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Analysis and Control of Technical Errors in Machining Technology

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Abstract

Excessive errors in the machining process affect the performance of mechanical products. In the study of analytical machinery.On the basis of the source of technical error in the processing technology, the source of error is determined, mainly including positioning error,machine tool manufacturing errors and tool geometric errors; The corresponding error control methods, including error compensation, are analyzed method, direct error reduction method and error grouping method, and compare; Finally, three error control parties are proposed.Characteristics of the application of the method in different machining. It has reference value for practical work.

Keywords

Mechanical Products; Processing Technology; Error Analysis; Error Control; Precision.

1. Introduction

Machining technology determines the accuracy and reliability of mechanical products to a certain extent. In recent years, affected by the development trend of product refinement, people's requirements for the quality of mechanical products are getting higher and higher. However, in the actual process, there is always an inevitable error between the parameters of the processed product and the planning and design, and if the error exceeds the standard range, it will inevitably affect its performance. Therefore, it is necessary to strengthen the error analysis in the machining technology, and on this basis, explore measures to improve the process technology, so as to ensure the optimization of product quality.

2. Machining Process

In mechanical machining, process engineers determine the appropriate machining processes based on the conditions of the machining equipment, the quantity of products to be machined, and the skill level of the workers. They then compile relevant machining content and requirements into process documents, also known as process specifications, which are crucial technical documents for organizing production. Due to variations in actual production conditions and process flows among different factories, these process specifications exhibit a high degree of specificity. The term "mechanical machining process" refers to the process of altering the surface quality, dimensions, and shape of raw materials through mechanical processing to transform them into components. For instance, rough machining, precision machining, assembly, inspection, packaging processes involved in producing a standard component constitute a complete set of mechanical machining processes. The techniques employed in these processes are referred to as mechanical machining technology.

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3. Sources of Error

In the machining process, it will be affected by the processing environment, personnel operation and the lathe itself and other factors, resulting in a large difference between the workpiece and the design size, especially for some of the tightness requirements of the "high precision" equipment, if the error is too large, will lose the use value, resulting in material waste and economic losses. Therefore, it is necessary to analyze the source of error in machining technology in detail to lay the foundation for error control [1].

3.1. Positioning Error.

In the use of machine tools for product processing, it is often necessary to select a geometric element on the product as a positioning benchmark. However, affected by human operation or the factors of the parts themselves, it is easy to lead to inaccurate reference positioning, which has a negative impact on the later machining. Generally speaking, the positioning error generated in the machining stage is mainly divided into two categories: positioning reference error and reference non-coincidence error.

3.2. Machine tool Manufacturing Error

According to the source of machine tool manufacturing error, it can be divided into three categories: transmission chain error, guide rail error and spindle rotation error.[2].

4. Machining Technology Error Control

Although the error is inevitable, it can be compensated by human parameter modification and mechanical adjustment to achieve the purpose of error control. The prerequisite for the implementation of the method is that the error in the mechanical processing is visible, that is, before the processing, the relevant equipment management personnel can clearly understand the direct cause of the workpiece processing error, so as to take this as a starting point, the error compensation measures are targeted. For example, when making a ball screw on a CNC machine tool, considering that it will wear due to frequent operation in the later period, resulting in a reduction in its pitch, a tensile force is pre-added during assembly, which indirectly increases its pitch, so as to effectively avoid the above problems. For some individual workpieces, it is often not appropriate to adopt error compensation method. For these one-time machining completed workpiece, the error mainly comes from the precision of the processing hardware, so for such problems, first need to analyze the decisive factors affecting the error of the workpiece, and then take a direct error reduction method. The application advantages of direct error reduction method are mainly reflected in the following two aspects: First, it greatly simplifies the machining process [3]. Compared with other error treatment methods, the direct error reduction method does not need to adjust equipment and replace instruments in the later stage, so the machining efficiency is greatly improved. Secondly, the error processing effect is good. The purpose of the direct error reduction method is to prevent and control the error from the source of machining, so as to avoid the occurrence of uncontrollable factors in the subsequent machining process. In the process of mechanical processing, the following problems sometimes occur: although the process capacity of one process is sufficient and the processing accuracy is stable, in the processing of semi-finished products in the previous process, the accuracy is too low, resulting in excessive reproduction errors or positioning errors, so that it is difficult to ensure accuracy. It is usually not economically reasonable to require the machining accuracy or blank accuracy of the previous process. At this time, the error grouping method can be used to divide the semi-finished product or blank size into several groups according to the error size, and the blank error of each group will be reduced accordingly [4]. Then, adjust the relative position of the workpiece and the tool,

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or adjust the positioning element to reduce the size distribution range of the whole batch of workpiece. The advantage of error grouping is that errors can be found and modified in time. In the two error control methods, once there is an obvious error in the processing of the workpiece, the processing process can only be terminated, affecting the processing efficiency of the entire workpiece. Error grouping method can realize error differentiation in the machining process, thus ensuring the continuity and economy of machining [5].

5. Conclusion

Machining accuracy is one of the scales to measure the level of a country's industrial technology. In the process of the transformation of China's industrial development from "Made in China" to "created in China", ensuring the accuracy and reliability of machining workpieces has gradually become the focus of attention in the machining industry. Objectively speaking, the machining error is inevitable, but as long as the error is controlled within the allowable range, it will not have a significant impact on the use of the workpiece. Therefore, it is necessary to continuously optimize the machining technology, do a good job in the quality inspection of the processing stage, and provide the necessary guarantee for the accuracy of the machining.

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