Process analysis of plastic parts

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Abstract

This paper focuses on the analysis and design of the injection molding process of mineral water bottle caps, and has developed a reasonable processing technology. The various requirements are elaborated in detail, so that the processing technology meets the production needs. This process has the processing of similar parts. A certain reference role.Analysis of the relationship between mold types and mold design.

Keywords

Injection molding, processing technology,Mold.

1. Introduction

The development status of injection molds at home and abroad, China's mold industry, in general, the level of development is not high, and there is still a certain gap with the international advanced level. However, since the beginning of the 21st century, China has continuously learned advanced technology from the West and introduced advanced equipment, which has made China's mold manufacturing level advance by leaps and bounds. There are many types of molds, which are mainly divided into: injection molds, hollow molding molds, and extrusion molding molds. The manufacture of injection molding dies in China is relatively mature; however, the manufacturing of hollow molding dies has yet to be developed.

At present, China's mold design and manufacturing has reached a high level in some aspects or has reached the world's advanced level. For example, the design and manufacture of small modulus plastic gears and large plastic molds, the largest plastic mold has reached 50 tons. In recent years, although China's mold industry has made rapid progress, it still needs to be developed in some specific aspects. For example, in the manufacture of precision, complex, larger and longer life molds, many still need to be imported. In order to improve the quality of plastic parts and shorten the production time, highly intelligent, networked, centralized and softened are the basic characteristics of mold manufacturing.

In the past few years, the domestic mold industry has developed rapidly. However, the development of each module is still unbalanced. The development of injection molds is relatively rapid, and will definitely surpass the overall development speed of molds in the future. In order to meet the needs of customers, injection molds are developing towards small, specialized, small and refined trends.

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2. Plastic design requirements

Raw data: Figure 2-1 shows a bottle of mineral water bottle made of polypropylene. The inner body of the cap has an internal thread connected to the bottle body, and the inside of the cap has a convex annular table, which has a matching relationship with the long rod of the mineral water bottle, and the specific size of the cap is shown in the figure.

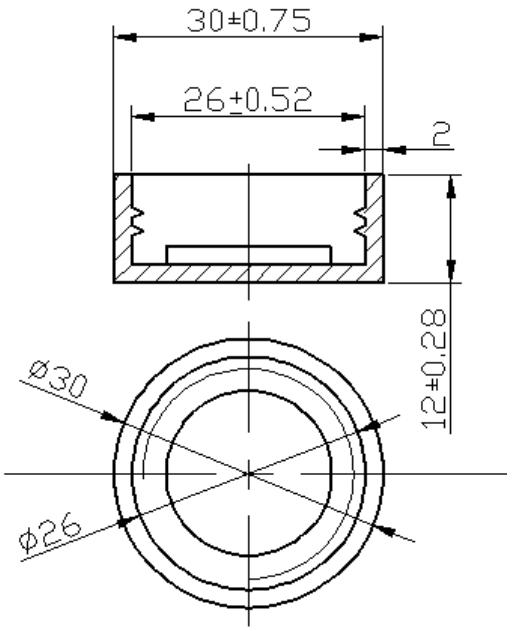

Figure 1. Cap size

The appearance of this product is shown in Figure 2.1. Its accuracy is general precision. Its main function is to be able to tightly bond with the bottle mouth to seal. Because the product requires a large amount, the production efficiency is high, the ancient design mold is a mold and four chambers, and the free mold release method greatly improves the production efficiency.

The dimensional accuracy of the parts designed this time is mainly three: size: 26±0.52mm; 12±0.28mm; wall thickness: 2mm, plastic precision is MT6. Accuracy requirements: 30 ± 0.75mm. It is necessary to strictly ensure the dimensional accuracy requirements, other dimensions are not strictly required, and it is reasonable to meet the needs. Plastic color: blue.

The overall shape and size of the cap are as shown above. The main dimensions of the cap are: height 12 and radius 15. Due to the external parts, although the dimensional accuracy is not high, it has a high surface precision. The inside of the cap is threaded and the screwing problem needs to be considered during the design process.

The requirements for the cap are: (1) Long life and impact resistance (2). The surface is shiny and looks good. (3). Chemical stability, high temperature resistance.

2.1 Material characteristics of plastic parts

Polypropylene (PP) is a semi-crystalline material that is harder and has a higher melting point than PE. Non-toxic, odorless, low density, strength, stiffness, hardness and heat resistance are better than low-pressure polyethylene, can be used at about 100 degrees. It has good electrical properties and high-frequency insulation, which is not affected by humidity, but becomes brittle at low temperature, not wearable and easy to age. It is suitable for making general mechanical parts, corrosion-resistant parts and insulating parts. Common acid and alkali organic solvents have little effect on it and can be used in food utensils. Since the PP temperature of the homopolymer type is higher than zero. C is very brittle above, and many commercial PP materials are random copolymers with 1 to 4% ethylene or block copolymers with a higher ratio of ethylene. The copolymer type PP material has a lower heat

distortion temperature (100 ° C), low transparency, low gloss, low rigidity, but has stronger impact strength, and the impact strength of PP increases as the ethylene content increases. The Vicat softening temperature of PP is 150 °C. Due to the high degree of crystallinity, this material has excellent surface stiffness and scratch resistance. There is no environmental stress cracking problem in PP. Typically, PP is modified by the addition of glass fibers, metal additives or thermoplastic rubber. The flow rate of PP has a MFR ranging from 1 to 40. Low MFR PP materials have better impact resistance but lower elongation. For materials of the same MFR, the strength of the copolymer type is higher than that of the homopolymer type. Due to crystallization, the shrinkage rate of PP is quite high, generally 1.8 to 2.5%. And the direction uniformity of shrinkage is much better than materials such as PE-HD. The addition of 30% glass additive can reduce the shrinkage to 0.7%. Both the homopolymer type and the copolymer type PP materials have excellent moisture absorption resistance, acid and alkali corrosion resistance, and solubility resistance. However, it is not resistant to aromatic hydrocarbons such as benzene solvents, chlorinated hydrocarbons (carbon tetrachloride) solvents, and the like. PP does not have oxidation resistance at high temperatures like PE. The material of the plastic part is PP (polypropylene) and its surface is required to be free of dents. The performance of all aspects is as follows: 1) Physical properties It is a non-toxic, odorless, tasteless, milky white high crystalline polymer with a density of only 0.9-0.91/, which is one of the lightest varieties of all plastics. It looks like polyethylene, but it is more transparent than polyethylene, but it is particularly stable to water. The water absorption rate in water 24 is only 0.01%, the molding performance is good, the surface gloss of the product is good, and it is easy to color. Polypropylene has all the excellent properties of polyethylene, such as excellent dielectric properties, water resistance and chemical stability. It is suitable for forming and processing; it also has many properties that polyethylene does not have. It can be used as a hinge and has high bending fatigue resistance. For example, various containers with lid and body are not bent after 7x107 opening and closing. Damage and fracture occur, but it is easy to depolymerize and age under the action of oxygen, heat and light, so it is necessary to add anti-aging agent. 2) Mechanical properties Polypropylene has high crystallinity and structural fineness with excellent mechanical properties. It has outstanding resistance to bending fatigue. 3) Thermal properties It has a melting point of 164 ° C - 170 ° C. The product can be sterilized at a temperature above 100 ° C. It does not deform at 150 ° C when it is not subjected to external force, and the embrittlement temperature is -35 ° C.

Main use: It can be used in various mechanical parts such as flanges, joints, pump impellers, auto parts; as a conveying pipe for various acids and alkalis, lining of chemical containers and other equipment, surface coating; can make cover and body A case, a variety of insulating parts, and used in the pharmaceutical industry.

Forming characteristics: large forming shrinkage range and shrinkage rate, easy to shrink holes, dents, deformation, strong directionality, excellent fluidity, easy to form; large heat capacity, injection molding must design a cooling circuit that can fully cool; pay attention to control Forming temperature. When the material temperature is low, the directionality is obvious, especially when it is low temperature and high pressure. The suitable mold temperature for forming polypropylene is about 80 degrees, and should not be lower than 50 degrees. Otherwise, the surface of the formed plastic part will have poor gloss and defects such as weld lines. Excessive temperatures can cause warping or deformation.

2.2 Relationship between mold type and mold design

Different materials have different molding characteristics and different process properties. In order to obtain better products, we need to fully grasp the characteristics and performance of the materials used.

Molding requirements for plastic parts: The chemical properties of plastic parts should be stable and the impact resistance is strong. Plastic parts are required to have no burrs, no cracking, flying hair, and flow.

Plastic molding process parameters: mold temperature: 40 ° C - 60 ° C, nozzle temperature: 190 ° C - 220 ° C, Barrel temperature: the previous section temperature: 200 ° C - 220 ° C, the middle section temperature: 220 ° C - 240 ° C, the latter section temperature: 180 ° C - 210 ° C.

Injection pressure: 40-80MPa, injection machine type: screw type, holding pressure: 50--60 MPa, nozzle form: straight-through, injection time: 0-5S, dwell time: 20-60S, cooling time: 15- 50S, forming cycle: 40-120S.

Injection molding process conditions: Injection molding machine selection: machine tools should be easier to control, I choose computer-controlled machine tools, high injection pressure.

Drying treatment: Under normal circumstances, reasonable storage of materials does not require drying. Melting temperature: When the temperature reaches 170 °C, the PP material will melt. When it reaches 350 °C, it will decompose. Under normal circumstances, it will be set at about 240 °C.

Mold temperature: The temperature is set between, the higher the accuracy, the higher the temperature. Injection pressure: consists of injection pressure and holding pressure. The injection pressure is 1500-1800 bar; the dwell time is longer, and the pressure is about 80% of the injection pressure.

Injection speed: In general, the injection speed is faster, but if the surface is uneven, the speed should be appropriately lowered to increase the mold temperature.

Runners and gates: The diameter of the runner is about 4-7 mm, and the gate is needle-shaped with a length of about 1-1.5 mm and a diameter of 0.7 mm. The gate length is 0.7 mm, half of the wall thickness is taken as the depth; and the width is twice the wall thickness. The mold has good venting performance, the vent depth is about 0.025mm-0.038mm, and the thickness is about 1.5mm. Try to reduce the appearance of shrink marks.

3. Conclusion

This paper mainly studies the process of plastic parts, and comprehensively considers its analysis according to the design requirements. The characteristics of plastic parts, the relationship between mold types and mold design can be analyzed in detail, which provides a reference for the processing of plastic parts.

References

[1] Hong Shenzhang. Practical injection molding and mold design. Beijing: Mechanical Industry Press, 2006

[2] Weng Qijin. Plastic Molding Technology. Beijing: Mechanical Industry Press, 2000.11

[3] Long Jiazhen, Xiao Ailin. Exploration of core processing technology for molded shell plastic parts[J]. Mould Industry, 2015, 41(12): 58-62.(12):58-62.

[4] Shi Tieliang. Mold Design Guide. Beijing: Mechanical Industry Press, 2003.8

[5] Yan Lianggui, Ji Minggang. Mechanical Design. Eighth Edition. Beijing: Higher Education Press, 2010

[6] Wang Kun, He Xiaobai, Wang Xinyuan. Mechanical Design Course Design. Beijing: Higher Education Press, 2007

[7] Wu Tuo. Mechanical Manufacturing Technology Foundation. Beijing: Tsinghua University Press, 2007