DESIGN AND DEVELOPMENT OF MOULD CALCULATION SOFTWARE

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ABSRACT

Manual calculation for injection moulding operation is time consuming and intends to make a miscalculation because of many parameters that need to be considered. In this project, mould calculation software is developed and design. It is created to help the users to calculate the injection moulding parameters that involve in some processes. The software is developed and design by using Microsoft Visual Basic 2008 programming. The formulae of injection moulding parameters are input into the software, in the form of computer coding. The interfaces of injection moulding parameters are created by using the graphics in Microsoft Visual Basic 2008. At the end of the project, the Mould Calculations Software is created. The aid from software, time to calculate mould parameters in designing stage is shorter than manual calculation

ABSTRAK

Pengiraan secara manual untuk operasi acuan ini memakan masa dan berkemungkinan untuk membuat perhitungan yang salahkerana banyak parameter yang perlu diambilkira. Dalam projek ini, perisian pengiraan acuan dibangunkan dan direka bentuk. Ia dicipta untuk membantu pengguna untuk mengira parameter acuan yang terlibat dalam beberapa proses. Perisian ini dibangunkan dan reka bentuk dengan menggunakan Microsoft Visual Basic 2008pengaturcaraan. Formula acuan parameter input ke dalam perisian, dalam bentuk kod komputer. Muka parameter acuan dicipta dengan menggunakan grafik dalam Microsoft Visual Basic 2008. Pada akhir projek, PerisianPengiraan ParameterAcuan dicipta. Dengan bantuan daripada perisian, masa untuk mengira parameter acuan dalam peringkat mereka bentuk adalah lebih pendek daripada pengiraan manual

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CHAPTER 1

INTRODUCTION

1.1 Project Background

The project is about developing the plastic injection mould calculation software. Its involves parameters such as shot capacity, clamping pressure, plastic size capacity, calculation cycle time, number of cavities that determine by shot capacity, by plastic size capacity and by clamping capacity, gate and runner size . These criteria are important in injection moulding process.Sofware that used to develope the mould calculation sofware are visual basic and C++ programming. The result from the moulding calculation sofware will make the injection database more accurate. These two combination of sofware will make the mould calculation became more effective and save the time for doing calculation by the manually. At the end of the project, the sofware will be give a lot of benefit to the manufacturer especially in injection moulding process.

1.2 Problem Statement

Manufacturers may have some difficulties in finding commercial software for plastic injection mould parameter estimation which really suits their immediate use. Some existing software in the market has many restrictions in data entry. Even

though the software is easy to use, users require a long time to become famaliar with the software. They are time consuming for learning, not user friendly if users do not well understand the meanings for individual input.

1.3 Objectives

The objectives that going to achieve in this system is:

i. To design mould parameter calculation sofware system.
ii. To develop mould parameter sofware system with the injection database.

1.4 Scope

The scope of the project is:

1 Developing the mould calculation software by using visual basic
2 Creating a database of the injection parameters.

1.5 Project Significance / Impact

There are few benefits that a user can gain from this software system such as it will savethe calculation time. Futhermore, the calculation will be more accurate. Besides that, this system also assist industrial practitioner in producing an accurate calculation for certain mould manufacturing projects. The usage of mobile devices results in improved data accuracy and increased mobility and convenience thereby streamlining movement and reducing human errors. Mobile devices increase productivity through reduced data entry efforts, reduced data capture activities, streamlined user time-motion efforts, enables process automation which increases throughput and decreases cycle-times.

CHAPTER 2

LITERATURE REVIEW

2.1 Mould

Mould is the common terms used to describe the tooling used to produce plastic parts in moulding. It's usually only used in mass production where thousands of parts were being produced. Typical moulds are constructed from hardened steel, pre-hardened steel, aluminum, and/or beryllium-copper alloy. The choice of material to build a mould from is primarily one of economics; in general, steel moulds cost more to construct, but their longer lifespan will offset the higher initial cost over a higher number of parts made before wearing out. Pre-hardened steel moulds are less wear-resistant and are used for lower volume requirements or larger components[1].

2.2 Mould Types

Mould is the production tooling used to produce plastic parts in moulding.There are two type of mould. There are **two-plate mould** and **three-plate mould.**Both of the mould type have different characteristic.

2.2.1 Two-Plate Mould

The two plate mould is simple in design, yet versatile. It consists of a front and stationary half. The cavity or core can be mounted on either half, depending upon the part design and the location of the location of the knock-out pins. This mould is easily adapted for different designs and all part ejection methods.The standard mould (Figure 2.1) is the most simple design, basically the standard moulds is same as two plate moulds construction, they divided in two side : cavity side and core side, cavity side is the side that construct to flowing plastic material from nozzle to cavity parts, basically they consist of sprue, runner.

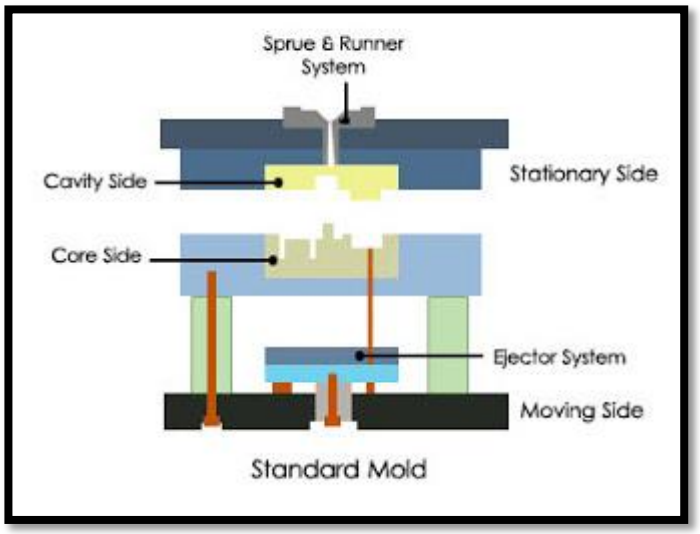

Figure 2.1: Two-plate mould

Core side constructed to make shape for core, demolding system and ejection system, at this side the design ejection system.Standard mould have one parting line, and have one opening direction. this type of mould use in all kinds of plastic parts that doesn't have undercut, inner and outer screw.Light brown color little and straight in ejection system is shown ejector pin.

2.2.2 Three-Plate Mould

This type of mould (Figure 2.2) is used primarily to centre gate or submarine gate parts in multiple cavities. It consists of the standard two-plate design with the third movable between the two. Automatic degating is possible with three-plate moulds, but runner scrap is increased.Basically three plate moulds has two parting line, and floating plate, floating plate support by support pin, Since the mould has two parting planes, the runner system can be located on one side of floating plate or make special plate that attach in floating plate, we called runner plate, see post about runner plate. Three plate moulds are used because of their flexibility in gating location. this types of moulds is flexible even use in multiple cavity.

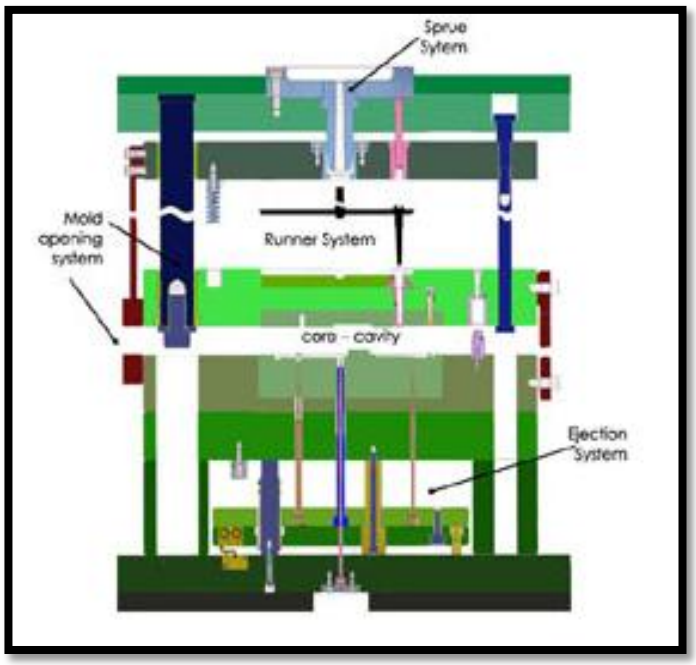

Figure 2.2:The Three plate moulds

2.3 Basic mould construction

TheFigure 2.3 below show Three-Plate Mouldbase type with closed position, basically 3 plate type and 2 plate type has some main plate.

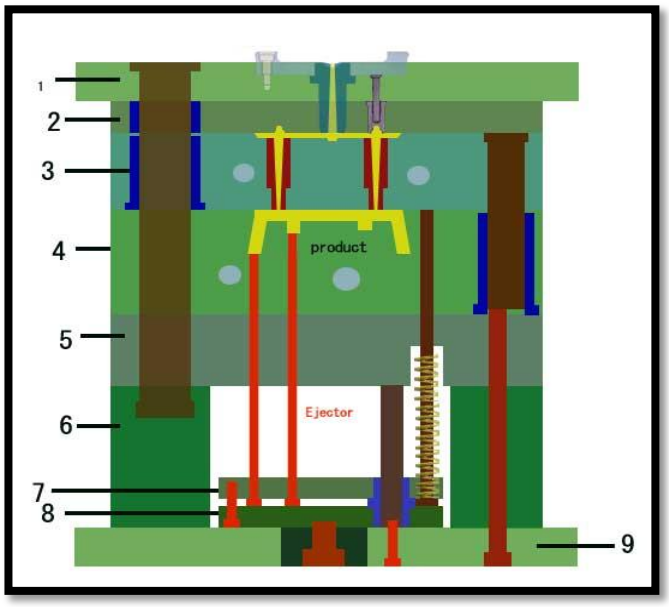

Figure 2.3:The Basic mould contruction

1. **Fixed Clamping Plate or Top Plate:** The function of top plate is to holds the fixed side of the mould to attached at the fixed platen of the injection machine at this plate will attach locating ring, eye bolt, and sprue bush.
2. **Runner Stripper Plate**: The runner stripper plateonly used in 3 plate moulds type, the function is to cut resin from nozzle in top of sprue bush, and pull the runner by runner locking pin.
3. **Fixed Mold Plate or Cavity plate:** The function of cavity plate is to hold cavity side of product, leader pin, support pin, Puller bolts, and Angular pin when slider attached.
4. **Movable Cavity Plate or Cavity plate**: It used to attach core side of product, return pin, leader bush and slider core if needed.

5. **Back up Plate or Support plate**: The function of support plate is to support cavity plate, attach the hole for return pin's spring, and cooling channel when in cavity plate can not make it.
6. **Spacer Block**: The spacer blocks are mounted between the movable clamping plate (bottom plate) and the movable cavity plate to give space and allow the ejector plate to move when ejecting thepart and the required length of spacer block depend on ejector stroke that needed to eject product.
7. **Ejector retainer plate**: The function of the ejector retainer plate is to hold the ejector, Z pin, shoulder bolts,and give space to ejector leader pin and support pillar.
8. **Ejector Plate**: The function of ejector plate is to pushes the ejector pins and return pins, connected with ejector rods.
9. **Movable Clamping Plate or Bottom plate**: The function of bottom plate is to holds the movable side of the mold like spacer block, support plate, cavity plate and ejector mechanism to the movable platen of the injection machine.

2.4.1 Sprue Bush

The sprue bush is defined as that part if the mould in which the sprue is formed. In practice (Figure 2.4) the sprue bush is the connecting member between the machine nozzle and the mould face, and provides suitable aperture through which the material can travel on its way to the impression or to the start of the runner system in multi-impression moulds.

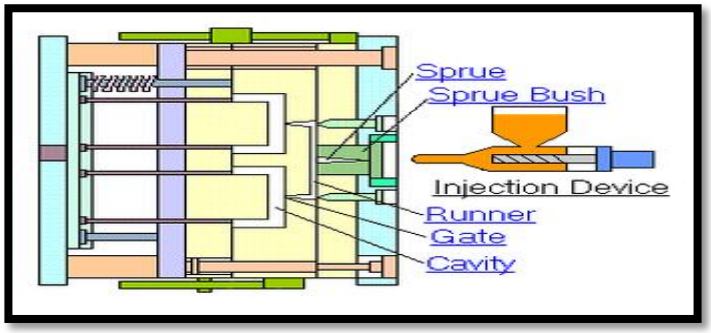

Figure 2.4: The location of sprue bush

The sprue bush is fairly highly stressed in some appliance and should therefore be made from a 1.5% nickel chrome steel and should always be hardened. The internal aperture of the sprue bush has between 2˚ and 4˚ included taper, which facifilitates removal of the sprue from the mould at the end of molding cycle.

There are two basic design of sprue bush. There are **spherical recess**and**flat rear face**as shown in Figure 2.5 :

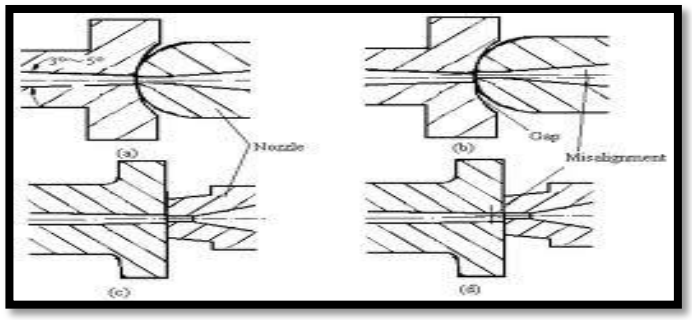

Figure 2.5: Two basic design of sprue bush,spherical recess and flat rear face

1. The first of these is a sprue bush with a **spherical recess** which is used in conjunction with a spherical front ended nozzle.
2. The second has a perfected **flat rear face**, the seating between it and it corresponding nozzle.

2.4.2 Register ring / Locating ring

The register ring is a circular member fitted on to the front face (and often also to the rear face) of the mould. Its purpose is to register (or locate) the mold is correct position on the injection machine.

When the mould is mounted n the machine, the front mounted register ring fits into a circular ole which is accurately machined in the injection platen on the cylinder-nozzle axis. This ensures that the small aperture in the nozzle is in direct alignment with the sprue bush. Now, since the sprue bush is the connecting member between

the machine nozzle and the mould face, this alignment of nozzle aperture and sprue bush hole permits an uninterrupted flow of material from the cylinder, through the nozzle and sprue hole into the mold runner system. The register ring, in fact, forms a direct connection between the sprue bush and the hole in the injection platen of the machine (Figure 2.6).

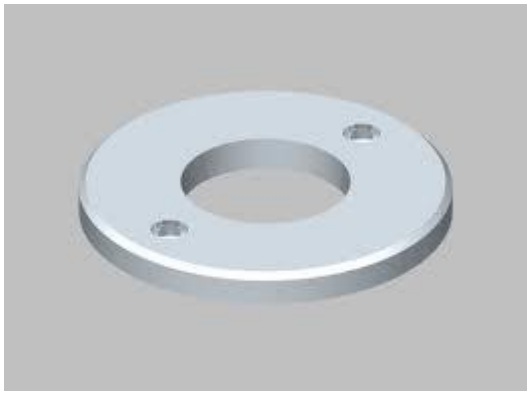

Figure 2.6: The Register ring / Locating ring

2.4.3 Runner

A Runner is a machined groove located between (and includes) the Sprue Bushing and the Gate. The function of a runner is to provide a passage for the material to flow from the Sprue Bushing to the Gate. There are many types of Runner cross sectional shapes. Most common shapes are the Full Round, Half Round, and the Trapezoidal. The length of a runner system should be kept to a minimum. Injection Pressure build-up due to long runner lengths can be reduced by increasing the runner diameter. However, larger runner diameters increase cycle time due to the added volume of material that needs to be chilled/solidified.

There are two types of runner:

1) Cold Runner
2) Hot Runner

2.4.3.1 Cold Runner

This runner system have similar use with hot runner, but in different temperature, the temperature between 80-120 C, this Cold runner system used in reactive material such us rubber and thermosets type of plastic.

The difficulties in Cold runner system is :

1. High pressure consumption, so design more expensive
2. Because material is reactive, a little different temperature make different viscosities, this will make every cavity have different time to full fill.

2.4.3.2 Hot Runner System

This system (Figure 2.7) should be viewed as extended nozzle in form of block, the hot runner system contains : sprue bush, runners, gate and extended nozzle, the advantage of hot runner is:

- They can completely eliminate runner scrap, so there are no runners to sort from the parts,
- No runners to throw away or regrind and remix into the original material.
- No loss of melt and thus less energy and work input
- Easier for fully automatic operation
- Very good quality because melt can be transfered into the cavity at the optimum site

The hot runners also have their own disadvantages and there are :

- High cost
- Thermal isolation from the hot runner manifold block is problematic

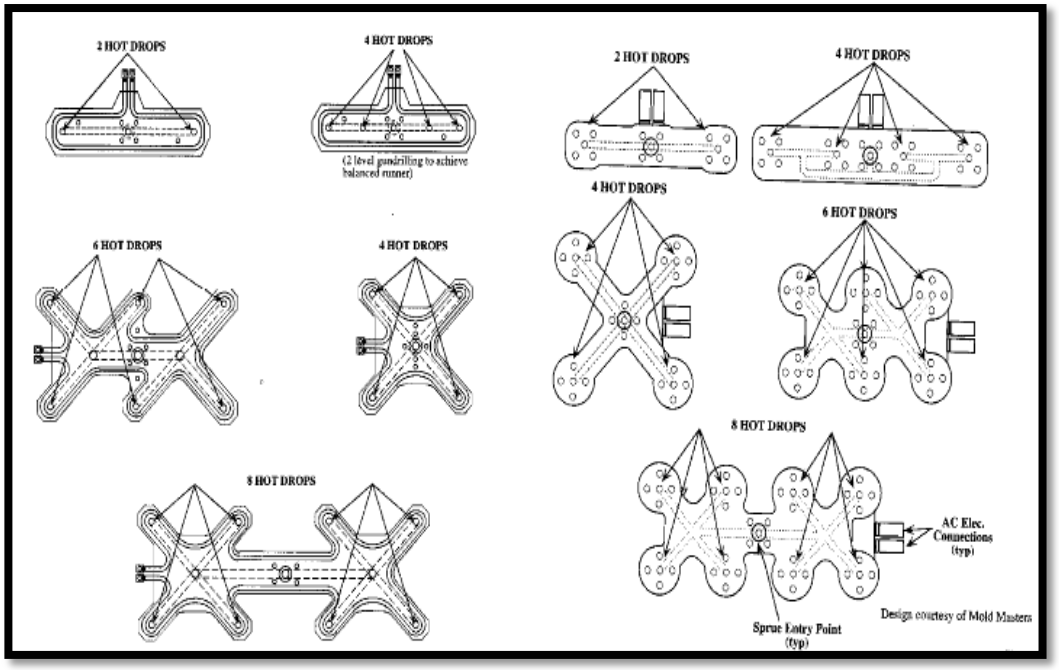

Figure 2.7: The hot runner system

The hot runners are popular in high production parts, especially with a lot of cavities, there is 3 type of Hot Runner are :

1. the insulated hot runner,
2. the internally heated hot-runner system,
3. the externally heated hot-runner system

2.4.4 Gates system

The narrow and shallow portion of the runner as it enters the cavity is called the gate.

Listed here are the different types of gate with their characteristics :

- Side gate

Side gate (Figure 2.8) is the most commonly used gate type and is commonly used for mould structures with 2 or more cavities. It is placed at the side of the plastic product. The gate has to be cut manually by a cutter.

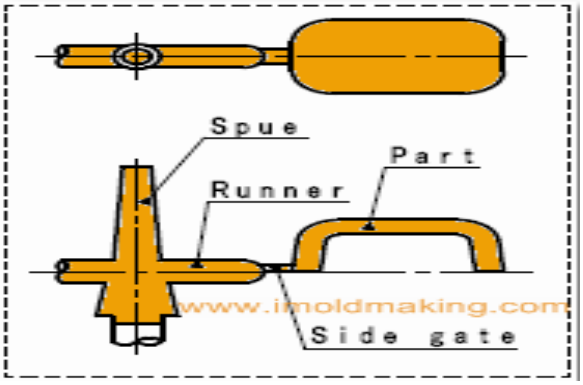

Figure 2.8 : Side gate

- Submarine gate

The positioning of this gate (Figure 2.9) is flexible thoughout the sides of the plastic product. It can be placed on the fixed or movable side of the mould but the design has to be thought about carefully so that the product will not be left inside the fixed cavity. The gate automatically cuts itself as the mould opens.

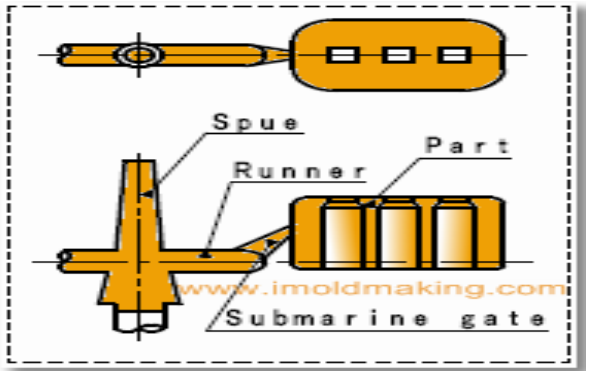

Figure 2.9 : Submarine gate

- Fan gate

Fan gate (Figure 2.10) used for large and flat plate products. It is placed at the side of the product – same as the side gate. The gate has to be cut manually by a cutter.

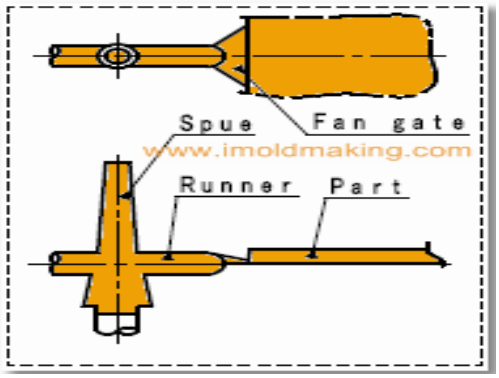

Figure 2.10 : Fan gate

- Pin gate

Pin gate is possible for molding multiple cavities or parts. The gate positioning (Figure 2.11) is relatively flexible at the top side of the product. The runner layout is very flexible as well. The mould base structure is complicated because it uses a 3-plate method.

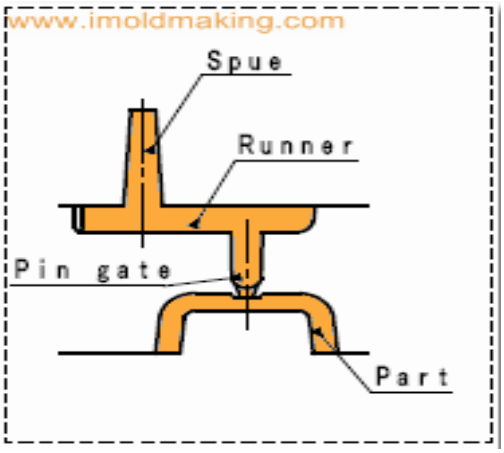

Figure 2.11: Pin gate

2.5 Injection Moulding Process

The mould consists of two primary components, the injection mold (A plate) and the ejector mould (B plate) as shown in Figure 2.12.