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Injection Molding Parameters Calculations by Using Visual Basic (VB) Programming

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Abstract: Now a day's manufacturing industry plays a vital role in production sectors. To fabricate a component lot of design calculation has to be done. There is a chance of human errors occurs during design calculations. The aim of this project is to create a special module using visual basic (VB) programming to calculate injection molding parameters to avoid human errors. To create an injection mold for a spur gear component the following parameters have to be calculated such as Cooling Capacity, Cooling Channel Diameter, and Cooling Channel Length, Runner Length and Runner Diameter, Gate Diameter and Gate Pressure. To calculate the above injection molding parameters a separate module has been created using Visual Basic (VB) Programming to reduce the human errors. The outcome of the module dimensions is the injection molding components such as mold cavity and core design, ejector plate design.

1. Introduction:

Injection molding process is mostly used to create plastic components. So the effective design of mold is very important to crate the exact component. Design calculations plays an vital role in desining the mold. Kriging model and multi-objective particle swarm optimization (PSO) algorithm was constructed based on optimization strategy [1]. To complete the design of the main components of a die, such as upper dies, lower dies, and blank holders minimum set of parameters required to design knowlwdge based parametric design [2]. Feature-based design technology has been demonstrated as very effective in capturing non-geometric information in a geometric design model [3]. The web based system interface uses maps plus parametric and feature-based database to make the processes of design smoother, and also edition and viewing of the results [4]. The designer can easily modify the model by merely changing the parameter's value, types of geometric entities, and topologies. The connection between geometric parameters can accelerate the design and redesign, and minimize the mistakes [5]. CAD/CAM integrated system with features regarded as units of models and processing in concurrent engineering works based on the concept of virtual enterprise, an environment that can support collaborative work of multi-disciplinary groups distributed in different places[6].

The aim of the research is to create a special module using visual basic programming (VB) to calculate the injection molding parameters and to avoid the human errors.Using the module molding parameters such as cooling channel length and diameter, runner length and diameter, gate pressure and diameter, cooling time calculations are carried out in this module.

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2. CALCULATION OF INJECTION MOLDING PARAMETERS

2.1 Cooling Capacity and Cooling Channel Diameter Calculation

For the calculation of cooling capacity and cooling channel diameter several values are given as the input. The inputs are shot weight, enthalpy values of melt temperature and ejection temperature and cooling cycle time. Now the software calculates the cooling capacity, volume of flow required to remove the heat and cooling channel diameter. Calculation using the form is shown below in Fig 1. Using the .NET the forms are created and the program which used to create the cooling capacity and cooling channel diameter calculation is given below in the form.

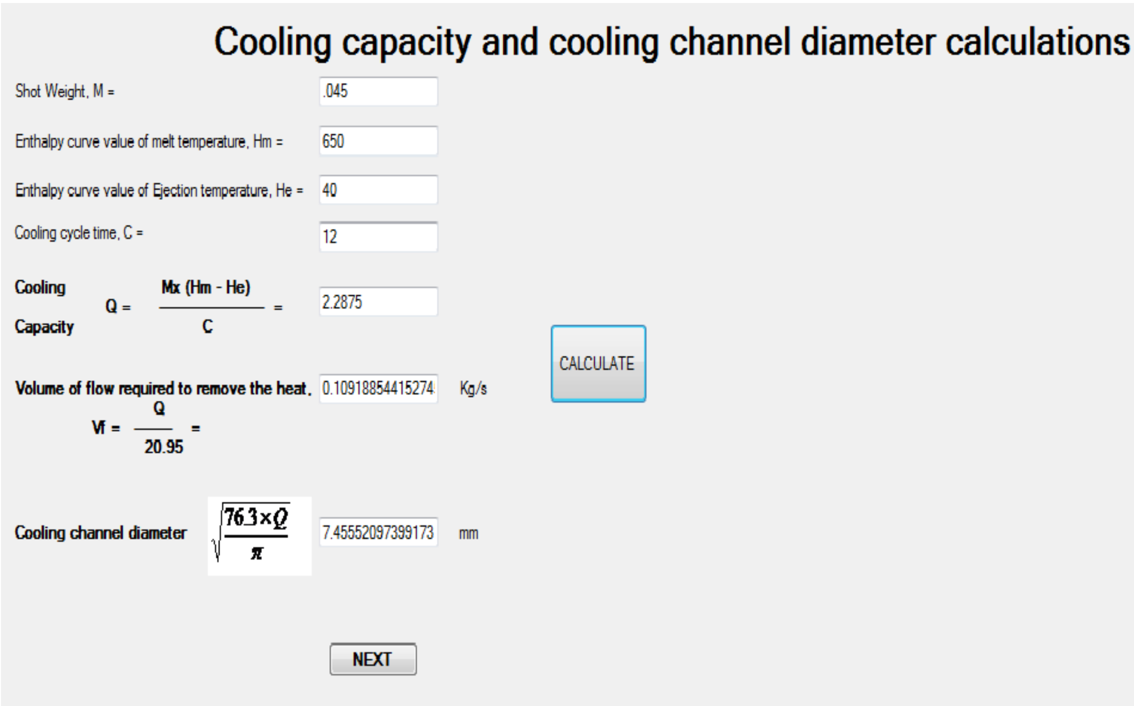

Fig. 1 Cooling Capacity and Cooling Channel Diameter Calculations

2.2 Cooling Channel Length Calculation

Using Poiseulle's equation cooling channel length can be calculated. Injection pressure (P), radius of channel (r), the viscosity of coolant (η) and flow rate (F) is given as the input in the form 2 and the system calculates the cooling channel length. Calculation using the form is shown below in Fig. 2.

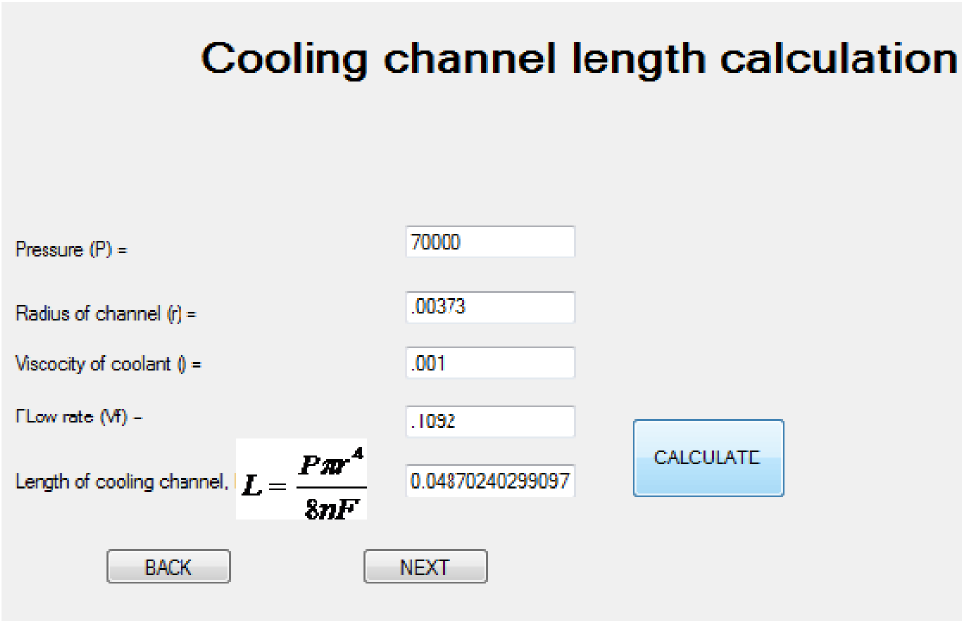

Fig. 2 Cooling Channel Length Calculation

2.3 Calculation for Runner Length and Diameter

Flow rate (Q) and runner radius (r) is given as the input and the system calculates the shear rate (γ). The calculated shear rate (γ) and viscosity of material at a melt temperature (η) and the system calculates the shear stress (τ). Using the shear rate and shear stress the system calculates the runner length and runner diameter. Calculation using the form is shown below in Fig. 3.

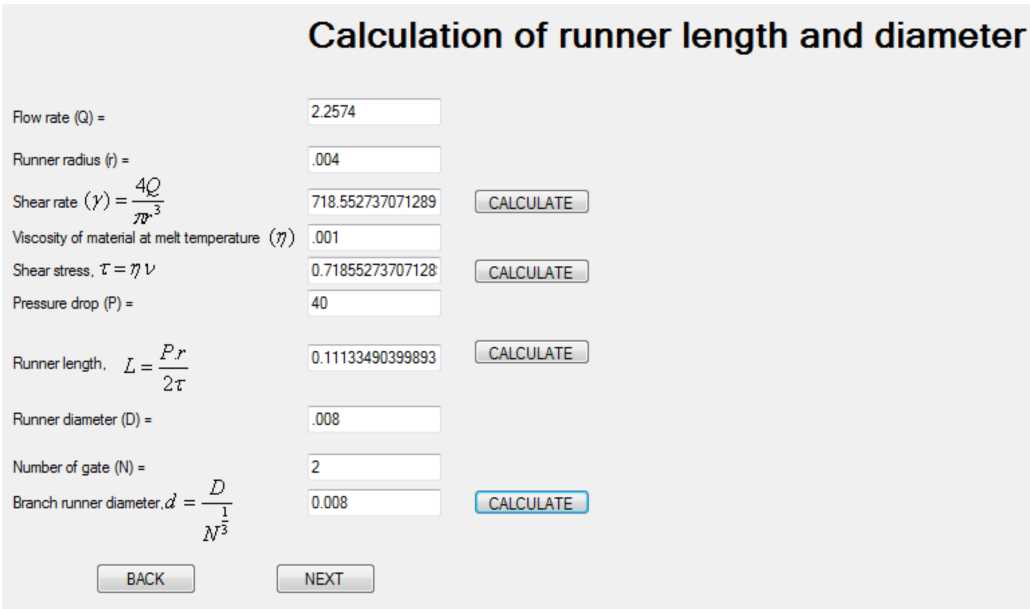

Fig. 3 Calculation of Runner Length and Diameter

2.4 Gate Diameter and Gate Pressure Calculation

The empirical factors (N, C) and area of the part (A) given as the input and the system calculates the gate diameter (d). And the system calculates the gate pressure (ΔP) using the analytical formula. Calculation using the form is shown below in Fig. 4.

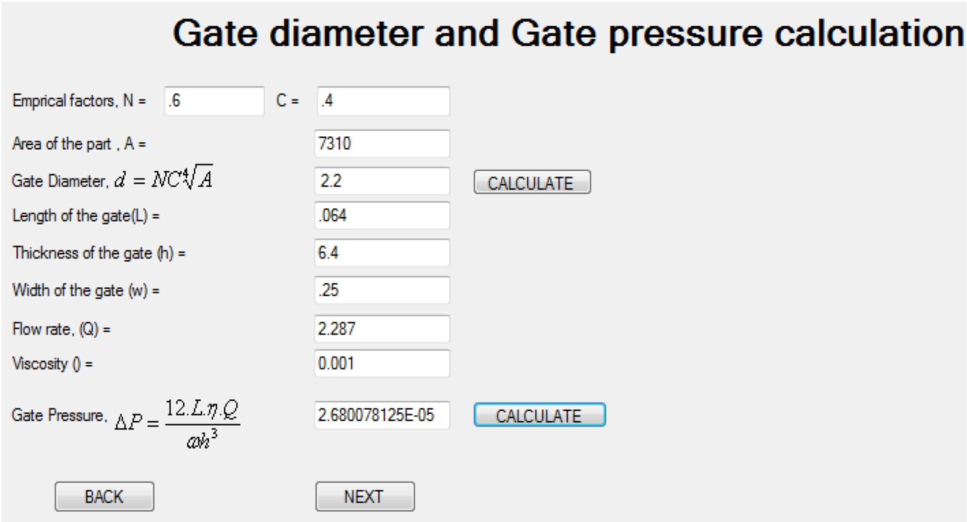

Fig. 4 Gate Diameter and Gate Pressure Calculation

2.5 Calculus of Cooling Time

Plate thickness (h), thermal diffusity (α), melt temperature (T_m), mold temperature (T_w) and ejection temperature (T_e) are given as the input and system calculates the cooling time (t_c) required for the particular component. Calculation using the form is shown below in Fig. 5.

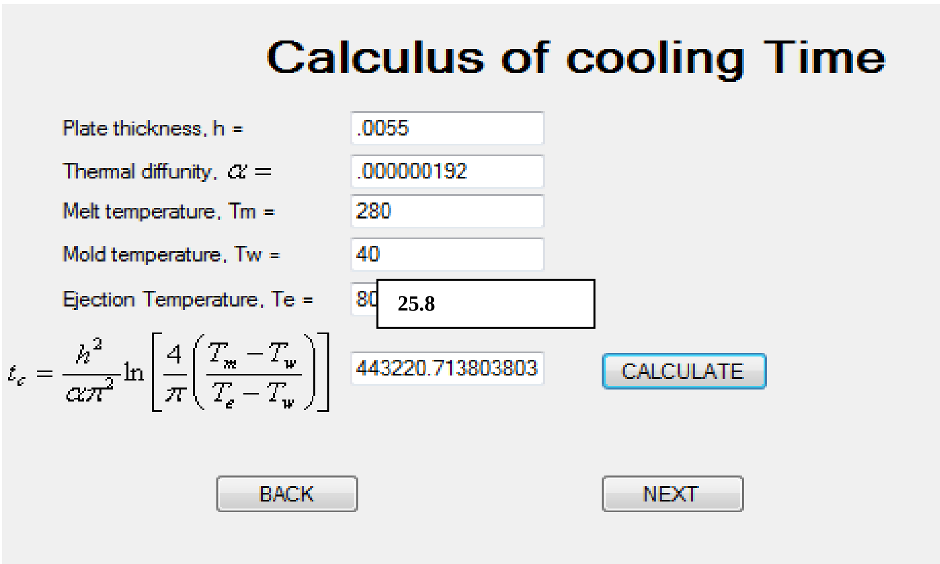

Fig. 5 Calculus of Cooling Time

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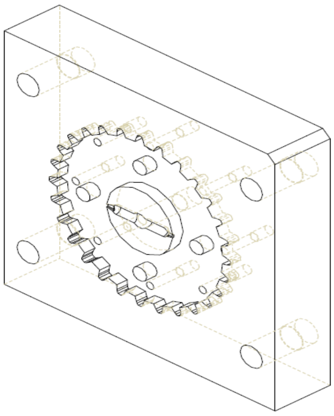
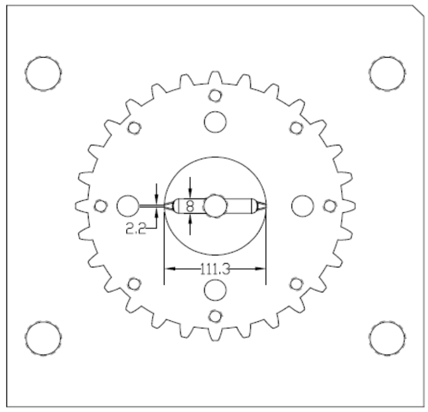
3. MOLD DESIGN

3.1 Injection Mold Components Design

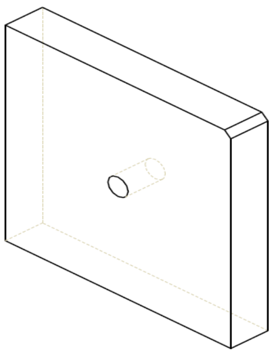
Based on the above module calculations the injection molding components are created using the modeling software SOLIDWORKS. The below Fig.6 shows the standard component design.



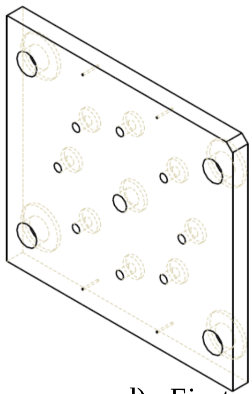
a) Mold Cavity



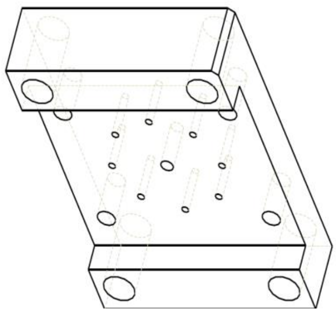
b) Mold Core Plate



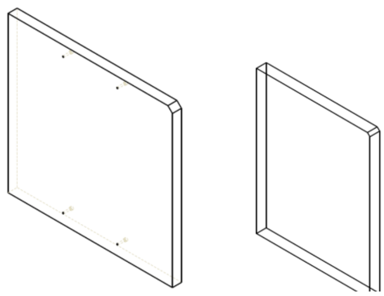
c) Ejector Retainer Plate



d) Ejector Box Main



e) Ejector Plate

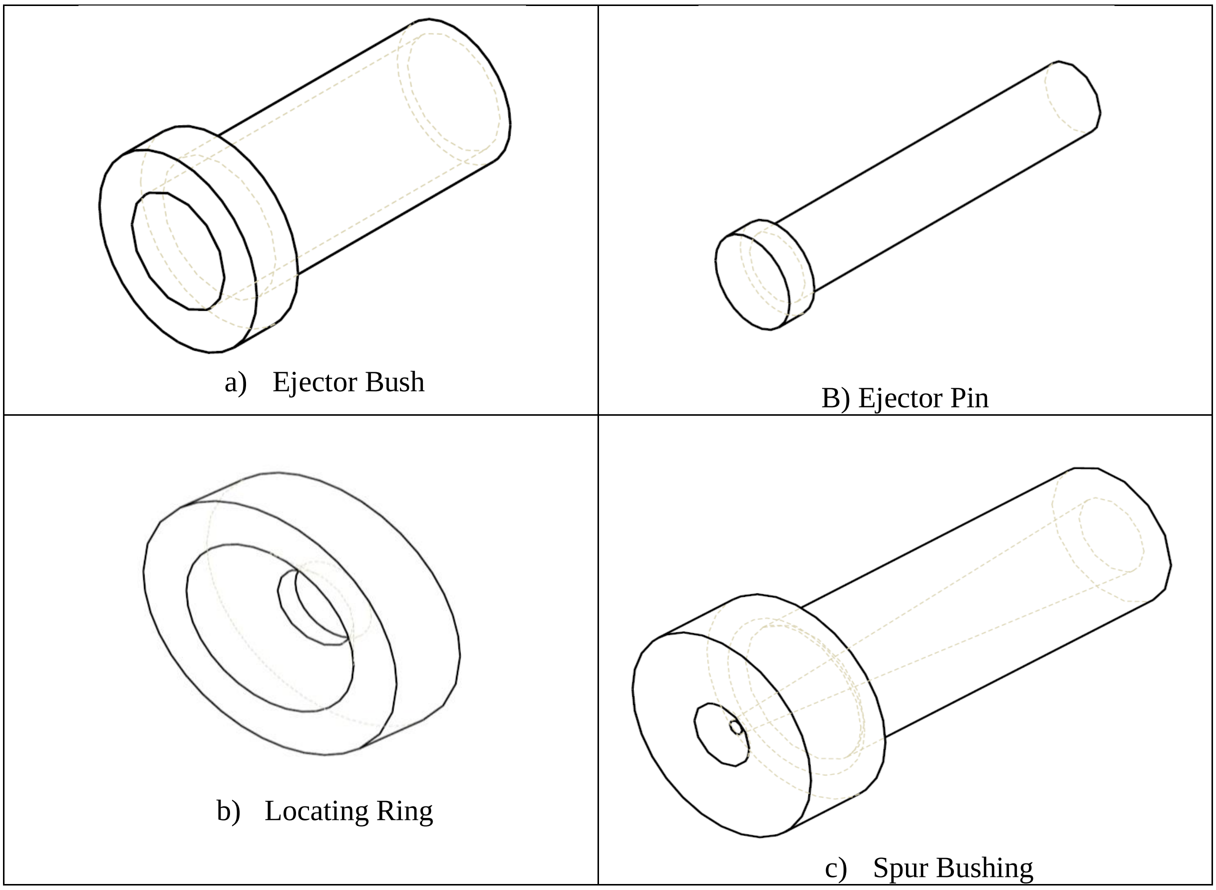


f) Support Plate

Fig.6 Standard components of Mold

Before modeling the mold shrinkage factors and runners and water surfaces are created. Modeling has been carried out using the above dimension calculations. Design steps are creating the mold cavity, mold core plate, ejector retainer plate, ejector box main, ejector plate and support plates.

Once the main components are designed using modelling software the next step is carried ours to create the non-standard components. The non-standard components are ejector bush, ejector pin, locating ring and spur bushing. Fig.7 shows the non-standard component designs.



a) Ejector Bush

B) Ejector Pin

b) Locating Ring

c) Spur Bushing

Fig. 7 Non-standard Components design

4. Conclusion

The outcome of the research is injection mold design components with suitable dimensions for manufacturing the plastic parts. To avoid the human errors the visual basic programming is used to create the forms in which the mathematical calculations have been done step by step. The formulae are inserted in the form. Once the parameters are given as the input, the output values required to create the mold are given by the special module as an output. Using the special module exact calculations can be done without any errors.

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