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6. Cost-saving designs

Low-cost designs

Price as a Design Factor – The designer of a plastics component bears a large part of the responsibility for its final cost. His decisions essentially predetermine the costs of production, mould-making and assembly. Correction or optimization at a later stage is generally costly or impracticable.

Influencing cost through material properties

Taking full advantage of specific properties of plastics materials can help to save costs in many ways:

Designs with multiple integrated functions
Reduction in the number of individual parts through integration of several functions in one part.

Use of low-cost assembly techniques
Snap-fits, welded assemblies, riveted assemblies, two-component technology, etc.

Exploitation of dry-running properties
Saves the need for additional or subsequent lubrication.

Elimination of surface treatments
Integral colour, chemical and corrosion resistance, electrical and thermal insulation properties.

Nucleation
Materials in the same product family can have different cycle times. The reason for this is a nucleating additive that accelerates crystallization of the melt during the cooling phase.

By Jürgen Hasenauer, Dieter Küper, Jost E. Laumeyer and Ian Welsh

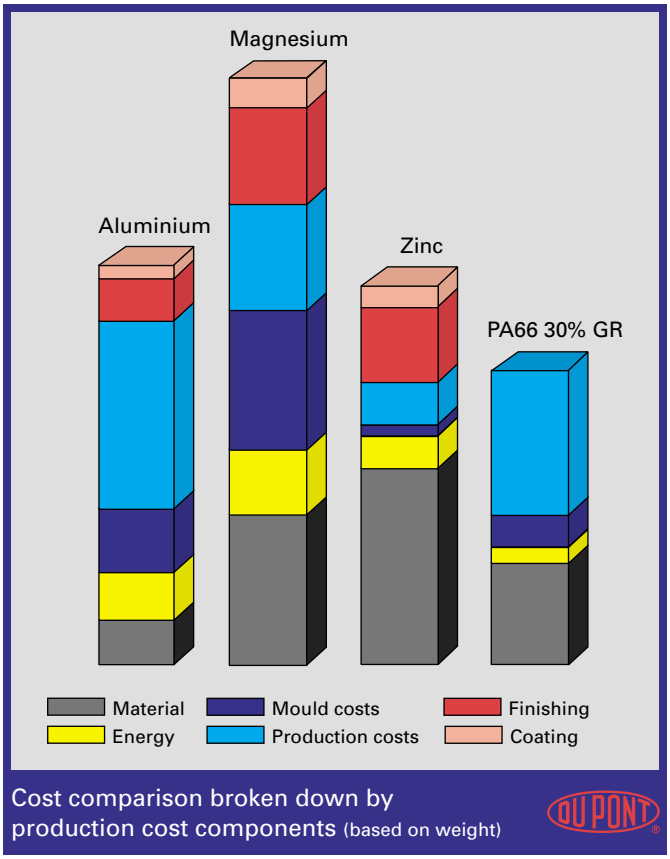

Fig. 1

Influencing cost through finished-part design

Further cost reductions can be achieved, over and above those mentioned above, by observing the following points:

Wall thickness
Optimized wall thickness distribution influences material costs and can reduce production time.

Moulds
Two-plate moulds, reduction in the number of splits, etc.

Tolerances
Excessively high tolerance requirements increase the reject rate and quality control costs.

Materials
Reducing cycle and cooling times through the choice of materials that set up rapidly, minimizing warpage problems by using low-warpage polymers (e.g. optimization of the ratio of mineral to glass-fibre reinforcement).

Cost comparison broken down according to production cost components

Injection-moulded parts should be ready for assembly as soon as they are ejected from the moulding machine, without needing any additional finishing operations. If finishing operations are required, the cost of plastics components often reaches that of metal designs (Fig. 1).

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Design determines production costs

A general increase in wall thickness will not always lead to the desired strength increase in a component, but it will certainly mean a steep rise in production and material costs (Fig. 2). Partially crystalline thermoplastics undergo volume shrinkage as they set up. This shrinkage must be compensated for by continuing melt feed during the holding pressure phase. The approximate holding pressure time per mm wall thickness is, for example:

– POM = 8 s
– PA66 unreinforced = 4-5 s
– PA66 reinforced = 2-3 s

(Applies up to wall thickness of 3 mm)

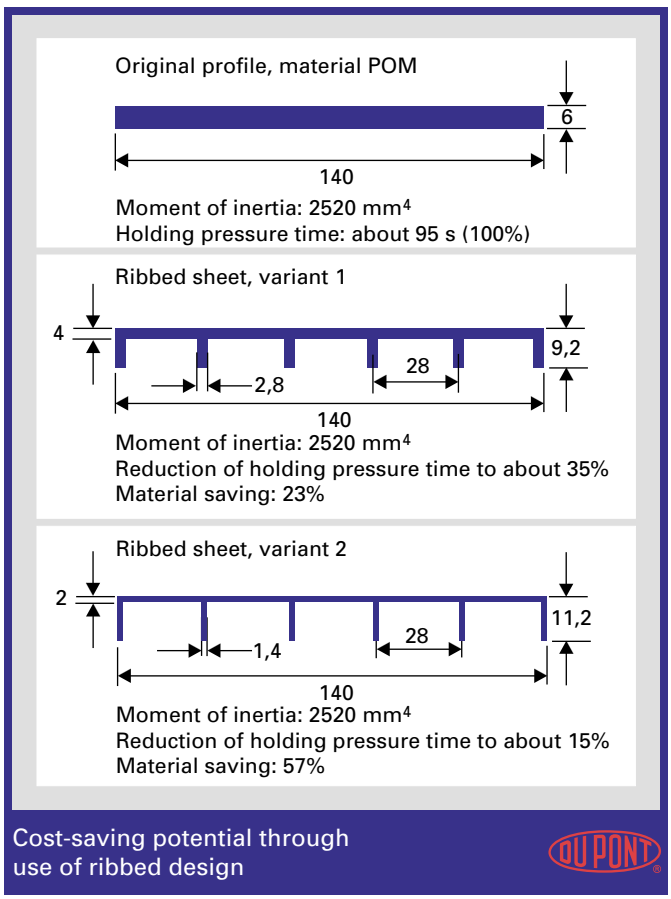

Fig. 2

Examples of typical applications

In contrast to metal designs, which have to be machined and often pass through many assembly stages to turn out a single functional part, plastics technology offers considerable savings potential. In this example (Fig. 3), the guide and drive rods, spring, barbed-leg snap-fit element and bearing arrangement are injection-moulded in one piece. The equivalent metal design would require not only five individual parts that have to be assembled, but the rod would also need lubrication where it comes into contact with the stop. Choice of a POM homopolymer in fact made lubrication unnecessary at this point, too.

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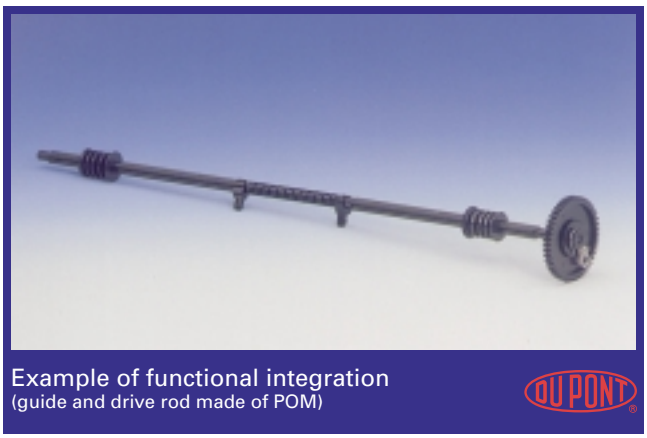
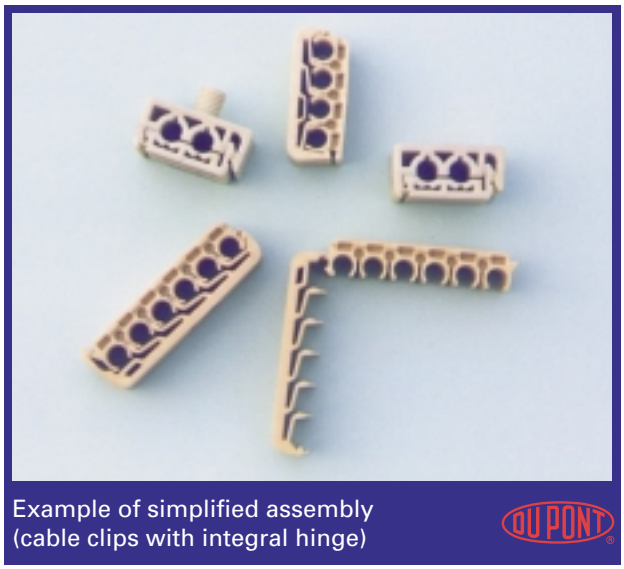
Barbed-leg snap-fit designs in combination with integral hinges reduce the number of individual components, thus making assembly easier and thereby lowering costs. If brittle materials are used, another barbed-leg snap-fit element takes over the locking function if the integral hinge breaks (Fig. 4). In designing the part, the designer also necessarily defines the design of the mould cavity. He therefore determines the ejection system and the number of splits required. By judicious arrangement of undercuts, splits can be replaced by cores (Fig. 5).



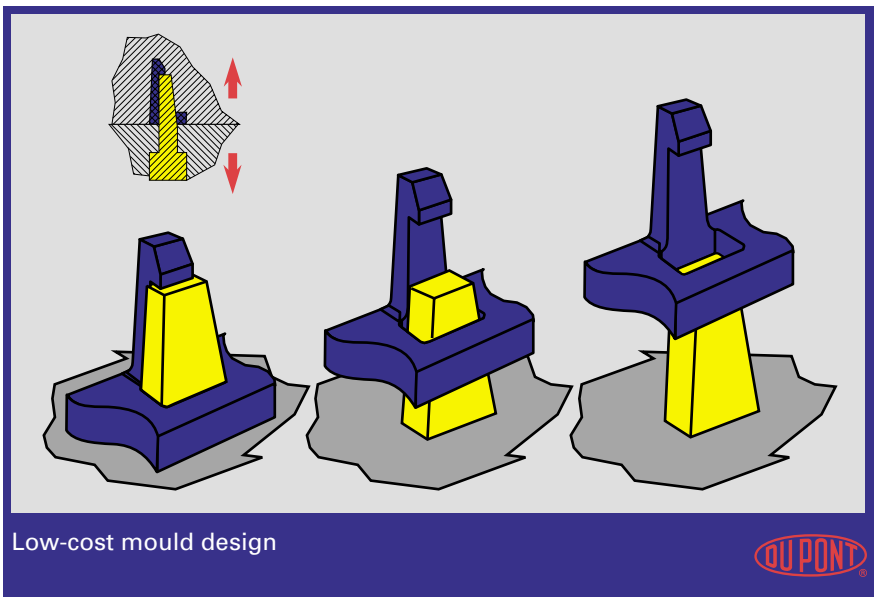
Example of functional integration
(guide and drive rod made of POM)

Fig. 3



Example of simplified assembly
(cable clips with integral hinge)

Fig. 4



Low-cost mould design

Fig. 5

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