Moldflow Krypton for Inventor and SolidWorks

Autodesk®

Contents

Moldflow Krypton for Inventor and SolidWorks

1

Design decisions can impact on the manufacturability of a plastic injection molded part.

Moldflow Krypton is an add-on that gives real-time feedback on the implications that design decisions will have on the manufacturing process.

NOTE:

- If a non-plastic material is selected in Inventor, Moldflow Krypton is disabled
- Moldflow Krypton does not support multi-bodied parts
- Moildflow Krypton supports Inventor 2010, Inventor 2011, Inventor LT 2011, and SolidWorks 2009 SP3 or later.

Indicators

Three indicators are displayed on the workspace that highlight different aspects of manufacturability that the designer can influence.

Manufacturability indicator

Cost efficency indicator

Plastic material impact indicator

These indicators represent the affect the design has on the Manufacturability, Cost efficency and Plastic material impact of the final product.

Cost efficency indicator

Cost efficency indicator is a combination of the following contributing factors:

- Material cost
- Mold cost
- Production cost

The greater the blue indicator bar, the more cost efficent the design.

A warning icon ⚠ incorporated in the Cost efficency indicator means that there are areas within the design that are adversly impacting on this result. Click the icon for more information.

Material cost

The Material cost depends on a range of factors. Some of the characteristics considered when determining this value include the following.

- Volume of the part
- Number of gates and the volume of the associated feed system
- A projected scrap rate based on how the material processing characteristics
- Cost of the material

Design suggestion

To reduce the material cost, each of the above factors need to be considered.

Mold cost

The cost to produce a mold depends on a range of factors. Some of the characteristics considered when determining this value include the following.

- The size, volume and complexity of the part
- Number of gates and the associated feed system
- Extent and type of undercuts required

Design suggestion

To reduce the mold cost, each of the above factors need to be considered.

Production cost

The production cost depends on a range of factors. Some of the characteristics considered when determining this value include the following.

- Part cooling time
- Total machine cycle time

Design suggestion

To reduce the production cost, consider reducing the thickness of the part. This will reduce the cooling time. A reduction in the part thickness, however, can have the negative impact of increasing the number of gates required, with the associated possible increase in mold base cost. Reducing the thickness could also impact on the strength of the feature.

At the toolmaking stage consideration can be given to multi-cavities and customized cooling channels. This also has a mold cost implication.

Manufacturability indicator

Manufacturability is a combination of the following:

- Ease in which the part is processed
- Likelihood of defective parts

The greater the blue indicator bar, the more efficent the design.

A warning icon ⚠ incorporated in the Manufacturability indicator means that there are areas within the design that are adversly impacting on this result. Click the icon for more information.

Draft angle

A draft angle is a slight taper added to surfaces to assist in the ejection of the molded part from the mold. Surfaces parallel to the direction the part is ejected in, will cause difficulties in production.

The amount of draft added will depend on the material to be used and the surface finish of the part.

Highly polished surfaces often have a draft angle of 1.5^{o} while heavily textured leather-like surfaces can require a draft of 6^{o} to 8^{o}.

NOTE: Because there is a range of suitable draft angles, the design is only checked to determine that there is a draft angle. The appropriatness of that angle will need reviewing.

Design suggestion

Select **Highlight region** from the **Alerts** tab to view possible problem surfaces. Adjust draft angles as appropriate.

Processability

The processability of the design is a combination of several factors which includes the following.

- Ease with which the part is processed
- Likelihood of defective parts
- Production rates and cycle times
- Range of processing parameters that will produce a good part

Design suggestion

To aid the processability, consider the following options.

- Refine the design to eliminate unnessecarily thick sections of the part
- Select a material that flows well within a reasonable temperature range

This will help ensure that the part will fill easily and have a short cooling time.

Undercuts

An undercut is a design feature that interfers with the ejection of a molded part from the mold. An undercut can include features such as holes or boses that are not aligned with the direction of ejection, threaded sections, and snap fingers.

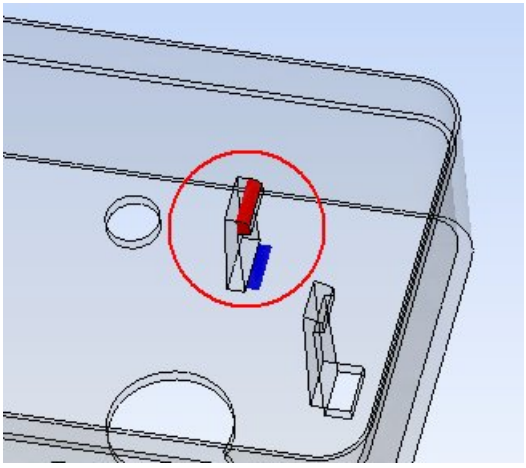

Figure 1: Undercut problem

The snap finger shown above has an undercut surface highlighted in red.

This part could not be produced without the inclusion of moving parts within the mold to ensure the part could be ejected.

This will add to the cost of the mold.

Design suggestion

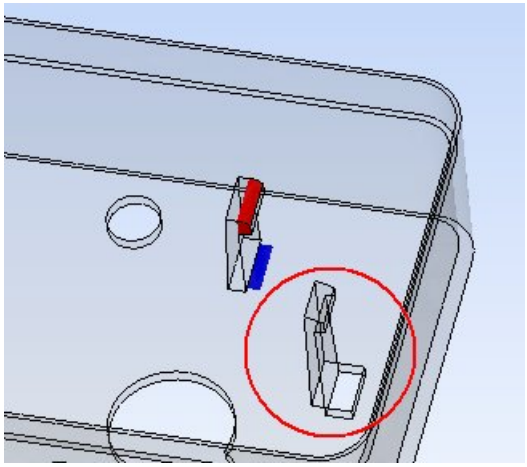

Figure 2: Modified design

The inclusion of a hole at the base of the snap finger shown in Figure 2, will allow a fixed rectangular pin to be included in base of the mold. This design modification will allow the part to be ejected without the need for moving parts in the mold.

It is not always possible to design a part without undercuts.

Wall thickness

Ideally, a plastic part should have an even wall thickness across the entire part otherwise quality problems can occur.

The thickness also defines the filling and cooling of the part. Molten plastic will prefer to flow through thick sections of the mold so excessively thin areas may have problems filling. Excessively thick areas will take longer to cool which may lead to the part deforming as the molten plastic solidifies.

The wall thickness indicator examines the part thickness and its variation to highlight regions that could cause molding problems.

Plastic material impact indicator

Plastic material impact is measured by a combination of the following considerations:

- Emissions (i.e. carbon footprint)
- Energy usage

- Water usage
- End of life (i.e. recyclability)

The larger the blue indicator bar, the better the material choice is from the environmental standpoint.

A warning icon ⚠ incorporated in the Plastic material impact indicator means that there are areas within the design that are adversly impacting on this result. Click the icon for more information.

Carbon footprint

The carbon footprint is a measure of the amount of CO_2 gas produced by the production of the selected material.

There is publically available data on the material production costs of plastic material families. This information is the basis for the carbon footprint contribution to the Plastic material impact indicator.

Data source: PlasticsEurope *http://www.plasticseurope.org*

Design suggestion

The selection of a material is primarily based on the physical and mechanical requirements of the product. If alternate materials can be used, then selecting a material with a lower carbon footprint will reduce the CO_2 generated.

Embodied energy

The embodied energy is the total energy required in the making of a part. Typically 70-90% of the energy is associated with the material manufacture.

Publically available data for each plastic material family is the basis for the embodied energy contribution to the Plastic material impact indicator.

Data source: PlasticsEurope *http://www.plasticseurope.org*.

Design suggestion

The selection of a material is primarily based on the physical and mechanical requirements of the product. If alternate materials can be used, then selecting a material with a lower embodied energy will reduce the energy requirements associated with this product.

Embodied water

Embodied water is a measure of the amount of water required to produce the selected material.

Publically available data for each plastic material family is used to calculate the embodied water contribution to the Plastic material impact indicator.

Data source: PlasticsEurope *http://www.plasticseurope.org*

Design suggestion

The selection of a material is primarily based upon the physical and mechanical requirements of the product. If alternative materials can be used, then selecting a material with a lower embodied water value will lessen water resourses required to make the material and part.

Recyclability

The recyclability of a material is a measure of the percentage of the material that is recovered as scrap and subsequently reprocessed into useful products

Publically available recycling rates are the basis for the recyclability contribution to the Plastic material impact indicator.

Design suggestion

The selection of a material is primarily based on the physical and mechanical requirements of the product. If alternate materials can be used, then selecting a material with better recyclability will have a positive impact on the environment.

Materials

The selection of a material is primarily based on the physical and mechanical requirements of the product. The chosen material will affect the indicator values.

Finding a material

Selecting a suitable material for your project is simplified by the using the filters in the Material selection dialog.

1. Right-click the widget panel
2. Click **Select material**
3. Ensure the **Non-plastic—ujnable to apply injection molding rules** check-box is not selected
4. Apply filters as required
5. Select the required plastic material family from the filtered list
6. Click **OK**

NOTE: The individual grade of material required will need to be specified before the part can be manufactured.

Material family information

Different plastic material families have different characteristics and applications. The following table is an initial guide to selecting an appropriate material.

Individual plastic grades, and the use of suitable additives, need to be considered before finalizing the material to be used.

Generic grades	Typical Applications
ABS Offers superior processibility, appearance, low creep, excellent dimensional stability, and high impact strength.	Automotive (instrument and interior trim panels, glove compartment doors, wheel covers, mirror housings); refrigerators; small appliance and power tool housings (hair dryers, blenders, food processors, lawn mowers); telephone housings, typewriter housings and keys; recreational vehicles such as golf carts and jet skis
High Density Polyethylene (HDPE) An odorless, tasteless, and nontoxic polymer that makes it suitable for food contact applications. HDPE has greater tensile strength, heat distortion temperature, viscosity, and chemical resistance than LDPE, but has lower impact strength.	Containers in refrigeration units; storage vessels; household goods; seal caps; bases for PET bottles; major use in blow-molding applications (packaging)
High Impact Polystyrene An inexpensive and hard polymer that is used extensively.	Packaging; home wares (tableware, trays); electrical (transparent housing, light diffusers, insulating film)
LCP Plastic Excellent mechanical properties, high chemical and thermal resistance	Electrical (connectors, switches) and medical (surgical and dental instruments, drug delivery systems) applications
Low Density Polyethylene (LDPE) An odourless, tasteless and nontoxic polymer that makes it suitable for food contact applications. It has higher impact strength than HDPE, but lower tensile strength, viscosity and chemical resistance.	Closures, bowls, bins, pipe couplings
Nylon 6 One of the major engineering thermoplastics. Nylon 6 is tough, has excellent abrasion resistance, good chemical resistance, fatigue endurance, lubricity, impact strength, high strength, and rigidity.	Structural applications (due to mechanical strength and rigidity); bearings (due to wear resistance)

Generic grades	Typical Applications
Nylon 66 An engineering-grade thermoplastic. Nylon 66 has higher strength but lower impact resistance than Nylon 6.	Automotive industry; appliance housings; competes with Nylon 6 for most applications especially where impact resistance and strength are required
PBT Plastic Has high strength and rigidity for a wide range of applications. PBT is one of the toughest engineering thermoplastics.	Household appliances (food processor blades, vacuum cleaner parts, fans, hair dryer housings, coffee makers); electronics (switches, motor housings, fuse cases, key caps for computer keyboards, connectors, fiber optic buffer tubing); automotive (grilles, body panels, wheel covers, components for doors and windows)
PC/ABS Plastic Combines the high processibility of ABS with the excellent mechanical, impact and heat resistance properties of PC	Computer housings, business machine housings, electrical applications, cellular phones, garden equipment and automotive
PEEK A high performance thermoplastic that is light weight, with good chemical resistence, strengthlow coefficent of friction, and fatigue resistance.	Aeronautical, aerospace applications. Medical applications such as implants. Chemical processing applications where it shows minimal contamination.
PET Plastic Has excellent chemical resistance and barrier properties, good strength, rigidity, fatigue endurance, and abrasion resistance.	Automotive (mirror backs, grille supports, electrical parts, headlamp reflectors, alternator housings); electrical (motor housings, electrical connectors, relays, switches); industrial applications (furniture chair arms, pump housing, hand tools)
PMMA Plastic Has excellent chemical and weather resistance.	Automotive (signal light devices, instrument panels); medical (blood cuvettes); industrial (video discs, lighting diffusers, display shelving); consumer (drinking tumblers, stationery accessories)
Polycarbonate An amorphous engineering material with exceptionally good impact strength, heat resistance, clarity, sterilizability, flame retardancy, and stain resistance.	Electronic and business equipment (computer parts, connectors); appliances (food processors, refrigerator drawers); transportation (headlights, taillights, instrument panels)
Polypropylene A widely-used, translucent, semi-crystalline, thermoplastic polymer with excellent chemical resistance to a range of chemicals.	Automotive (dashboard components, ductwork, fans, some under-hood components); appliances (door liners for dishwashers, ductwork for dryers, wash racks and lids for clothes washers, refrigerator liners); consumer products

Generic grades	Typical Applications
	(garden furniture, lawn mower components, sprinklers)
Polyvinyl chloride (PVC) A widely used polymer. The range of additives used with this polymer can alter its physical properties to create a tough rigid polymer used for water pipes through to a pliable material used for fabric applications.	Water distribution piping; home plumbing; house siding; business machine housing; packaging (electronics, foodstuffs); medical apparatus
POM Plastic Has a low coefficient of friction, good dimensional stability, and high temperature resistance.	Gears and bearings (due to low coefficient of friction and good dimensional stability); plumbing equipment (due to high temperature resistance)
PPS Plastic Good thermal and dimensional stability, excellent chemical and fire resistance	Pump and valve parts, Automotive components, structural components in a corrosive environment.
SAN Has good rigidity, strength, and toughness, and better chemical resistance than polystyrene.	Electrical (kitchen appliances, refrigerator fittings, TV chassis); automotive (head lamp bodies, reflectors, glove compartments, instrument panel covers); household appliances (tableware, cutlery, beakers); cosmetic packs

Selected material

The plastic material that is currently specified for this project can be determined as follows

1 Right-click on the widget panel

2 Click **Select material...**

3 Scroll down the list until you find the highlighted material family

---

NOTE: If the **Non-plastic—unable to apply injection molding rules** check-box is selected at the top of the dialog, the plastic material family list is not active.
