# Injection is not solely based on the desired

Business, Industries

Injection MoldingIntroduction Injection molding is a manufacturing process for producing products in larger scale. It’s the most used manufacturing process for the fabrication of thermoplastic and thermosetting polymers, but it can be performed with a host of materials mainly included metals, glasses, elastomers, confections. The process requires to use an injection molding machine, raw material and mold. In the machine the materials melt and injected into the mold, then the material cold down and solidifies to be a final part. The process goes over and over again, because it’s a fast and sheep method, Injection molding is perfect for producing products in larger scale (http://www. custompartnet. com/wu/InjectionMolding 2017-12-11).

Materials The most used materials in Injection molding is polymers, including thermoplastic, some thermosets and some elastomers. These materials are used in a raw form like small pellets or fine powder. Each material has different properties, not just for the final part. It is important to know all about the materials processing parameters in the injection molding process, included injection pressure, mold pressure, ejection temperature and cycle time.

It is important to remember that the selection of material for creating injection molding parts is not solely based on the desired properties of the final part. While each material has different properties that will affect the final result in strength and function (http://www. custompartnet.

com/wu/InjectionMolding 2017-12-11). Process Cycle  Injection molding is used by a machine. The machine included a lots of parts, (see figure 1 and 2) Filling and pressure process The hole process starts when the pellets are

feed into the heated cylinder, and the melt is forced into the mold either by a hydraulic plunger or by the rotating screw system of an extruder. In a plastic extrusion the polymers are promoted melted in the cylinder, the barrel is externally heated.

Most of the heat in the injection molding is transferred to the polymers by frictional heating. The polymers push forward at the mold entrance and the pressure builds up, then the rotating screw starts to move backwards under pressure to a predetermined distance, this is for controlling of the material to be injected. When the material has been injected the screw stop rotating and just push forward hydraulically and forcing the material into the mold cavity. The pressure from the screw developed usually from 70 to 200 MPa (KALPAKJIAN, S.

& SCHMID, S. R. 2014). Cooling and remove process Now is time for the injected material to cool down and been removed from the mold. After the part has been cooled or cured sufficiently the mold are opening and ejectors are used to remove the part from the mold. After this the mold get closed again and the process starts from the beginning again (KALPAKJIAN, S.

& SCHMID, S. R. 2014). EquipmentIt is really important to use the right equipment in the injection molding process. This process can be used by different molds. It’s depends on how the final product should look. Molds with moving and unscrewing mandrels are using if the parts have multiple holes or internal and external threaded features.

To make different designs the molds may have several components, including runners, cores, cavities, cooling channels, inserts, knockout pins and ejectors. There are three basic types of molds: 1: Cold-runner, two plate mold2: Cold- runner, three plate mold3: Hot-runner mold Cold runner is the simplest and most common design. It is a sheep mold and good for the environment. The remaining material in the channels connecting the mold cavity to the end of the barrel most be removed, usually by trimming and the rest of the material can be used for recycling. The hot-runner mold is more expensive but have shorter cycle time, it’s because only the molded part must be cooled and ejected (KALPAKJIAN, S. & SCHMID, S. R. 2014).

Process Parameters There’s a lot of process parameters which matters in Injection molding. It is all about how the final product properties should be, not only function and shape. Colors and mix of materials is also really important. In the Injection molding process there are four different molding process parameters. Multicomponent injection molding, this kind of molding is almost using with forming of parts with combination of colors and shapes. The rear-light on a car made of different materials and colors is an example there multicomponent injection molding are used.

Insert molding, this molding involves metallic components. The component been places in the mold cavity before the injection and become an integral part of the molded product. Hand tools where the handle is insert molded onto metal components are an example on a product who is produced by insert molding. Overmolding, this process will produce the products in one operation and without need for post molding assembly. Hinge joints and ball-

and-socket joints are two example of products who can be produced by overmolding. To avoid that no bonds will form between the molded halves of the joint, two different plastics are almost used. Ice cold molding, in this process is the same plastic used to form the both components of the joint.

A standard injection-molding machine and a two-cavity mold is used in one cycle. The two components have free movements and no bonds developed between the two pieces (KALPAKJIAN, S. & SCHMID, S.

R. 2014). DefectsInjection molding is a high-rate production process and it’s capable of producing complex shapes with good dimensional accuracy.

But it has also observed defects in the process. One defects are equivalent weld lines, they arise when molten metal flows in from two opposite runners and then meets in the middle of the mold cavity. The runners section could be too small and the polymer may solidify prematurely.

This defect can lead to prevent full filling of the mold cavity and solidification of the outer layers in thick sections can cause or voids due shrinkage. Like flash formation in impression-die forging can flash forms if the doors do not close completely. Another defect is known as sink marks, it could also be called pull-in. Proper control of temperatures, pressures and mold design modifications using simulation software are methods for avoiding defects. A lot of analysis and progress has been made in design of molds and material flow, modeling techniques and simulation software have been developed during the time. All of this analysis has made for studying optimum gating

systems, mold filling, mold cooling and part distortion. All for to make Injection molding free from defects (KALPAKJIAN, S.

& SCHMID, S. R. 2014).

Design Principles Understanding the Injection molding and the qualities of the product design is really important to optimize and efficiency the production of the product, and to end with a good quality on the finish product. Wei Wang describe in his power-point Injection Molding (2017) the most important design principles; Draft angle (see in figure 2) is one design principles; it makes easier to eject the part from the mold. It depends on the thickness and surface texture how big or small the draft angle should be. Figur 2 Draft AngleThe size is one of the design principles, Maximum dimension is follow; Size: 480mm x 751 mmVolume: 966. 837 cu. mmDepth: 101 mm from parting line, (if the parting line can pass through the middle of the part the depth could be up to 203. 2mm. Projected mold area: 112.

903 sq. mm. The milling process of the mold is usually used by an automated CNC-process, for that reason some part will have a radius rather than a sharp edge. Process EvaluationThe price of the injections moldings machine is rated according to the capacity of the mold and the clamping force. The force ranged from 0. 9 to 2. 2 MN (in most machines).

The largest machine in industry today has a capacity of 45 MN and could produce parts weighing 25 kg. The cost of the machine range from 60. 000 – 140.

000 dollar. High-volume production makes the prices lower. The mold life may be on the order of 2 million cycles for steel, but it can be about only 10.

000 cycles for aluminum molds. It’s really expensive for large mold, the price could be up to 100. 000 dollar (KALPAKJIAN, S. & SCHMID, S.

R. 2014). Here is a table from Wang, W (2017) Injection Molding Power-point presentation (se table 1) with comparison between Injection molding and Machining to compare Rate, Quality, Cost and Flexibility. Table 1 Comparison from Wang. W (2017)Injection moldingMachiningRateHighLow-medium QualityGoodAs good or betterCostLow (at high volume)Almost always greaterFlexibility Low (high tooling cost)High (within machine constraints)Reference KALPAKJIAN, S. & SCHMID, S. R. 2014.

Manufacturing Engineering and Technology (7 Edition in SI Units), New Jersey, Pearson. Wang, W. (2017) Injection Molding PowerPoint presentation. Published lecture. Retrieved 2017-12-12. http://www. custompartnet. com/wu/InjectionMolding 2017-12-11