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MULTI-SHOT CONSIDERATIONS

Multi-component moulding is an increasingly popular option today but still presents special considerations for the product development team, writes **André Eichhorn**

Taking the risk out of multi-shot

Multi-shot or multi-component moulding techniques have been used in the plastics industry since the early 1970s but the technology has grown in importance in recent years as designers have exploited the ability it provides to enhance the appearance or tactile response of a product, integrate new functionality, or reduce assembly costs.

One factor behind the growing popularity of multi-component moulding is the improvement that has been made in hot runner and injection moulding machine technology. Mould tool design and manufacturing know-how has also developed to a level that makes it possible today to effectively realise even the most ambitious projects.

Multi-shot applications have been used in the automotive industry for many years, often to eliminate complex and costly assembly procedures. For example, car lens and multi-colour automotive stop lights are almost always now moulded this way. And replacing assembly with a single automated production process – even one which requires a substantial capital investment in complex tooling – means an improvement in product quality.

Multi-component moulding is also useful where several surface textures are required in one part, either for functional or aesthetic purposes. Multi-shot injection of a combination of hard and soft polymers – such as polypropylene with thermoplastic elastomer – is perhaps the most common application of the technology today and is applied across a very wide range of industries, with the production of tooth brushes and razors prime examples.

In many situations, multi-component design considerations are driven by two key desires:

- To improve the visual appearance and/or tactile finish of the product;
- To reduce total manufacturing cost by eliminating expensive post processing operations such as painting, plating or assembly.

Consider the example of a casing for a mobile phone (shown in Figure 1). The phone manufacturer wanted to achieve a soft warm surface feel and a very good grip. But cost was also very important at the expected annual production volume of two million units.

Figure 1 below: A multi-component mobile phone cover moulded from PC/ABS blend and TPU.

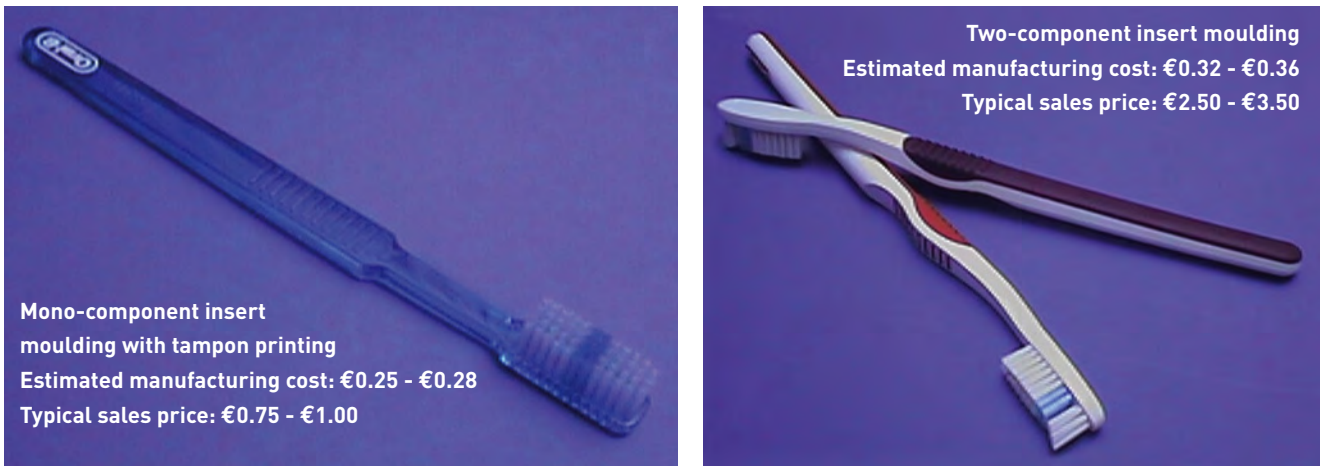

Figure 2: Comparison of estimated manufacturing cost and typical sales price for mono and multi-component toothbrush produced by insert moulding

Two production scenarios were considered and benchmarked prior to the start of the project. The first was to apply soft paint to the moulded part in a post processing step, while the second was to use a multi-component moulding technique. The most important requirements for each scenario, as well as their advantages and disadvantages are laid out in Figure 3.

While the tooling and moulding equipment cost was considerably higher for the multi-component option, the elimination of the labour intensive painting process provided a big saving. In fact, an overall annual saving of around €120,000 was estimated if the multi-shot solution was adopted. While the multi-component tooling and process is more complex, a risk anaylsis determined that the multi-shot scenario was manageable with regard to any expected quality issues. However, it does need to be emphasised that this risk can only be managed by investing a bigger upfront effort in Design for Manufacturing (DFM) during development of the multi-component product design.

The example in Figure 2 shows how multi-component moulding can help lift a product so it can be sold in a higher price segment. In this case study, the replacement of tampon print decoration on a single-piece injection moulded toothbrush with a well-designed two-component alternative adds only a slight premium to the manufacturing cost but almost doubles the typical retail price that can be achieved.

It can be seen that the cost, design and functional benefits of multi-component moulding makes the technology very attractive across all industries. The downside is that the component design can become very challenging, making it difficult to accomplish a good, reliable and cost effective moulding process.

The following list details the 10 most important points that need to be taken into consideration while

Figure 3: Comparison of post-moulded painting and multi-shot moulding for production of a phone cover

PAINTING		
Requirements	**Advantages**	**Disadvantage**
Single component moulds for PC/ABS component Painting masks Storage, shipping & part handling Paint and painting cost	Less complex tooling Lower overall tool costs Low risk of part distortion Suitable for production in low labour costs Low technical standards	High labour and side costs Additional cost of painting High scrap rate expected in production due to paint quality issues
MULTI-SHOT		
Requirements	**Advantages**	**Disadvantage**
Two component moulds	No post processes or additional labour required Improved tactile surface finish Potential production cost reduction	More complex component design Higher capital cost on tooling and IM equipment Research on material pairing for good adhesion Higher risk of distortion More effort on upfront DFM

designing a multi-shot injection component:

- Hard component first – the injection order should always be to mould the first shot hard and second shot soft;
- Consider shrinkage rates – different shrinkage rates for the two component materials can lead to high stress, distortion and/or poor adhesion between the component materials;
- Think about gating – the gate point of the first shot should be covered by the second shot wherever it is possible to do so;
- Consider wall thickness – keep wall thickness as even as possible to reduce risk of re-melting or cosmetic defects;
- Consider flow properties – the minimum wall thicknesss of each shot should be checked against each materials' flow properties, especially when both materials are overlapping;
- Split the design – the design for each of the different materials should be checked to achieve the most robust tooling and minimal risk of visual defects such as flash;
- Think about venting – venting of the second shot is more difficult to achieve due to the shut-off between the first shot and the mould steel;
- Take care with material selection – very good chemical bonding can be achieved with appropriate material combinations.
- Manage temperatures – the temperature of the first and second shot materials will have a significant effect on adhesion.
- Analyse the process – mould filling analysis software can predict gate positions, weld line and venting locations, temperature differentials, cooling times, and shrinkage and stress behaviour. Always make full use of these analytical tools.

About the author:

André Eichhorn is general manager of Germany-based AST Technology. This is the fourth instalment in a series of articles presenting a step-by-step discussion of the Design for Manufacturing (DFM) process. Previous instalments in this series can be viewed **here** and **here**. Part five, which will be published in the next edition of *Injection World*, will discuss how mould construction considerations can be integrated into the product development process.

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