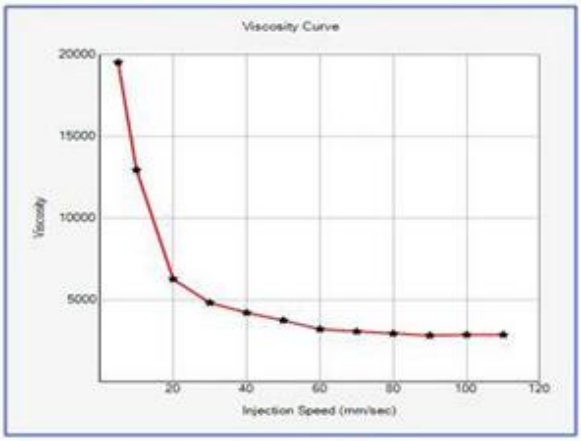
Scientific Molding

THE 6-STEP STUDY

The 6-Step Study: The Viscosity (Rheology) Curve, the Gate Freeze Study and the Pressure Drop Study were the three studies that were done as part of the Scientific Molding Studies. The Molding Area Diagram (MAD) has references in some early texts such as in the 'Handbook of Injection Molding' by Rosato, was not always considered. Suhas Kulkarni identified the MAD as THE most important and critical step for determining the robustness of the molding process. The balance of fill between the cavities was also identified as an important step. Incorporating this under one umbrella he coined the term 6-Step Study to help optimize the process robustness. Following are the 6-Steps that should be considered. As always there are always cautions and exceptions to each one of these.

Step 1: Viscosity Curve

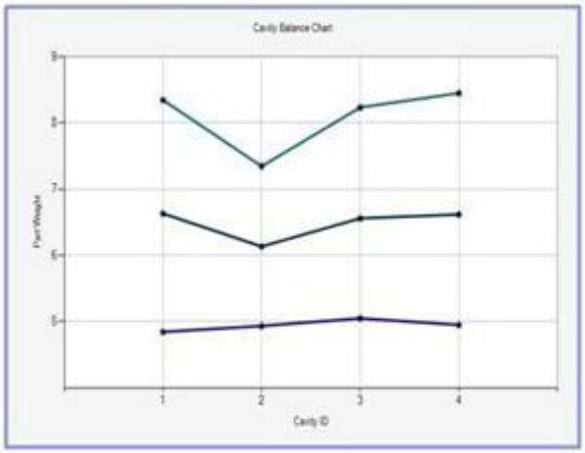


- Shows effect of injection speed on viscosity
- Shows the most consistent region of viscosity
- Reduces lot to lot variation
  CAUTION
- May not be applicable to insert molded components
- May not be applicable to optical components
- Fast injection speeds may cause material degradation and burning
  SUGGESTION
- Inject as fast as you NEED to and not as fast as you can. Slower speeds are perfectly acceptable

Step 2: Cavity Balance Study

- Shows the fill balance between all the cavities
- Helps in achieving better cavity to cavity consistency
  CAUTION

- % imbalance can be very deceiving on smaller parts
  SUGGESTION
- Study the % imbalance with the cavities almost full
- Do not have an 'acceptable imbalance limit', example 3% or 5 % or 10%. It should be on case to case basis

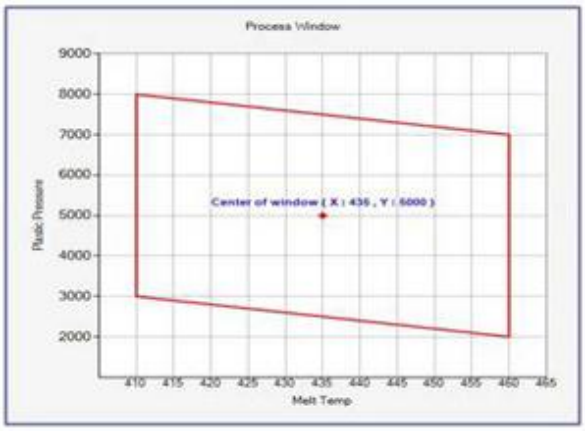


Step 3: Pressure Drop Study

- Shows if the process pressure is limited
- Helps in consistency
  CAUTION
- When increasing the pressure exercise caution to prevent mold damage
  SUGGESTION
- Record pressure drop through the nozzle and end of fill, the rest of the sections are important only if the process is pressure limited and can therefore be eliminated.

Step 4: Cosmetic Process Window Study

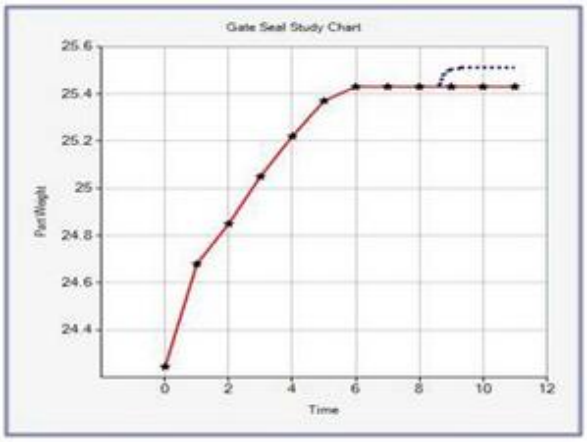
- Shows the extent of capability of the mold to make cosmetically acceptable parts
- Bigger the window, better are the chances of consistency
  CAUTION
- When increasing the pressure exercise caution to prevent mold damage
- Higher pressures can cause the overpacking of the part
  SUGGESTION



- Do not use pressures of over 5000 psi plastic pressure over the lower end of the acceptable pressure
- A large Cosmetic Process Window is the first step to a robust process

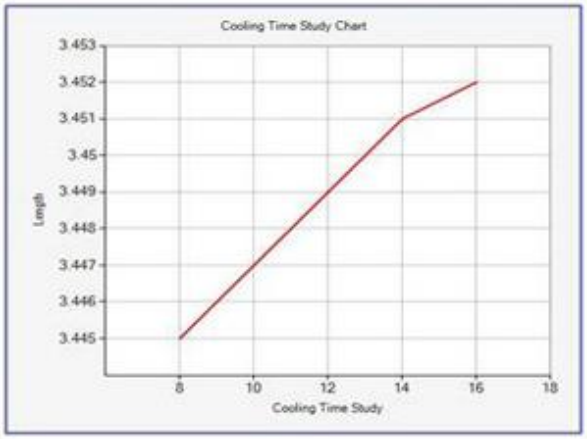
Step 5: Gate Seal Study

- Shows when the gate seals
- Helps in shot to shot consistency
  CAUTION
- Do not perform a Gate Seal Study on a Hot Runner Mold
- With large gate sizes the graph may never flatten out – be careful of overpacking of the part
- With softer materials such as olefins the graph may never flatten out
  SUGGESTION
- When the graph does not flatten out consider the 'Pack and Hold' concept



Step 6: Cooling Time Study

- Shows the effect of cooling time
- Improves Cycle efficiency
  CAUTION
- When molding at lower cooling times, the mold take a longer time to reach thermal equilibrium
  SUGGESTION
- Perform the study at the higher end of the melt or mold temperatures
- For olefins, set mold or melt temps to the lower side and work with the other on the higher side



With the increasing use of advanced concepts in Injection Molding, Scientific Molding Software and Design of Experience Software for Injection Molding are becoming increasingly necessary to manage the projects more efficiently. FIMMTECH provides the training in Scientific Injection Molding and also provides the tools for all the molding qualifictions and molding validations. The use of Scientific Molding has greatly enhanced the efficiency of the molding operations.