The Research on Injection Mould Design of Bearing Cylinder Plastics

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Abstract—It is analyzed by the technology plastics materials and molding process of bearing cylinder pieces, which has carried on the mold scheme demonstration and demoulding mechanism, the forming problem of bearing cylinder pieces is solved, and it is designed that the main runner, cold slug well, pull rod, the runner and gate of gating system .The ejection force is calculated, and which is design of parting surface. It is given to the assembly diagram of special injection mould. Practice has proved that the bearing cylinder pieces injection mold structure is reasonable, reliable, good machining quality and high production efficiency.

Keywords- demoulding mechanism; parting surface; bearing cylinder pieces; injection mould

I. INTRODUCTION

Injection moulds are always expensive to made, unfortunately without a mould it can not be possible a moulded product. Every mould maker has own approach to design a mould and there are many different ways of designing and building a mould. Surely one of the most critical parameters to be considered in the design stage of the mould is the number of cavities, methods of injection, types of runners, methods of gating, methods of ejection, capacity and features of the injection moulding machines. Mould cost, mould quality and cost of mould product are inseparable. In today's completive environment, computer aided mould filling simulation packages can accurately predict the fill patterns of any part. This allows for quick simulations of gate placements and helps finding the optimal location. Engineers can perform moulding trials on the computer before the part design is completed. Process engineers can systematically predict a design and process window, and can obtain information about the cumulative effect of the process variables that influence part performance, cost, and appearance[1].

Injection moulding is one of the most effective ways to bring out the best in plastics. It is universally used to make complex, finished parts, often in a single step, economically, precisely and with little waste. Mass production of plastic parts mostly utilizes moulds. The manufacturing process and involving moulds must be designed after passing through the appearance evaluation and the structure optimization of the product design. Designers face a huge number of options when they create injection moulded components. Concurrent engineering requires an engineer to consider the manufacturing process of the designed product in the development phase[2]. A good design of the product is unable to go to the market if its manufacturing process is impossible or too expensive. Integration of process simulation, rapid prototyping and manufacturing can reduce the risk associated with moving from CAD to CAM and further enhance the validity of the product development.

The injection moulding design task can be highly complex. Computer aided engineering analysis tools provide enormous advantages of enabling design engineers to consider virtually and part, mould and injection parameters without the real use of any manufacturing and time. The possibility of trying alternative designs or concepts on the computer screen gives the engineers the opportunity to eliminate potential problems before beginning the real production. Moreover, in virtual environment, designers can quickly and easily asses the sensitivity of specific moulding parameters on the quality and manufacturability of the final product. All these tools enable all these analysis to be completed in a meter of days or even hours, rather than weeks or months needed for the real experimental trial and error cycles[3]. As CAE is used in the early design of part, mould and moulding parameters, the cost savings are substantial not only because of best functioning part and time savings but also the shortens the time needed to launch the product to the market.

II. THE DESIGN ANALYSIS OF PLASTICS INJECTION MOULD

To choose the maximum thickness is at the center of the plane as the parting surface, mould opening flush is with the vertical direction. For ease of mold release, it should increase the draft, in order to ensure it the finally on the moving mould, plastic mold draft set must be greater than dynamic model draft.

Through internal cooling channel way, it cools the blocks at the same time, which can be a injection molding, greatly shorten the production cycle. Dynamic mould is set piece of structure, to reduce the mold cost, it is easy to replacement and exhaust, as shown in Fig .1.The design of mould plan[4] .The parting surface is options, due to the technical requirements of surface quality requirement, the parting surface is not set outer surface transverse. Parting surface is longitudinal Settings, by four side core working at the same time, parts are obtained by the shape.

The parting surface is the second option. The two end of the parts are flat, according to the parting surface design principle, the parting surface design is on this plane. Because of the length of the upper and lower surface of different hole, it is obviously different package force, so to

choose the parting surface on the surface. Comparing two options, one way is the part of the side core pulling, four cores are at the same time to participate in forming, the shape of the plastic parts size features ensures in good condition[5]. By using the die blocks, and mould parts constitutes the edge part of the appearance. And the scheme of two cores is the size of non critical part, plastic flow is of a longer trip. A side core pulling is overmuch, processing complex, to make the mould the complexity, the overall increases, the second scheme is practical.

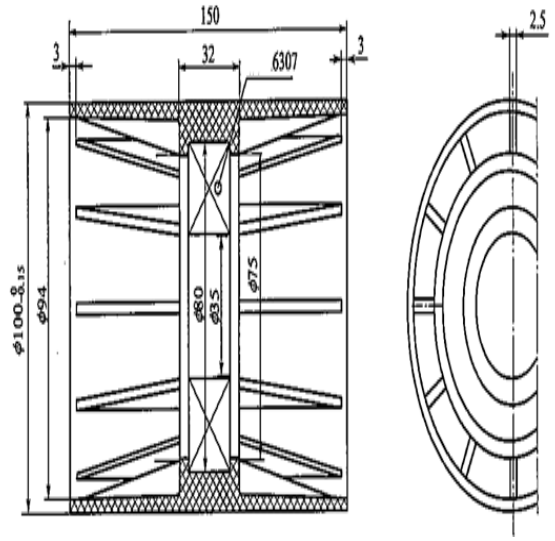

Figure 1. Bearing cylinder plastics

III. THE DESIGN OF GATING SYSTEM

The design is of the main runner. Main runner size directly affects the melt flow rate and molding time, because the main runner is with high temperature plastic melt, and injector nozzle is repeated contact, therefore, the main runner part is designed to remove the gate. In injection molding, injection machine mould pressure is very big, it is mainly effect on the gate set, so it doesn't usually put the sprue opening on the fixed template directly, but it is in a main gate set. Usually it is embedded mold after normalizing, such damage is in the process of mold, the use of easy is to replace or repair grinding. The sprue bushing is the use of T8A high quality materials, gate set length is fixed, mode with the thickness of the part is consistent, the mainstream way of exports face shall not be highlighted in the parting surface. In order to make the setting material pull out smoothly, the small end of the main runner diameter should be greater than the injection machine nozzle diameter, the technical parameters is of injection machine. Main runner pits is of the entrance to the spherical, radius should be greater than the injection machine nozzle radius of ball head, and to check the technical parameters of injection machine[6]. Usually gate set in diameter should not be too big, because the main role is by bending stress, to make the gate set easily damaged, gate set diameter also should not be too large, the purpose is to make the difference in temperature between gate set, the template is to achieve the minimum. Gate set of convex shoulders must have a circular arc transition, otherwise, it tends to damage due to stress concentration in the work. R is usually about 3 mm. Main runner half of cone angle is usually 2 ~ 4 °, big cone angle can produce turbulence or eddy current, which is easy to get involved in the air. The cone angle is too small, to make mould difficulty, which also can make the mold filling of melt, flow resistance is too large. The length of the main runner is general according to the thickness of the template. In order to reduce the pressure loss, the melt filling mold is material loss, it should as far as possible to shorten the length of the mainstream way, L is generally controlled within 60 mm. The main runner outlet should be larger than rounded corners.

According to the need of cold slug, it should be in place of melt flow direction, and along the upper, which reaches the melt flow direction. In the runner, design should be considered when reducing the pressure in the flow passage of loss, and as far as possible to avoid the melt temperature reduced, it should also consider reducing the volume of flow channel. Its design principle is that the smallest distance will melt quickly in input cavity smoothly. Materials must be in the same temperature, and pressure conditions is from the gate to the cavity feed at the same time. As far as possible big flow, channel section is advantageous to the mold filling, and it ensures the enough pressure maintaining pressure, but from the perspective of saving material, sectional area should be as small as possible, larger cross-sectional area also increases the cool down.

The cross section is shape of the runner. In the design, flow channel is to reduce the pressure loss of flow passage, and hope to flow the less surface area, therefore, available, cross section area is of flow channel, and the ratio of the circumference is to represent the port efficiency. Circle and square are the highest efficiency[7]. Due to the parting surface shape is as the plane, trapezoidal section flow channel can be used. Because the plastic melt flow is in the passage, it will be formed in the flow channel of wall solidified layer. This layer heats insulation effect, it makes the melt that department is in the center of the flow channel. Therefore, in the center of the runner, gate is located in the center of straight line.

IV. THE INJECTION MOULD STRUCTURE OF BEARING CYLINDER PLASTIC

Injection mould structure is shown in Fig .2, dynamic model and dynamic model coat are set piece of structure, the same as die body and fixed die coat, the interference is fit. Coat is opened cooling water channel, to seal on both ends, so it is easy to guarantee the accuracy coat. In the dynamic model of core also have open cooling waterway, and it can be adjusted by ejection mould core of insurance force. Mould opened, plastic parts is on the moving mould, demoulding mechanism is set by pushing plate and push rod to ensure plastics mold release.

The section size of distributary channel mainly depends on the size of the plastic products, mould structure and processing of plastic types. In general, the increase of product size is wall thickness, because the melt is in the big cross section, small flow channel section flows in the runner when the resistance is small, therefore, large cross section flows, channel can promote the mould filling process. If shunt way is longer, the process is longer,

plastic viscosity should be smaller[8]. In addition, the products of the production of economy should also be considered, otherwise, compared with the model of product, distributary channel cross section is too big, it will affect the cooling capacity and cooling time, which is causing the waste of material and time. Due to the size of the diversion channel, the product quality and production efficiency have a significant impact, therefore, the general points and the diameter of the sprue are within 3 ~ 10 mm. And distributary channel is length between 8 ~ 30 mm, it can be also according to the number of cavity appropriate lengthen, but it should not be less than 8 mm, otherwise, it is difficult to repair the mould. The section size of distributary channel is according to the variety of products used in plastic, weight, thickness and the length of the shunt way to determine. The look up table shows that the density of ABS plastic is 1.01 ~ 1.08, the calculation of plastic volume is for 98g. So the quality of plastic is 102 g. Because the wall thickness of parts is for 5 mm, for ABS plastic, in order to make the shunt way easy machining and easy to launch, coagulation is for 6 mm in diameter.

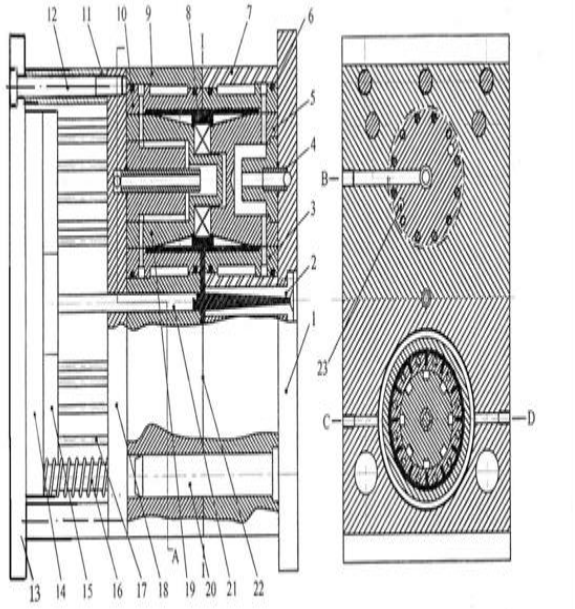

Figure 2. Injection mould structure

V. THE BALL SPINNING PROCESS TECHNOLOGY CHARACTERISTICS

The metal pipe mechanical properties was improved. Metal pipe fits in the deformation zone in compressive stress state, deformation is after the prolongs material grain and groups of woven refinement, which is with continuous fiber structure, it improve the yield strength of metal, tube hardness is as well improved, elongation is reduced.

The process method is simple, easy to grasp. Spinning process does not require relying too much on the operator of intervention technology, technology and equipment is simple. Usually cutting machine is to improve slightly, which can be used in ball spinning processing. Due to the deforming force is small, small tonnage equipment is used to processing large size products.

The mold consumption is low. Ball spinning is compared with deep drawing drawing, because the spinning deforming force is small, and the rolling friction insteads sliding friction, the ball spinning mould of more general can adjust the size range, the mold consumption is only 1/5-1/8 for stamping drawing die.

The deformation is high efficiency. For the plastic and alloy of general good gold scrap, the reduction of area of the single channel time can reach 70%~85%. While drawing pipe is only about 30%. If compared with the cutting, it can improve production efficiency of 30 to 50 times. It makes it easier for small batch more varieties, specifications length and diameter of the large one. Therefore, ball spinning is deformation of thin, which force is not only small, and spin after fitting surface is of high quality. Due to the required load of ball spinning is small, it can take advantage of small tonnage equipment to process large size pipe fittings. Moreover, because the quantity of application more ball is full of concave die. The process of deformation and stress tends to be more uniform, to prevent the instability of the process of spinning and distortion[9]. The radial component of tension and compression is more balanced, to reduces the pipe hole enlargement. It ensures that the ball spinning tube has a higher accuracy than the wheel pressure.

Ball spinning of processing and application range is 3 to150 mm in diameter, the tube wall thickness is less than 3 to 5 mm, the finished wall thickness is 0.1~1.2 mm, usually up to 0.04 mm of the thinnest. Due to production product has the high accuracy and good mechanical properties, and the advantages of saving time has saving raw material, thus ball spinning pressure in the aviation, aerospace, electronics and instrumentation, and which won the growing medical apparatus and instruments.

VI. THE BASIC PARAMETERS OF SPINNING TECHNOLOGY IS SET

The wall thickness is of reduction ratio. Reduction ratio is the important process parameters in the process of ball change, because it directly affect the spinning force size, production efficiency is high, and the stand or fall of fitting is accuracy. Thinning is always lose. Thinning ratio passes two slaughter. The total reduction ratio is of logarithmic reduction ratio for different combined. In the process of ball spinning thin, it is the time to become pressure reduction ratio of influence and choice[10].

Because the unique characteristics of thin ball spinning technology is better than wheel spin, tube can choose a larger one including a reduction ratio, it usually including a reduction ratio that can reach 40% ~70%. Therefore, it can greatly improve the production efficiency. However, including a reduction ratio, the material can spin and spinning equipment capability on craft, except that the restrictions are spinning pipe quality and accuracy requirements. Metal material is expected maximum spin, the limit of thinning rate depends largely on inherent plastic metal materials. Ball spinning thin thinning rate is expression. This is because the pressure has the following features:

It improves the spinning metal liquid, if spinning process parameters selection is undeserved, it can cause

deformation zone before the metal accumulation, wall instability produces the disadvantages such as hole enlargement. To improve the process parameters, it usually lower the spinning production efficiency. And after the pressure, it can make gold flow conditions greatly improved. This can increase the wall thickness of reduction ratio noise and reduce skin pile product, to improve product quality and production efficiency.

The pipe shape and dimension precision was improved after spinning. The existence of axial tensile stress can be suppressed to tensile stress, it is not easy to produce hole enlargement. Tensile stress is easy ball bearing deformation area before fitting the mobile, the prompting metal accumulation is reduced, supination are more likely to die pipe fittings. It makes rotary pressure decreased significantly. It is shown as curve of carbon steel pipe without tension axial force.

The figure is shown that the use of tension has significantly reduced than without tension. And the decrease depends on the axial feed rate, wall thickness thinning, tension values, and materials performance, etc. In a word, experimental study and production practice shows that application with pressure method is to produce one specifications, an effective method is high precision, and high surface quality is thin-walled tubes.

VII. CONCLUSIONS

It is analyzed by the technology plastics materials and molding process of bearing cylinder pieces, which has carried on the mold scheme demonstration and demoulding mechanism, the forming problem of bearing cylinder pieces is solved, and it is designed that the main runner, cold slug well, pull rod, the runner and gate of gating system .The ejection force is calculated, and which is design of parting surface. It is given to the assembly diagram of special injection mould. Practice has proved that the bearing cylinder pieces injection mold structure is reasonable, reliable, good machining quality and high production efficiency.

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