Session Chairperson
UBE Machinery Corp. Kousei Murakami

JD24-08

Investigation of Wave Behavior during Ladle Pouring and Plunger Advancing in Aluminum Alloy Die Casting

Daido University ●**Fuga Itakura, Toru Yamada, Dr.Eng Yasuhiro Maeda**

Ryobi Limited **Ph.D. Akihito Hasuno., Yasushi Mochida**

In the ladle pouring and plunger advancing processes of die casting, air entrainment due to turbulence in the flow front and the formation of cold flakes due to a drop in the molten metal temperature are causes of defects. So, quick and quiet pouring is preferable in these processes. In the previous study, the particle-based SPH method considering the oxide film could simulate the flow behavior from ladle pouring to plunger advance. In the present study, wave behavior caused by ladle pouring and plunger advancing processes is simulated to investigate the relation between injection conditions and wave behavior of height and velocity. The effects of a ladle tilting speed, switching time, plunger advancing speed, and some conditions on the wave behavior are investigated to study a reasonable condition in quick and low air entrainment injection.

JD24-09

Numerical Simulation to Predict Casting Defects by Using Machine Learning

Hitachi Industry & Control Solutions, Ltd. ●**Ph.D. Hirata Naoya**

Recently, casting simulations have been widely used for casting design and defect prediction. However, in order to utilize casting simulation effectively, it is necessary to understand “fitting” and “modeling errors”. Therefore, even if analysis results and knowledge about casting defects are accumulated in shop floors, human judgment is required to utilize them for the future prediction based on personal knowledge or experience.
This research introduces a technology that uses machine learning to statistically and objectively process individual judgments regarding "fitting" and "modeling errors" by linking conventional analysis results with defects observed in the actual field.

JD24-10

CAE prediction of core pin breakage by supervised learning function

Ahresty Corporation ●**Rintaro Yoshinaka Kiyomi Sakai Dr.Shinji Sannakanishi**

To predict the occurrence of defects and failures in aluminum die castings with casting CAE,
it is necessary to encompass the entire occurrence mechanism and check each result individually. Therefore, it is difficult to establish clear criteria for judgment, and there has been variation in judgment among CAE engineers. Therefore, there is a need for a method to replace CAE results with comprehensive indicators, and one such method uses the machine learning function of casting CAE software.
In this study, core pin breakage was selected as a prediction target using the machine learning function. Finally, by using clearly set pin breakage prediction criteria,
a certain percentage of correct responses was obtained. In this presentation, we report on the input conditions, final results, and future tasks.

Session Chairperson
Hitachi Industry &Control Solutions, Ltd. Ph.D. Naoya Hirata

JD24-11

Evaluation of Die Cast by Machine Power and Die Compatibility applied Super High Velocity Injection

(retired)Yamaha Motor Co., Ltd. ●**Yamada Youji**

The PQ^2 diagram was developed by Alfred Marshall in the turn of the century, and the importance of diagram can be demonstrated by NADCA and other major institute, and it also introduced industry by A. J. Davis in the late ‘70s. The Analysis Cold Chamber Die Cast PQ^2 diagrams allows us to graphically describe both the shot system’s power envelope and the power requirements of the die, both in term of metal pressure and metal flow rate. This is a convenient and visual way to determine whether the shot system has the capacity required for a particular die process setup. The PQ^2 diagram shows how the various elements of shot system, such as operating pressure, shot cylinder size and shot speed capability, affect the power curve in final gating pressures. The shot system elements (cylinder size, maximum dry shot speed and operating pressure) that allows machine manufacturer to specify a shot system for a given set of requirements. The recent development of space and aviation hydraulic machine instruments (Moog system) can apply large volumetric and high speed actuate one’s to Super High Velocity Injection cold chamber machine, that allow the improvement of dry shot speed and large diameter plunger cylinder. This paper describes qualities improvement methods aim to decrease casting defects, the occurrence delays of casting burrs and die heat check by impact pressure peak at final cavity fill stage. The improvement of dry shot velocity and effective metal pressures contributed not only decrease defects but also multi-cavities layout that lead to increase productivity with large die cast machines.

JD24-12

Casting pressure transfer behavior of die casting on porosity formation

Institute of Technologists Professor Emeritus
●**Naomi Nishi(Dr.Eng)**

Die casting fills the die cavity in an extremely short period and rapidly cools and solidifies, resulting in defects such as blowholes and shrinkage porosity. To prevent these, pressure of over 50 MPa is generally applied after filling die cavity with molten metal. A pressure sensor was used to measure how this casting pressure was transmitted into the die cavity. Then, the

relationship between pressure transfer behavior and porosity defects was investigated. The casting pressure transmitted to the die casting die cavity is divided into three regions. Region Ⅰ is the casting pressure is transmitted into the die cavity immediately atter filling die cavity. Region Ⅱ is mainly caused by solidification shrinkage of the casting alloy after gate closed. Region Ⅲ is caused by thermal contraction of the cast alloy atter solidify. The occurrence of porosity is influenced by the pressure transmission behavior in region Ⅰ.

Session Chairperson
Institule of Technologists Dr.Noami Nishi

JD24-13

Effect of over flow shape on formation of defects in zinc alloy die casting

Sato Research Laboratory for Foundry Technology
● **Kenji Sato(Dr.Eng)**

Small parts of zinc alloy die casting tend to occur defects of gas porosity and flow line. In order to find suppression condition for the occurrence of these defects, the specimen of JIS ZDC2 was cast using a small-sized hot chamber die casting, and the influence of casting variables and over flow shape on the occurrence of defects was examined. The shape of specimen is a rectangular plate and a gating system without air vents is adopted. Under casting conditions, the injection speed is strongly dependent on suppression of surface defect. The increase in injection speed suppresses the occurrence of flow line, but the effect of reducing the amount of gas in the specimen is small. The overflow is changed from a conventional square shape to a round shape, and the overflow volume ratio is changed. The round shape increases the gas trapping efficiency, and increasing the overflow volume significantly affects the decrease in the amount of involved gas in the specimen, but has little effect on reducing flow line.

JD24-14

Three-point bending properties of aluminum secondary alloy with high ductility and high yield strength

Daiki Aluminium Industry Co., Ltd. ● **Naoko Otsuji, Yoshiyuki Oka, Kosuke Nakakado, Takuro Miyake, Teruaki Danno(Dr.Eng), Naoto Oshiro**

In order to lighten automobiles, the use of aluminum die-casting alloy for body parts is progressing. Although 365 alloy, which is primary, is in use for body parts, high CO2 emissions during manufacturing are concerned. We developed new secondary alloy which has high ductility and high yield strength, and can be substituted for 365 alloy. We perform the bending test of German Association of the Automotive Industry (VDA) standard on this alloy plate by vacuum die-casting. This bending test has been attracting attention as a method that is not easily affected by internal defects and is suitable for evaluating the impact of defects in collisions. The bending angle of this alloy is roughly same as that of 365 alloy for as-cast and heat treated condition. In order to investigate the effect of elements on the tensile and bending properties of this developed alloy, we performed tests by varing Si, Mg, Cu and Fe.

JD24-15

Identification of impregnant in Al alloy and evaluation of impregnation effect using photon counting X-ray CT

Chuo Hatsumei Institute Co., Ltd. ● **Yusuke Katanaga**

Impregnation technology is used as a countermeasure against blowholes in the aluminum die casting industry. Impregnation is a technology that seals the cavities in the product with an impregnant to prevent leakage. Currently, pressure test and non-destructive test are often used to confirm whether impregnation is necessary. Pressure test is a method of checking for leaks using air, He, etc. Ultrasound and X-ray CT are used for non-destructive testing, but there have been no reports of confirmation or quantitative determination of the impregnant inside the cast cavity. In this study, we used a photon counting detector that can directly convert X-ray photons into electric charges without converting them into visible light. Photon counting X-ray CT method and other techniques were used to identify the blowholes and impregnants in the Al alloy, and to evaluate the impregnation effect.

Session Chairperson
Ahresty Corporartion Ph.D.(Eng.)Shunzo Aoyama

JD24-16

Soldering Behavior at Contact Interface between High-Manganese Cast Steel or High-Manganese Spheroidal Graphite Cast Iron and Molten Aluminum Alloys

Graduate School of Engineering Science, Akita University
● **Ph. D. Ikuzo Goto**
Hokko Metal Industry Co., Ltd.
Masanori Chiba, Toshiharu Kon

Soldering of ferrous components such as molds becomes a problem in Al die casting processes. The soldering is generally caused by the repetition of both the formation of the intermetallic layers at the contact interface with the molten Al alloys and the delamination of the layers. Although our research team indicated the superior erosion resistance of high-Mn cast steel and high-Mn spheroidal graphite cast iron, the relationship between the erosion and soldering resistances had not been clarified. In this study, we conducted the shear test of the specimens prepared by the contact of those ferrous materials and the molten Al alloys and then cooling, and investigated the soldering and delamination behaviors at these contact interfaces.

JD24-17

Development of a mold release agent adhesion evaluation system that utilizes the visibility of organic acid salt mold release agents

MORESCO Corporation ●**Hiroaki Tomimatsu, Takahito Tsujimoto, Yuusuke Sueyoshi**

Organic acid mold release agents have properties that dramatically improve molten metal heat retention and gas amount control compared to conventional mold release agents whose main component is silicone oil. In this study, we will focus on visibility, which is another characteristic of this organic acid salt mold release agent. We propose a method to manage release agent adhesion on molds by utilizing the visibility of forming a white film. Adhesion management using visibility enables visualization and quantification through DX, and has the potential to improve release agent management.

This new index has the potential to contribute to environmental considerations and improve the quality of manufacturing processes, and is expected to be applied to the evolution of new era die-casting machines and mold technology. We will report on the film thickness measurement of a mold release agent using the white film on the mold and its problems, and will also report on the solution and the system we developed independently.

JD24-18

Die-casting production line that contributes to CN

AISIN KEIKINZOKU Co., Ltd. **Shinichi Asai, Tsuyoshi Yoshioka, Atsushi Takayasu, ●Hideaki Kajii**

In recent years, environmental initiatives have been required from multiple directions, and activities toward carbon neutrality (CN) have become an important issue. In order to reduce CO_2 emissions on the die-casting production line, we are using equipment that aims to minimize the energy generated in each process from aluminum melting to inspection.

In the equipment, the melting and retention processes that require heat account for the majority of CO_2 emissions, and it is necessary to make improvements such as reducing the amount of melting by eliminating waste such as reducing yield and defects during production. In this article, we will report on a case study in which we have introduced an integrated production line focused on reducing CO_2 emissions and contributed to carbon neutrality.