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Reduction in Die-casting Burrs by Shot Profile Control

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Burrs formed on aluminum die-castings had resulted in increased man-hours for deburring and the suspension of production due to the flashes of molten metal, and had eventually become major factors affecting productivity. To eliminate these factors, we had taken conventional countermeasures, such as reducing casting pressure and reducing shot speed immediately before completely filling the die cavities with molten metal. However, these countermeasures did not stabilize the external and internal quality of products. Under these circumstances, we successfully developed technology that reduces burrs without having any adverse influence on quality, by controlling shot pressure before and after completely filling the die cavities with molten metal. This paper reports on that technology.

Keywords: *burrs, surge pressure, intensification profile*

1. Introduction

We mounted a displacement sensor on the parting line of the dies to check the clearance between the die halves during casting, and conducted practical casting operations. This caused the gap of die to be affected by surge pressure upon completion of filling of molten metal into die cavities and shot pressure after the completion of that, as shown in Fig. 1. Furthermore, as shown in Fig. 2, the gap of die and burr thickness were found to have a strong correlation. Consequently, we worked on improving these two items concerning the gap of die.

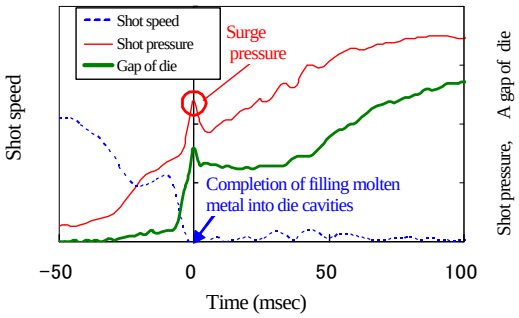

Fig. 1 Typical shot pressure and a gap of die during casting

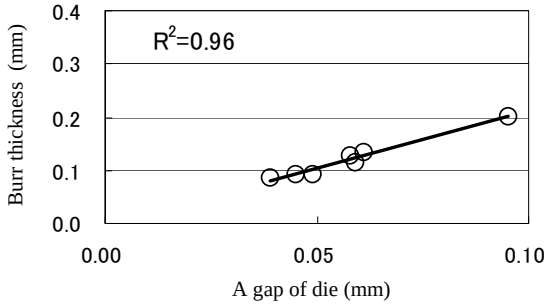

Fig. 2 Correlation between a gap of die and burr thickness

2. Reduction in surge pressure upon completion of filling of molten metal into die cavities

Figure 3 shows a diagram of the start of intensification under shot position control. In die-casting, starting intensification after completely filling the die cavities with molten metal results in quality degradation. Therefore, intensification is set to start at a point where it can begin without delay even if the pouring amount increases.

In the meantime, we found that a time lag from the start of intensification to the completion of filling (i.e., intensification time lag) varied according to changes in pouring amount and this affected surge pressure upon the completion of filling (Fig. 4).

So, we examined ways to start intensification after judging the filled amount of molten metal into die cavities. As a result, we found that making this judgment according to shot speed provided higher reproducibility.

Figure 5 shows the intensification time lag when the intensification start control factor was changed from the shot position to the shot speed. This change reduced the variation in intensification time lag to 1/9, thus making it possible to suppress variations in intensification start timing and control surge pressure upon completion of molten metal filling into the die cavities.

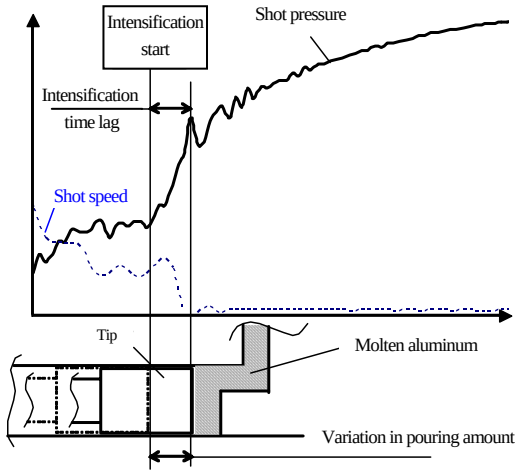

Fig. 3 Diagram for intensification start under shot position control

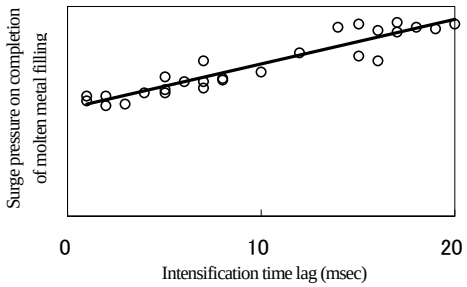

Fig. 4 Correlation between intensification time lag and surge pressure upon completion of molten metal filling into die cavities

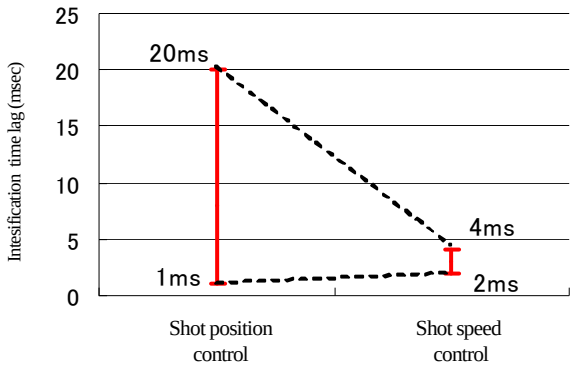

Fig. 5 Intensification time lag values

3. Pressure build up profile change

As shown in Fig. 1, the gap of die for intensification increases with the rise in pressure. However, it is important to "add the necessary pressure when needed" in order to reduce burrs and ensure quality.

Therefore, we conducted tests to verify the correlation with quality by replacing the intensification control valve with one of excellent responsiveness and changing the pressure build up pattern with this valve.

As a result, we found that shot pressure served as follows in each period.

1. Initial intensification: Completely fills molten metal up to the ends of die cavities and builds in appearance quality.
   (Solidified ratio: Not more than 35%)
2. Final intensification: Builds in internal quality after the outmost surface of the product solidifies.
   (Solidified ratio: Not less than 45%)

Intensification in the solidified ratio range of 35 to 45% has no effect on quality. However, continuing to increase pressure in this range will result in increased a gap of die as shown in Fig. 1. Therefore, we controlled the pressure build up profile so as to suppress intermediate intensification without changing the initial intensification or final shot pressure.

4. Verification of effect

As a result of using surge pressure control and intensification profile control, we successfully reduced a gap of die during casting by 36% and a significant reduction in burrs while maintaining the quality of castings at the conventional level (Figs. 6 and 7).

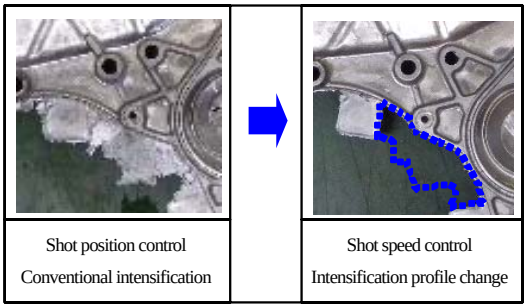

Fig. 6 Comparison of development of burrs

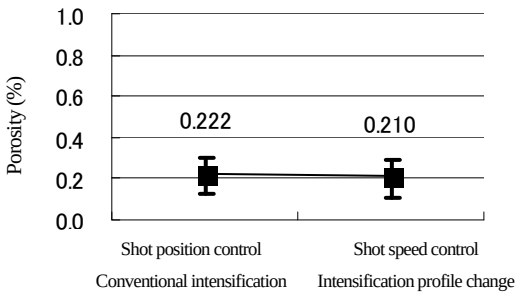

Fig. 7 Comparison of porosity of castings