

Application of Intelligent Digitization in the Design and Production Process of Injection Molding Machine

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Abstract: *The combination of industrial information technology, automation technology and design and manufacturing technology can not only give full play to the advantages of existing technology, but also optimize the process technology and practical operation skills of injection molding machines, ensure the accuracy and simplicity of precision processing processes, and improve the quality and efficiency of products. On the other hand, it can also effectively guide the urgently needed intelligent manufacturing talents in China, promote the career transformation of universities, ensure the full use of talents, and promote the technological development of high-tech industries. In this paper, the author makes a detailed analysis and research on the application of intelligent digitization in the production and assembly of injection molding machines, hoping to provide conditions for the current production and assembly of injection molding machines.*

Keywords: *Injection molding machine production and assembly; Intelligent digitization; Digital design; Application*

1. Introduction

Domestic injection molding machine manufacturers are at a disadvantage in terms of technical level, design capacity, process technology, equipment, etc. Their products are mainly concentrated in the middle and low end. They have no great competitiveness in the world, and their profits are not high. Therefore, injection molding machine enterprises urgently need to improve their core technology, process and production level, and promote the sustainable development of the entire industry and related industrial chain through technological progress. This paper introduces the design and production of a new type of injection molding machine product which integrates key technologies and technical achievements such as design and manufacturing, and understands the application of its digitalization in the production and assembly process of injection molding machines. [1]

2. Basic overview of injection molding machine

Injection molding equipment is also called injection molding machine. The equipment uses plastic as a template to process thermoplastic or thermosetting materials into plastic products of different shapes. It is divided into vertical type, horizontal type and all-electric type. The injection molding machine is the most widely used machine in the plastic industry at present. It can not only directly use the injection molding machine to produce a large number of products, but also is an important equipment for the injection drawing and blowing process.

The injection molding machines produced by most injection molding machine manufacturers in China are mainly horizontal screw injection molding machines. This paper focuses on the basic principle of this injection molding machine and its assembly process, as well as intelligent digitization. The structure of injection molding equipment includes: injection system, mold locking system, lubrication system, hydraulic system, electrical system and body components.

The mechanical components of the injection molding machine mainly include the mold locking system, the glue spraying system and the body components. The main working elements of the mold locking system include: mold locking cylinder, mold closing device, mold comparison, mold adjustment mechanism, etc; The glue spraying machine is mainly composed of nozzle, screw and nozzle; The fuselage components include doors, racks, chassis, etc., which play the role of support and protection.

The working principle of the injection molding machine is to use the driving force of the screw to inject plastic into the closed mold cavity, and then solidify to form the product. First, add granular or powdered plastic into the drum, melt the plastic by the rotation of the screw and the heating of the outer wall of the drum, then move the mold closing and injection table forward to make the nozzle contact with the injection channel of the mold, and then introduce pressure oil into the injection cylinder to make the screw move forward. In this way, under high pressure and high speed, the molten material is injected into a closed mold with low temperature, and it is kept under pressure and cooled for a period of time to solidify. Then open the mold and take out the product. The function of pressure retaining is to prevent the reflow of molten material in the mold cavity, fill the mold cavity with material, and ensure the density and dimensional tolerance of the product.

The most basic requirements of injection molding are plasticization, injection and molding. Plasticization is the prerequisite to realize and ensure the quality of formed products. In order to achieve the purpose of forming, the pressure and speed in the injection process must be guaranteed. At the same time, the injection pressure is high, and the pressure in the mold is also high, so the closing pressure in the mold must be high. From this point, we can see that the glue spraying machine and the locking system are the core parts of the molding machine. [2-4]

3. Design of intelligent digital platform for injection molding machine products

3.1. Digital design technology of injection molding machine

In short, the digital design technology of injection molding machine based on the product platform refers to the product platform for developing injection molding machine products by analyzing and understanding the injection molding machine products, using advanced design technologies such as modular product platform design and development technology, module library development and management technology, and configuration design technology. On this basis, the injection molding machine required by customers when ordering is designed in the form of configuration design, and the product is provided to the next production process in the form of digitalization and customized BOM.

The technology can be divided into two main stages: one is to develop a product platform for injection molding machines, and the other is to meet user requirements based on the product platform. [5] It can be seen that product platform is the key in design technology. The injection molding machine product platform is a market for modular products. The main structure, module information, configuration rules, module models, module documents, module instances, etc. of the products are the basis of modular products and can be used as templates or references.

Due to the differences in the scope of application and designers of configuration design, its importance is also different, which must be clarified here. In daily life, the most common configuration design is to cooperate with the salesperson to select the appearance, color, accessories, decorations and many other items for the goods to be ordered, which will not have a substantial impact on the product, such as the ordering of cars. The other configuration is for experienced designers to determine the components of the product according to the structure of the product, under specific conditions and according to specific requirements. The configuration of these components will directly affect the function and performance of the product, such as the configuration of PC. [6] The configuration design described in this paper refers to the development trend of the current production mode of injection molding machines, that is, according to the product platform, configure the modules that determine the product performance, and design a fully formed injection molding machine according to the needs of users.

3.2. How to carry out digital design of injection molding machine based on product platform

While applying advanced product design technology, many data to be processed and collected will also be generated. The rapid and accurate collection, collation, analysis and decision-making of these data is the key to achieve high-quality product design technology. At the same time, through the analysis of product technology, the informatization and intelligence of product design can be realized, thus shortening the product development cycle. [7]

Therefore, in the development of injection molding machine, we need a corresponding information system, which will provide certain support for the digital design of injection molding machine products according to the actual situation of the enterprise and the characteristics of the product itself, and on this

basis, we will carry out the digital design of injection molding machine products, and on this basis, we will process the product information. This paper presents a digital design support system for injection molding machine based on product platform.

3.3. Architecture of digital design and development platform for injection molding machine

The injection molding machine is a medium and complex mechanical, electrical, hydraulic, control and other design content. Its design knowledge is diverse, and the design process has certain complexity. In the field of product design, it mainly includes: layout design, structural design, strength analysis, etc. In the process of design, it is necessary not only to have rich domain knowledge, experience, skills and scientific analysis and calculation, but also to meet the structural strength, kinematics, dynamics, hydraulic system design and other design problems of the injection molding machine. There are many disciplines involved, and the analysis, design and optimization of various disciplines need to be integrated together. Therefore, there is an urgent need for an advanced and efficient design method and software integration environment.

The digital design platform of injection molding machine based on knowledge engineering, object-oriented, collaboration and other technologies has made up for the defects of previous technologies to a certain extent, and opened up new ideas for the future design field. The digital design platform of injection molding machine is based on a variety of CAD technologies and is oriented to the integrated and integrated application of product life cycle, covering CAX CAD CAM CAM, product development management, virtual product development, virtual production technology, etc. However, the injection molding machine design platform does not simply integrate individual technologies, but systematizes production knowledge, establishes engineering objectives and production activities, and organically combines relevant theories and knowledge.

4. Technical requirements for product manufacturing of injection molding machine

4.1. Product requirements

From the market point of view, the design and production requirements of injection molding machines are comprehensively analyzed. Due to the low precision and low production efficiency of injection molding machines on the market, they need to be designed and manufactured according to their internal needs. First of all, we should strengthen the safe production of injection mold from the perspective of waterproof and fireproof, and formulate corresponding intelligent manufacturing process specifications.

Secondly, on the premise of ensuring the safety of the whole production process, we should consider the requirements of cost, environment and aesthetics, and establish a green manufacturing system to reduce resources and costs. In the design process, the overall layout of the product should be optimized by fully taking into account the production process, sequence and other factors of each part of the injection molding machine. It also strengthens the connection between local production and overall production, and ensures the accurate control of the production process through the difficulty judgment and reliability analysis methods. In the injection molding process, it is necessary to analyze various injection molds to increase the scalability of injection molding, so as to achieve product diversification.

4.2. Production efficiency

From the perspective of performance and efficiency, the design should comprehensively consider the design elements and design elements according to the relevant specifications, and evaluate the injection mold design and production economy. Design is the prerequisite of production, and production is the central link of design. The ultimate goal of injection molding equipment is to ensure product quality, reduce production costs, and enhance its competitiveness in the market. Therefore, in the process of design and manufacturing, relevant departments should take improving production efficiency as the maximum economic benefit of the injection molding machine.

5. Intelligent digital virtual design of injection molding machine

The virtual design technology of injection molding machine platform is to express the rules, ideas and experience data produced by designers in the design process in computer form. It breaks through the limitation of repeated design, manufacture and test of traditional injection molding machine design,

manufacture and test, and creates a comprehensive product R&D model integrating design, assembly, manufacture and test. Through the digital prototype of the system, the virtual analysis, virtual test, virtual production and other functions of the product can be realized. [8-9]

Virtual development is mainly divided into the following three stages.

5.1. Digital prototype design

Using the virtual design technology of computer, the overall design concept of the injection molding machine can be fully displayed, and a digital prototype can be built and put into the virtual environment for simulation and analysis. In the design stage, it can simulate the design scheme, structure, etc., and conveniently and intuitively inspect the working performance, so as to predict, analyze and evaluate the various quality, performance indicators, production and manufacturing methods and possibilities of the product in the design stage.

5.2. Analysis and optimization

Adopt the built digital prototype of the injection molding machine to carry out assembly simulation and mechanism motion simulation, complete the inspection of dimensional interference and motion interference, discover the design error in time, and achieve the purpose of product design dimensional accuracy. Based on the basic principles of finite element analysis and optimization analysis, the static and dynamic analysis is carried out using MATLAB, ANSYS and other tools, and the optimal solution of each parameter is obtained.

5.3. Cooperative design and production

In the platform development environment, the development process of the injection molding machine is transiting from the original serial mode to the parallel cooperation mode. In the whole design stage, the overall design of the injection molding machine and the design of each component are synchronized and interact with each other. On this basis, the concurrent engineering technology is adopted to realize the synchronous research and development of engineers at all stages, and also provide advance preparation for manufacturers and suppliers, shortening the product design and manufacturing cycle.

In the engineering management of the platform, a dynamic injection molding machine product R&D team composed of industrial modeling, mechanical analysis, electromechanical control and other professionals has been established. On this basis, technologies such as communication mechanism, data confidentiality, data consistency inspection and conflict elimination among customers across regions, departments and platforms have been implemented. Through digital modeling of injection molding machine products, real-time communication of product development and design issues of injection molding machine is realized, barriers to communication are eliminated, product information is inspected and evaluated, problems are discussed together, and solutions are sought.

5.4. Application of product data management

PDM is based on software, which integrates all information about products and the whole production process. The platform integrates database management, network communication capability and system control capability, provides information integration management for the whole life cycle of products, and also provides a concurrent environment for collaborative product development. PDM is the core technology of the platform. It provides the necessary support environment and overall architecture. Its main functions are:

(1) Data management. The core of PDM platform is to manage the product data. Its main role is to manage the data of various design stages, such as the layout of injection molding machines, three-dimensional drawings, various tests and analysis of parts, to ensure the interactivity of products, clear borrowing relationships, and convenient query.

(2) Engineering management and parts warehouse management. Be able to manage and supervise the R&D process and process of injection molding machine products on the platform, and provide necessary information for ongoing projects or activities. At the same time, the existing design data of various injection molding machine parts can also be classified to make full use of the existing design results, thus providing support for the research and development of new products.

6. Conclusion

To sum up, according to the characteristics of China's injection molding machines and the lack of development capacity, this paper proposes the development and design platform of injection molding machines, and discusses its application in the whole life cycle of design, development and manufacturing. By establishing this platform, we can effectively accelerate the research and development of new products of injection molding machines, shorten the production cycle, and enhance the competitiveness of enterprises. With the application of intelligent digitization in the production and assembly process of injection molding machines, the production and assembly quality of injection molding machines has been improved. The injection molding industry is an intensive labor industry, which usually requires manual control of product quality. At the same time, personnel are also responsible for product quality management. There are many risk factors during this period. With the rapid development of information technology, the work mode of controlling product quality by a single person can no longer keep up with the development of the times and science. In the production and assembly of intelligent digital application and injection molding machine, it can make the products produced more diverse and novel, can make the product quality meet the standard, and achieve the expected ideal production effect. Therefore, the progress and development of information technology is also driving the development of all walks of life, and the old-fashioned will be eliminated. Especially, the injection molding industry should keep pace with the development of the times and information technology, and carry out industrial innovation.

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