Intelligent material selection can have a big impact on the cost of a product and is an essential step in any good DFM project. **André Eichhorn** explains why

Effective material selection essential for good design

Selecting the correct material for production of a specific injection moulded part can be a challenging task that requires in-depth knowledge of the huge range of injection moulding resins that are available on the market today. It also requires a sound understanding of the part's requirements.

Before any intelligent material selection can be attempted, all product-related characteristics and costs need to be identified and carefully taken into consideration. Therefore, it is important to first work closely with the developer of the product, who will have the best understanding of what the requirements are with regard to critical aspects such as part geometry, shape and loading, as well as what the environmental influences will be when the product is in use.

If an incorrect material selection is made, it does not matter how good the part design may be as the end result will potentially be an unreliable product that is liable to in-service failure. If such problems arise after the mould tool has been built, financial cost can rise dramatically. A change of material at this stage in the development process will very often require rebuilding all or part of the tool, as the new material will have a different shrinkage rate, or need different gating arrangements or venting requirements.

For reasons of speed, is not uncommon for a material to be selected based on prior experience – specifying a resin that was used successfully in the past on a similar product or assembly. Of course that may not have been the best choice then, but even if it was it may not be any longer. Materials manufacturers continually improve their products so it is always worth talking to your resin supplier to find out if there is a new material or grade available that will suit the new application better. An improved material formulation could lead to a big improvement in the quality and performance of the final part, as well as helping to reduce production costs.

Materials with lower density will help to make the final products lighter. By introducing reinforcement such as glass fibre, component properties such as strength will be improved and part dimensions potentially reduced. In this way, it may be possible to optimise the design to make a lighter and more robust component.

Figure 1 shows a simple but high volume cover part that was intended initially to be moulded in ABS. Around 14m parts were required annually. The key driver in this project was to reduce the cycle time by decreasing the overall wall thickness, while keeping the mechanical strength at the same level.

By changing the material from the original ABS to a

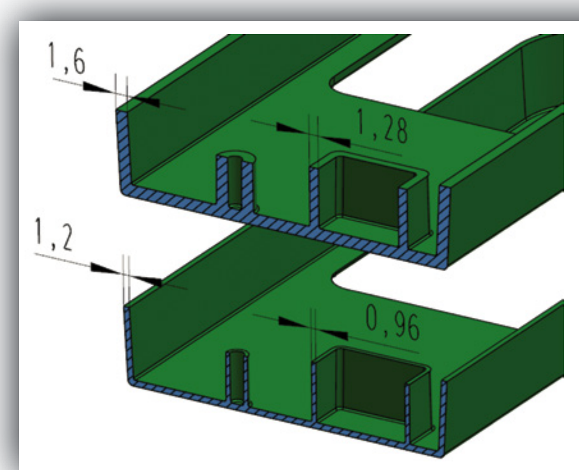

Figure 1: Selection of a more rigid resin for this housing application enabled the part to be reduced in thickness, cutting cycle time and cost

Table 1: Savings resulting from value engineering analysis of a water meter part produced in brass, POM and reinforced PA6,6

Volume/Year	Material	Volume/part (cm³)	Density (g/cm³)	weight/ part (g)	weight/ 35k pcs (t)	Price/ kg (€)	Design Comment	Material Costs (€)
35,000	Brass	281	8.4	2360.4	82,614.00	3.50 €	original design	289,149.00 €
35,000	POM	281	1.4	393.4	13,769.00	1.80 €	POM version of original	24,784.20 €
35,000	PA6,6	208	1.14	237.12	8,299.20	2.50 €	optimised design 35% material saving	20,748.00 €

PA reinforced with 30% glass fibre it was possible to reduce the overall wall thickness and, due to the new material's characteristics, reduce the cooling time. The higher raw material price of the glass reinforced polyamide meant there was very little cost saving from the alternative material option. However, the savings in cycle time (-18%) were significant and estimated to amount to about €45,000 a year.

The faster cycle time meant it was also possible to reduce the total tooling requirement. Eliminating the need for an additional four-cavity mould resulted in an estimated additional cost saving of around €68k in this project.

The DFM stage of any product development programme is also the appropriate time to carry out some value engineering calculations to determine if the mechanical properties, visual quality and other properties resulting from the incorporation of costly additives such as fire retardants in the material selection are in line with the overall project goals.

Recently, AST was involved in just such a value engineering project for a water metering component. The client wanted to replace a part originally cast in brass and capable of withstanding a water pressure up to 12 bars. The main goal of the project was to reduce the component cost while maintaining similar mechanical properties, such as dimensional stability and resistance to water absorption.

Figure 2: The thick wall sections in this POM water meter component design required a cycle time of around 120s. Switching to reinforced PA presented big cost reduction opportunities.

Switching from brass to an injection moulded POM (Figure 2) but retaining a similar wall thickness to the original part not only reduced the material cost significantly, but was also able to meet the high mechanical requirements. However, by introducing a water resistant, glass reinforced PA6,6 into the analysis it was possible to develop a component design with a much thinner overall wall thickness and increased overall strength.

Analysis of this thinner component design in PA6,6 showed the cycle time could be reduced from 120s (for the POM part) down to 50s. The overall savings achievable by using the new PA component compared to the POM version was calculated to amount to around €45,000 a year. The main bulk of this saving was accounted for by the faster cycle time, resulting predominantly from the shorter cooling times required for the thinner wall thickness.

The full breakdown of the cost savings for the two alternative polymer-based components against the the cost for the original brass design are shown in Table 1. It should be noted, however, that the weight savings in the plastic designs also provided a further and quite significant saving on shipping charges.

Experience shows that material selection can have a huge influence on part cost and production economics. Companies that take an intelligent approach to resin selection will realise valuable capital and production cost savings, speed their time-to-market, and produce parts that perform better.

About the author:

André Eichhorn is general manager of Germany-based AST Technology. This is the second instalment in a series of articles presenting a step-by-step discussion of the Design for Manufacturing (DFM) process. If you missed the first instalment in this series you can view it **here**. Part three, which will be published in the next edition of *Injection World*, will look at optimisation of part structure.
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AST Technology will also be exhibiting at the Fakuma trade fair in Friedrichshafen in Germany later this month. You can find the company in Hall A1, Stand 1302.