Session Chairperson Tohoku University
Dr. Eng. Koichi Anzai

JD18-30

Influence of Composition and Thickness on Mechanical Properties of Non-Heat Treatment High Pressure Die Casting Al-Mg Based Alloy for Automotive Body Parts

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JAPAN DIE CASTING ASSOCIATION Die Casting Aluminium Alloy Committee
Die Casting Aluminium Alloy Committee
Japan Die Casting Association · Japan Aluminium Alloy Refiners Association

In recent years, ADC3 has been partially used as a substitute for stamping steel plate structural parts. However, the heat treatment process and the strain correction are cost consuming and reduce the productivity. On the other hand, non-heat treatment Al-Mg-Si alloy for HPDC is being applied to body parts in Europe these days. Even in Japan, studies on Al-Mg based alloys for HPDC including ADC6 have been conducted previously, but there are limited cases in which systematic investigations aimed at application to automobile body parts are disclosed. In this study, the influence of the composition of solid solution-strengthening Al-Mg-Mn alloy, and the wall thickness of HPDC on mechanical properties were investigated. Among the studied alloy compositions, a composition that satisfied the target value of the set mechanical properties and having a possibility of low wall thickness sensitivity as compared to the Al-Mg-Si alloy was confirmed. In addition, in conducting HPDC with Al-Mg alloy, it was suggested that performing molten metal treatment sufficiently is necessary to prevent the risk of inclusion.

JD18-31

Research on Factors Affecting Die Cast Surface Quality of Die Castings

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UBE MACHINERY CORPORATION, LTD. Kousei Murakami
TOSHIBA MACHINE CO., LTD. Masaaki Koiwa
AISIN KEIKINZOKU CO., LTD. Shinichi Asai
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A.K.DIE CASTING CO., LTD. Jun Kawada
JAPAN DIE CASTING ASSOCIATION Research & Development Committee

An experiment to investigate factors affecting die cast surface quality of die castings was conducted with a test die. Several experiment conditions of factors affecting the die cast surface quality were established to make die cast parts. And the surface topography of the die cast parts were measured with a digital microscope in order to identify the correlation between each factor and the die cast surface topography. The relationship between flow marks and the production conditions of an aluminum alloy die cast and a zinc alloy die cast were also studied. These studies revealed that a factor affecting the molten metal flow pattern was a major factor that dictates the formation of the flow marks. More specifically, it turned out that 1: flow marks are created when gas entrapment occurs during the die cast surface formation process. 2: the flow marks become more apparent as the molten metal solidification advances. 3: by conducting a flow simulation to confirm gas entrapment locations of a die cast surface, the possibility of flow mark formation can be predicted.

JD18-32

Development of Static Filling Die Casting Method by high speed optimization.

PACIFIC INDUSTRIAL CO., LTD. ●Dr. Eng. Susumu Yamada
TOSHIBA MACHINE CO., LTD. Masaki Fujimoto

In injection setting of die casting, discussion has been made as to not involving gas in the molten metal in the low speed zone and how fast it can be filled in the high speed zone. On the other hand, when molten aluminum solidifies, pressure change during filling at high speed is not taken into consideration though it accompanies solidification shrinkage. Generally displayed pressure is the result of position-speed control. By using it, we found a filling method that raises the pressure up to the pressure increase zone without reducing the pressure in the high speed zone by supplementing the pressure drop at the speed. The authors decided to call this a Static Filling Die Casting Method. The authors found that internal quality can be improved by various experiments. We report the results of experiments carried out by the Static Filling Die Casting Method considered being beneficial not only for internal quality but also for mold and machine life.

JD18-33

Correction of injection condition of die casting machine corresponding to fluctuation of the metal feeding amount.

TOYO Machinery & Metal Co., Ltd.
●Shingo Ikeda, Masaya Kita, Takashi Ijiri, Yosuke Fujii, Hiroshi Ogawa

In recent years, the stability and repetition accuracy of the injection operation of a die casting machine have been improved by technologies such as electric drive machines. However, the method of using the ladle for supplying the molten metal of the cold chamber die-casting machine is still mainstream, fluctuation in the supply amount of the molten metal due to the remain in the ladle or spilling of the molten metal influences the injection condition and deteriorates the quality of the product. In this paper we report that the height of the molten metal actually supplied to the plunger sleeve is measured using a laser type displacement meter and the measurement result is feed back to the injection operation of the die casting machine, This is an experiment result that the injection condition response to fluctuation in the metal feeding amount.

JD18-34

Quality improvement evaluation by each casting method using Cavity Direct Valve System

KOTOBUKI KINZOKU KOGYO CO., LTD.
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At present, the most popular high quality die casting method is a vacuum die casting method, and it is utilized as a method for improving the quality of die castings. Although there are several methods of vacuum die casting method, there are common drawbacks may be to generate a filling time (secondary filling) of the vacuum runner. Most die-casters are not aware of the need to shorten the filling time and also do not seem to understand the adverse effect on quality (a decrease in product density and a decrease in die life due to an increase in casting pressure). In order to solve the drawbacks of the vacuum die casting method, we have been developing a construction method which does not generate the secondary filling with "Cavity Direct Valve" and is not affected by gas in mold cavity.

Session Chairperson Aisin Seiki Co., Ltd.
Tatsuyuki Kobayashi

JD18-35

Investigation on characteristics of die-casting methods with various alloys.

TOSHIBA MACHINE CO., LTD.
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Western Region Industrial Research Center, Hiroshima Prefectural Technology Research Institute
Dr. Eng. Terayama Akira, Fuyama Nobuyuki

In late years, die-casting products diversify into structural and high-strength elements with light weighting of automobiles. These products are replaced from those made with other process, and the material are not ordinary alloy. Thus, the basic characteristic of alloys, other than ADC12, is investigated by measuring molten metal flow and temperature. Also, we examine and report findings from actual castings how those conditional factors can influence manufacturing products.

JD18-36

Die casting technology of large structural member for automobiles

UBE MACHINERY CORPORATION, Ltd.
Kousei Murakami, Motoki Tanaka, Noriyuki Oe, Yuuichirou Tsurugi, ●Naoki Ishibashi

Due to strengthening of environmental regulations in recent years, strict emission regulation and weight reduction are required in automobiles. For this reason, not only the conventional drive system is made into an aluminum but also aluminum structure and multimaterialization of the body structure portion which occupies about 1/4 of the weight of the automobile are progressing. Against such a background, opportunities and areas for adopting aluminum die castings capable of integrating a complicated shape of a rib structure and multiple parts into a large structural member for automobile are rapidly increasing and expanding. Therefore, in this report, focusing on "Shock Tower" which is a typical large structural member for automobile, and is expected to increase in the future, in establishment of die casting technology for shock tower and development of injection device, we report on the newly developed high vacuum system and the influence of short time filling and short time intensification, which are the key technologies, on pressure transmission efficiency and product quality due to large projected area and thin product wall thickness.

JD18-37

Characteristic Evaluation of Crack Caused by SPR Joining of Steel Sheet and Aluminum Alloy Die Cast and Influence of Die Shape

Ahresty Corporation
Kazuki Sasaki, ●Shigeyoshi Komaki, Norihiro Ogawa, Katsuhiro Ode

With aggressive efforts being undergone in the automobile industry towards weight savings, the use of lightweight materials is of utmost importance. The joining of steel sheet metal components, the main constituent material in automobiles, and the dissimilar lightweight material is important. There are several possible joining methods for connecting aluminum alloy die castings to steel sheet metal, but the Self Piercing Rivet method (SPR) has been put into practical use as a method for obtaining stable joining without heat effect in joining process. The primary failure in use of the SPR joining method is the formation of cracks in the aluminum alloy die casting. Formation of these cracks can't be managed by material elongation alone. Because of this Ahresty has been evaluating joining of materials by the SPR method for strengths and weaknesses. Our testing has focused on local bending at SPR locations as a method to evaluate the characteristics of formation of cracks at the time of the joining, the examination of the bending angle, die shapes and other factors.

Session Chairperson TOSHIBA MACHINE CO., LTD.
Masaaki Koiwa

JD18-38

The technology of two-cavity casting in GD-squeeze casting process

RYOBI Limited ●Yosuke Kado, Ph. D. Masanobu Furuta, Etsuji Ogawa, Shigeki Fukuoka, Kenji Nobusato

GD-squeeze casting process is our proprietary casting method suitable for manufacturing thick-walled products with a pressurizing mechanism added for tilting die casting. Since this casting process does not use the mold wash and brings the molten metal into close contact with the die mold by pressurization, the solidification rate is higher than that of general tilting die casting. Therefore, there is an advantage that the productivity can be improved by reducing cycle time. In order to expand this casting process, further productivity improvement is required. One idea to improve productivity is multi-cavity casting. Multi-cavity casting has been common in low pressure casting and gravity casting so far. So, in order to achieve multi-cavity casting by GD-squeeze casting process, we attempted to do two-cavity casting by the way of "squeeze branch inside the die mold" which used existing GD-squeeze casting machine that has single squeeze.

JD18-39

Formation of heat radiation coating by residual heat of die-casting

TOYOTA MOTOR CORPORATION ●Yuta Egawa, Yuichi Furukawa

With the recent increase in the number of electronic parts accompanying the electrification of automotive, the need for heat dissipation to those parts is increasing. Casting parts have high thermal conductivity of metallic materials and it is possible to integrally mold part shapes that promote convective heat transfer. But in the no wind condition it is difficult to dissipate heat to the outside. Then, as a unique technology corresponding to it, there is a method of forming an oxide layer or a resin layer that promotes thermal radiation, but the treatment equipment is large and it takes time to form a layer. In this report, we describe the method about making high heat dissipation heat sink which compatible heat conduction and heat radiation with short time and small scale by spraying high emissivity resin material on the casting immediately after casting and forming it by residual heat of the casting. Test pieces made of aluminum die casting with heat dissipating layer fabricated by this construction method. We conducted heat dissipation test of natural air cooling and clarified that the heat dissipation amount improves by about 20% compared with without the layer.

JD18-40

Improvement of calculation efficiency in heat transfer and solidification analysis using adaptive resolution particle method

Hitachi Industry & Control Solutions, Ltd. (Prev. Tohoku University) **●Dr. Eng. Naoya Hirata**
Tohoku University Dr. Eng. Koichi Anzai

Finer calculation elements (meshes) are required to conduct accurate simulation of solidification for thin walled casting. Calculation methods using non-structural mesh relatively keep its efficiency even for complex shaped castings, because the methods can use adaptive mesh size for various size of parts, regions around interfaces. However, methods using non-structural mesh tend to have complexity in mesh generation or calculation program itself. A particle method, which is one of the Lagrangian method, uses calculation elements called "particles", which are simply placed in the space. However, a calculation time of the particle method tends to be longer than the conventional methods because the particle method must search neighboring particles constantly. On the other hand, different size, multi-physical model can be adopted easily compared with the other conventional methods, so the particle method has a high possibility in simulating complex and combined phenomena in casting processes. In this study, we conduct heat transfer and solidification simulation using various kind of particle size as adaptive resolution method in a similar manner of non-structural mesh, and tried to improve the calculation efficiency.