-round way, material selection and application in the field of mechanical manufacturing has become the focus of attention of all sectors of society. At this stage, the public's awareness of energy conservation and environmental protection has gradually increased, and resource consumption and environmental pollution have become the core content of environmental protection projects. To ensure sustainable development, the first prerequisite is to increase resource utilization and eliminate excessive consumption. Therefore, in the process of mechanical design, it is very important to ensure the energy-saving and environmental protection of material selection. Mechanical designers should strictly implement the strategic concept of sustainable development and give priority to materials with low energy consumption and light pollution on the basis of fully meeting the design requirements so as to save non-renewable resources and promote the rapid development of the industry[7].

4.3 Focusing on the Principle of Sustainable Development

In the process of selecting mechanical design materials, we must unswervingly implement the strategic principle of sustainable development and attach great importance to the steady development of mechanical design. On the premise of meeting the design requirements, mechanical designers should increase the utilization ratio of selected materials, expand the direction of material application, and tap the potential, so as to give full play to the maximum performance of materials and carry out the design application pertinently[8].

5. Epilogue

In summary, in the process of mechanical design, adhering to the basic principle of sustainable development, priority should be given to the selection of low energy consumption and light pollution materials to improve the utilization rate of resources. This will not only make the mechanical industry move forward steadily, but also maintain the ecological balance and maintain the harmonious coexistence between man and nature.

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