Session Chairperson
Atsushi Takayasu (Aisin Keikinzoku co.,Ltd)

JD26-07

Suppression of Heat Crack Formation Using a High-Toughness Die-Casting Die Steel

Proterial, Ltd. ● Kosuke Takagi, Dr.Eng. Yosuke Nakano
Kouta Kataoka, Dr.Eng. Osamu Kanechika

In recent years, die-casting dies have been subjected to more severe thermal and mechanical stresses due to the increasing size of dies and the demand for shorter cycle times. To address these challenges, we have developed a high-toughness die steel for die-casting applications. The developed steel has two key properties: (i) the ability to retain high toughness even in the slowly cooled cores of very large dies; and (ii) excellent toughness at high hardness. In this presentation, we present case studies in which the developed steel was applied at higher hardness levels than conventional die steels, with hardness set according to die size. This approach suppressed heat crack formation, a common die failure mode.

JD26-08

High-Temperature Properties of High-Performance Coatings for Die-Casting Molds

Kawata PE Office ● Dr. Kazuki Kawata
Castec Inc. Noriyuki Inatsu, Takasumi Tatsuno, Raiichiro Iijima

Various surface treatments are applied to aluminum die-casting molds to enhance their resistance to soldering, erosion, and heat-checking. In this study, SKD61 specimens were prepared under five distinct conditions to evaluate these properties: quenching and tempering, gas nitrocarburizing, plasma nitriding, an AlCrTiSiN-based high-performance coating, and a duplex treatment combining plasma nitriding with the AlCrTiSiN coating. The microstructure, hardness, and crystal structures of the treated specimens were characterized. Furthermore, the high-temperature performance of each treatment was assessed through molten aluminum alloy soldering and corrosion tests, high-temperature friction and wear analysis, and high-temperature tensile and rotating bending fatigue tests.

JD26-09

Factors affecting the die-heat crack identified through the mass-production casting

AISIN KEIKINZOKU Co.,Ltd ● Hiroto Koyama, Toshimasa Matsuki
Atsushi Takayasu, Takashi Okuno

In recent years, as the electrification of automobiles has progressed, cost competitiveness in the die-casting industry has intensified. We have been working to extend die life in order to reduce die and maintenance cost. One of the major factors contributing to die deterioration is die-heat check. We have previously implemented "suppression of die-heat crack through minimal application of water-soluble concentrated lubrication," which we reported in 2020, and have since applied this method to mass-production processes. The reason for this effect is that reduces temperature fluctuations on die surface. In this report, we present findings from mass-production casting regarding die-heat crack generation when using a powder lubrication, which enables further reduction of temperature fluctuation. We also report the results of evaluating, on mass-production casting, how differences in die materials affect die-heat crack.

Session Chairperson
Hiroshi Matsuda (Ryobi,Ltd)

JD26-10

Development of a High-Strength Zinc Alloy Die Casting Process Applicable to Hot-Chamber Die Casting Machines

Institute of Technologists Professor Emeritus ● Naomi Nishi Dr.Eng
A.K. Diecast Co., Ltd. Jun Kawada
YKK Corporation Taiji Yoshimura (Dr.Eng.)
Japan Die Casting Association Jo Asada (Ph.D.)

Zinc alloy die castings are characterized by excellent dimensional accuracy and suitability for producing thin-walled, precision components. However, their density is relatively high at 6.6 g/cm^3, which is approximately two to three times greater than that of aluminum alloys (2.7 g/cm^3) and magnesium alloys (1.8 g/cm^3). This high density limits their contribution to lightweight design. In this study, we aimed to leverage the advantages of zinc alloy die casting while developing a novel high-strength alloy, thereby contributing to the creation of new markets for thin-walled, high-strength products. Die-casting experiments were conducted by varying the amounts of Al and Cu added to the alloy. As a result, the Zn–10%Al–4%Cu alloy exhibited excellent tensile properties, including a tensile strength of 460MPa, a 0.2% proof stress of 370 MPa, and an elongation of 5%. The alloy's liquidus temperature was determined to be 409°C, and successful casting at 430°C was confirmed. These findings demonstrate that the alloy can be cast using a hot-chamber die casting machine.

JD26-11

Effects of Fe and Si on the Properties of High-Corrosion-Resistant Aluminum Alloys for Die Casting

Daiki Aluminium Industry Co., Ltd ● Takuro Miyake
Ayumi Miura, Shunta Kawate
Dr. Teruaki Danno, Naoto Oshiro

Recent trends in automotive and general-purpose components emphasize lightweighting and cost reduction, promoting the use of diverse die-cast aluminum alloys. AD12 is widely applied due to its excellent castability, mold-filling ability and high strength, but it has poor corrosion resistance, and surface treatment is essential for use in corrosive environments. AD5 and AD6 have better corrosion resistance, but these alloys have poor castability, making it difficult to apply them to products with complex shapes. To address these issues, this study focuses on Al–Si–Mg–Fe–Cr alloys, aiming to develop a die-cast alloy combining excellent castability with corrosion resistance. Previous work presented the development process and the effects of trace elements on corrosion behavior; however, the influence of Fe and Si additions remain unclear. This study investigates their impact on the mechanical properties and corrosion resistance of the alloy system.

Session Chairperson
Dr.Suguru Takeda (TAKEDA Die Casting Res.Lab. Lab.)

JD26-12

Development of molten magnesium alloy with flame retardance for die casting

National Institute of Advanced Industrial Science and Technology
● Yasumasa CHINO, PhD in Eng
The Japan Magnesium Association
Hiroshi Komai

Magnesium is the lightest structural metal, and its use is expanding, particularly in structural components for transportation equipment, where weight reduction is essential. However, its “flammability” during the melting process acts as a barrier to operability and safety during production, thereby becoming a bottleneck for increasing demand. The Japan Magnesium Association established the “Committee for Expanding Magnesium Applications in Automobiles” from 2014 to 2018, and developed a molten magnesium alloy with flame retardance for die casting, which has high flame-retardance during the melting process. In this presentation, we will introduce the background and overview of the activities of the committee, and also present the mechanical properties, corrosion resistance, and other characteristics of the molten magnesium alloy developed, including its flame-retardant properties.

JD26-13

Prototyping and Evaluation of Steering Wheel using molten magnesium alloy with flame retardance

TOKAI RIKA CO.,LTD.
● Toshiyuki Muto
Yuki Makida, Minoru Abe

Magnesium is the lightest structural metal, and its use is expanding, particularly in structural components for transportation equipment, where weight reduction is essential. However, its “flammability” during the melting process acts as a barrier to operability and safety during production, thereby becoming a bottleneck for increasing demand. The Japan Magnesium Association established the “Committee for Expanding Magnesium Applications in Automobiles” from 2014 to 2018, and developed a molten magnesium alloy with flame retardance for die casting, which has high flame-retardance during the melting process. In this presentation, we will introduce the die-casting prototype of a steering wheel using a molten magnesium alloy with flame retardance, its evaluation results. We also discuss the effects of melt flame retardancy on the manufacturing process and examine the alloy’s potential for practical application.

JD26-14

Development and Application of Flame-Retardant Magnesium Alloy Die-Cast Automotive Wheels

Tobata-Global Magnesium Corporation Inc. ● Yoichi Nosaka

Magnesium wheels have been attracting attention for a long time as a method to improve the fuel efficiency and driving stability of automobiles, but in recent years they have not been adopted in mass production due to their high price, but in the NEDO project, we have developed a lightweight and high-strength Magnesium die-cast wheel using molten flame retardant magnesium alloy die casting, and we report its outline.

Session Chairperson
Dr.Naomi Nishi (Institute of Technologists)

JD26-15

An Approach to Reducing Casting Defects Using Machine Learning

Ryobi Limited
● Takumi Suzuki, Akitomo Houku, Sho Tanaka
Kenichi Nishiura, Takayuki Nishikawa

In industrial settings, quality judgment and process adjustments still rely heavily on personnel experience, limiting reproducibility. In this study, a supervised learning model was constructed using casting process data collected for each cycle as explanatory variables and the presence of porosity (identified by X-ray imaging) as the target variable. The trained model was then used to evaluate predictive performance on test data. Furthermore, unsupervised learning methods, including clustering, were applied to identify patterns within multivariate data and to visualize characteristic process states. The results enabled the identification of states associated with relatively high porosity occurrence and the extraction of contributing factors. These findings indicate that the proposed method may support experience-independent decision-making, data-driven process management, and defect prevention.

JD26-16

Variable factors affecting on evaluation of aluminum alloy melt quality by vacuum gas test

Sato Research Laboratory for Foundry Technology ● Dr. Kenji Sato

The vacuum gas test is widely used as a foundry test that is effective for evaluating the hydrogen gas content of aluminum alloy melt. Since the amount of gas of the melt is strongly correlated with the density of the solidified specimen, it is possible to easily estimation of the gas content, and that improves the evaluation accuracy. In order to further improve the measurement accuracy, the variable factors that affect the evaluation is investigated. Based on the characteristics of this method, it is assumed that the element with high vapor pressure contained in the melt and the grain refinement element affect the formation of solidified specimen. In the case of AD12 melt containing zinc with a high vapor pressure, the amount of porosity of the specimen is increased. The effect of the grain refinement element with addition of titanium and boron to AC7A melt has little effect on the formation of porosity of the specimen. The amount of hydrogen of the sampled melt almost no changes with a drop in temperature over time. In addition, variables of test conditions on the evaluation accuracy of this method are examined.

JD26-17

Measure the effects of runner pressurization method on downsizing the casting machine and improving internal quality

Direct21 Corporation
● SATO Kunihiro, IWAMOTO Norihiro
NAGASAWA Osamu, KUBOKI Isao
KIKUCHI Masao

In the runner pressurization method, delaying pressurization enables applying up to 500MPa to molten metal. This allows casting products with more than twice the projected area of conventional ones using the same mold clamping force, this shows the potential for increased productivity in multi-piece castings. However, the effects of such high pressure on the casting machine remain unclear. This study evaluated the method by measuring mold clamping force and examining its relationship with internal quality. The results showed that clamping force could be suppressed even under high pressure. In multi-cavity molding, differences in filling timing usually cause pressure variations and unstable quality, but high-pressure runner pressurization enabled uniform pressure and stable quality. Overall, the method was shown to reduce casting machine size and improve internal quality and productivity.