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SOLVING DEPRESSIONS FORMED DURING PRODUCTION OF PLASTIC MOLDING

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This article deals with improvement of design properties of molded plastic parts. It can be achieved by modifying construction of metal injection mold and optimization of parameters in injection process. The subject of our examination was depressions formed on molded plastic parts which are inacceptable in the process of approval. The problem which has arisen was solved in two phases. The first phase consisted in alteration of injection mold design – enlargement of injection molding gate. In the second phase, we have changed the location of injection molding gate. After performing constructional modifications, new molded plastic parts were manufactured and assessed.

Key words: foundry, injection molding, construction, plastic parts

INTRODUCTION

Mold designing for products made of plastic places high demands on professional level. It is therefore necessary that an expert in this field has enough reliable information for implementing it correctly in manu-facturing of these products in practice. [1] Once such information is gathered, a series of questions related to a particular product to be designed is analyzed. [2]

First of all, a detailed analysis of product's function and related requirements on mechanical, thermal, electric and other properties of plastic is carried out. [3,4] We also have to deal with economical requirements (e.g. product price limit, mold production costs), requirements for decreasing labor intensity, price and availability of material, visual questions (e.g. shape, color, surface pattern, shine, trademark), questions of packing and transport. [5,6]

EXPERIMENTAL PROCEDURE

The subject of testing was molded thermoplastic part called Blende (Figure 1). It is used for headlights of Audi TT3 and serves as a bracket and a component of LED strips. It was made from polycarbonate (PC) with trade name Makrolon 1260. [7,8] This material has excellent mechanical properties; it is hard, firm, solid and resilient. It is widely used in automotive industry in achromatic or colored variant.

As it was already mentioned, the subject of our examination is deep depressions on molded plastic parts.

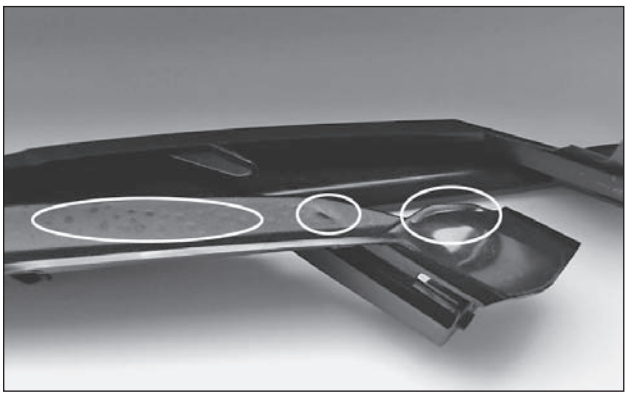

Figure 1 Molded plastic parts with depressions after 1st testing of a mold

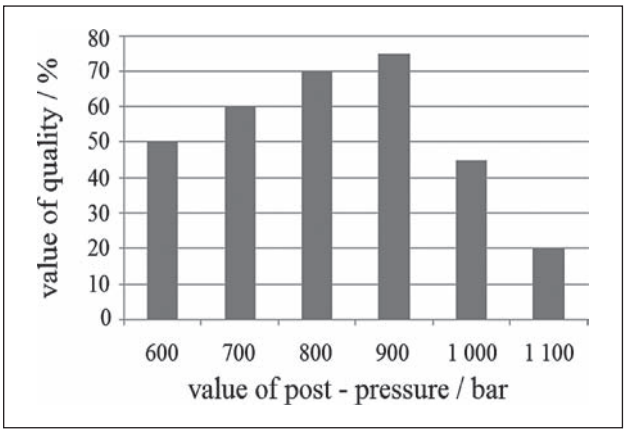

Figure 2 Quality percentage of a molded plastic part depending on the value of post-pressure

Since visual aspect of this molded plastic part is essential it must not be corrupted. The problem of deep depressions was noticeable after the first pressing. Thus, our aim was to improve visual aspect of a molded plastic part by modifying technology of pressing. By thorough examination it was discovered that parts were

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poorly post-pressed, therefore, we decided to increase post-pressure gradually and then observe possible improvement of quality of tested parts. At this stage, another problem has arisen. Higher pressure resulted in producing parts of higher quality, however, allowed threshold values of post-pressure caused deformation of parts during taking them out of a mold. Graphical representation of quality percentage of a part when increasing post-pressure up to deformation of a part caused by a high value of pressure is shown at the Figure 2.

FIRST PHASE OF PROBLEM SOLVING – ENLARGEMENT OF INJECTION MOLDING GATE

Due to persisting problem with the design of molded plastic parts it was necessary to modify the constructional design of injection mold. [9] Since modification of technology of pressing did not eliminate the problem in question we had to search for another way of improving the design of molded plastic parts. Our suggested solution to depressions on parts was enlargement of injection molding gate (Figure 3) which is used for injecting melted material into the cavity of injection mold. The part is filled directly into the rib from where melted material gets into the whole cavity.

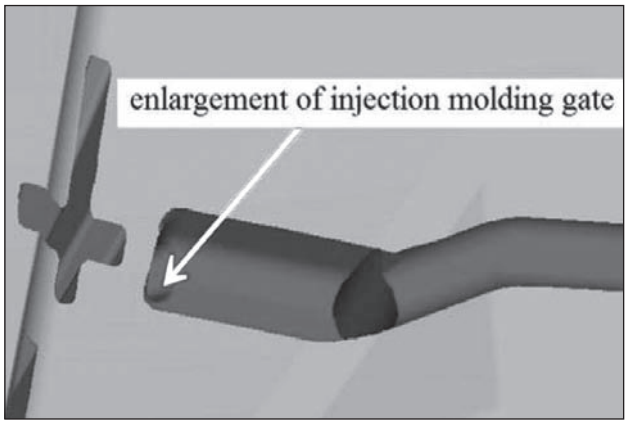

Figure 3 A detail of enlargement of injection molding gate

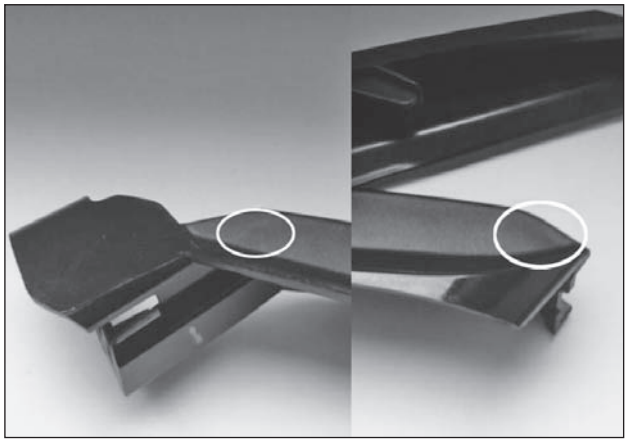

Figure 4 Slight depressions after modification - enlargement of injection molding gate

The injection molding gate of the mold was enlarged by 0,3 mm in order to fill the cavity of the mold better and faster what decreases the post-pressure. After perfor-ming constructional modifications of the mold and adjusting injection parameters, further testing with injection machine took place. Effect of these changes on newly produced molded plastic parts was evident. Enlargement of injection molding gate had a positive influence on design of molded plastic parts which were again thoroughly visually examined. Since the design aspect of these parts is essential, our next aim was to improve their design even more, so that these parts were without any noticeable depressions at all (Figure 4).

SECOND PHASE OF PROBLEM SOLVING – ENLARGEMENT OF INJECTION MOLDING GATE

Since enlargement of injection molding gate and adjustment of injection parameters did not contribute to 100 % improvement of the design of molded plastic parts further examination and modifications were carried out. The design was successfully improved by enlargement of injection molding gate, thus we tried to eliminate the problem completely in a similar way. However, further enlargement was not possible because a filling point was in the rib of the molded plastic point and further enlargement would make the injection molding gate larger than the width of the rib what is technically impossible.

Thorough examination brought us to conclusion that achieving functionally and visually perfect molded plastic part requires different location of injection molding gate. During construction of the mold it was required to place the injection molding gate into the rib, thus we have introduced the problem and our solution. Our suggested change of the location of injection molding gate was approved.

Subsequently, a simulation of flowing melted material into the mold with new location of the injection molding gate (moved from the rib to the wall of the molded plastic part) was performed and an injection molding insert ensuring functionality of this change was created. This modification was then submitted for approval (Figure 5).

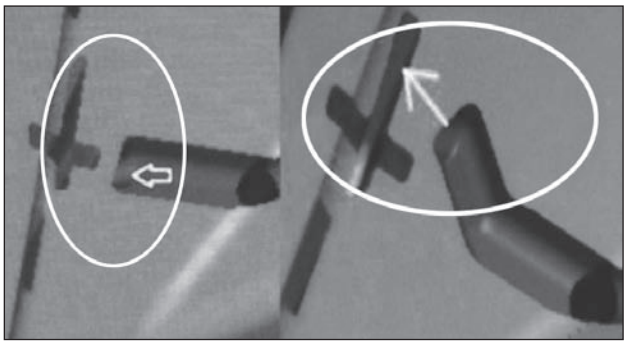

Figure 5 Illustration of changed location of the injection molding gate

RESULTS AND DISCUSSION

Our effort to improve quality of a molded plastic part by modifying injection parameters and an injection mold was not successful, thus we decided to change the location of the injection molding gate. After performing mold-flow analysis it was evident that changing the location of injection molding gate can eliminate depressions formed on molded plastic parts.

Based on this analysis was changed the location of injection molding gate on the mold and on molded plastic part as well. Further testing of performed modifications was carried out in order to confirm or refute correctness of our solution to initial problem.

New injection parameters resulting from changed location and design of injection molding gate were used during final functional testing. Table 1 shows adjustment of injection parameters during the first functional testing and parameters after suggested constructional modifications and recommendations.

The final functional testing has proved that changed location of injection molding gate has improved visual aspect of a molded plastic part which was then fully accepted. We have obtained molded plastic parts without any noticeable defects (Figure 6).

Table 1 **Comparison of injection parameters during performed testing**

Parameter	Parameter values – before modifications	Parameter values – after modifications
Cycle time / s	40	34
Freeze time / s	20	10
Post-pressure time / s	6	5
Pressure of post-pressure / bar	890	940
Injection time / s	1,5	1,2
Injection pressure / bar	1 350	1 550
Mold temperature / °C	85	100

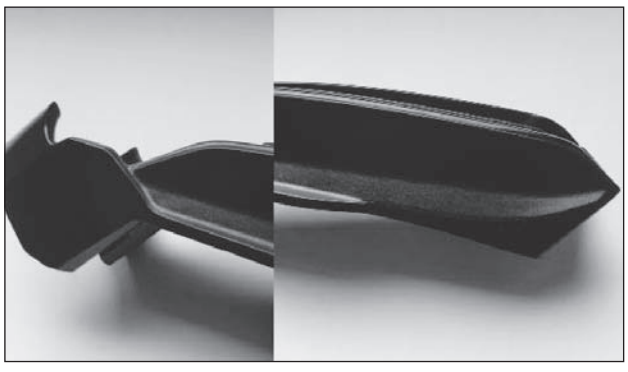

Figure 6 Functionally and visually approved parts without defects

CONCLUSION

The leg of a molded plastic part, where the gate was originally proposed, served as snap-in with counterpart, thus the designer of the molded plastic part chose a spot where no collision with other parts was noticed. After explaining the problem and performing a simulation of injection process we have carried out suggested modification.

The diameter of the original location of injection molding gate after enlargement was 1,65 mm. Since we were limited by width of the rib of the part changing the location of the gate provided larger diameter – 2,1 mm. This means that enlarged diameter (by 0,45 mm) was then used for filling the part. This modification enabled us to put more melted material into the cavity during the same time and the molded plastic part was not deformed by high post-pressure. Moreover, we succeeded in shortening whole injection cycle what has a positive influence on financial aspect.

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Note: The responsible for English language is Mgr. Lucia Gibľáková from Iluminata Linguistics.