Effect of Mould Coating Material on Microstructure of A356 Aluminium Alloy

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Abstract

In this study, three different mould coatings (named Fondermat, Dycote and BN) were applied onto three different dies. After the casting process of A356 alloy with coated and uncoated moulds, secondary dendrite arm space (SDAS) of the square and cylindrical sectioned samples were measured via image analysis software on an optical microscope. As a result, the secondary dendrite arm spaces of the samples were found to be close and no significant difference was found. The use of the coatings showed that the surface qualities of the samples were decreased.

1. Introduction

The two most common known methods for shaping aluminum alloys are casting and forging.

Casting operations can be applied in various moulds. One of the most suitable methods especially for mass production is die moulding. In die casting, choice of coating and application is important as well as mould design, alloy type, metal temperature.

Various surface treatments can be applied to permanent moulds. One of these treatments is coating. Surface coating processes aim to control heat transfer to ensure better solidification and full feed of cast parts. It is also supports the improvement of surface quality and mould service life.

2. Experimental Procedure

In the experiments, 2 different shaped, as shown on Fig 1 and 2, 1040 steel moulds were used to examined the differences of 3 coating. These molds have 2 different geometries with cylindrical and square sections. Fondermat, Dycote and BN were used as coats.

Mold surfaces were cleaned via compressor. Then all the molds were preheated at 200 °C during 30 minutes. Then brushed with Fondermat, Dycote and BN. After coating, the molds were again heated at 200°C for 30-45 minutes. Only Fondermat coating is left for 1 hour.

3. Results and Discussion

As a result, no significant difference was observed in the microstructures of non-coated and coated moulds. SDAS were measured on average 15-20 μm for all samples.
Fig 3. Comparing the SDAS measurements from microstructure of square and cylindrical sections.

(a)                               (b)

Fig 4. Microstructure images of uncoated samples in (a) cylindrical and (b) square sections at 10x.

(a)                               (b)

Fig 5. Microstructure images of Fondermat coated samples in (a) cylindrical and (b) square sections at 10x.

(a)                               (b)

Fig 6. Microstructure images of Dycote coated samples in (a) cylindrical and (b) square sections at 10x.

(a)                               (b)

Fig 7. Microstructure images of BN coated samples in (a) cylindrical and (b) square sections at 10x.

(a)                               (b)

Fig 8. Specimens from the uncoated mold.

The surface roughness increased visibly in all coated cast samples and there was a decrease in surface quality. The brightest and smoothest surface was achieved in uncoated die casting.

Fondermat coated mold has taken a long time to dry. So, melt was poured while the mould was not dry yet. There is a possibility of interaction between the humid mold surface and the liquid metal during aluminum casting, therefore sample surface became distorted.

Fondermat, which has a viscous structure, couldn't yet dry even after melting. For this reason, even after a long period of cleaning work such as wiping and grinding, the desired mold cleaning could not be achieved. It has also been observed that paint residues have accumulated on the surface of the samples which have been dyed with Fondermat. Other coatings did not show such a result.

Fig 9. Specimens from the mold coated with fondermat.
Samples of Dycote used mould casting have the most rough and porous surface.

Fig 10. Specimens from the mold coated with Dycote paint.

The best surface quality samples were obtained from mold coated with BN. The easiest to remove the sample from the mould was seen in the BN coating. However, the problem is that the service life of the paint is short and the paint needs to be repeat.

Fig 11. Specimens from the mold coated with BN paint.

4. Conclusion

In this study, microstructural changes and surface quality of A356 aluminum alloy are examined in general terms. Three different mold coating materials named Fondermat, Dycote and BN were used for this experiment.

It is desired to influence the solidification of the casting material with the mould dyes and to observe the change of the microstructure. As a result, these three coating dyes did not cause a significant change in the mold designs used.

Mold design is an important factor in solidification. There is a possibility that different results can be seen by using the coating dyes in different mold designs.

At the end of the study, the surface quality was also examined. It is seen that the surface quality of the coated molds is much lower than the uncoated molds. BN coatings showed the best performance among the coated molds with minimal roughness.

References


