



Session Chairperson

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

JD22-08

Benefits on casting brought on the dies made of high thermal conductivity steel

Daido Steel Co., Ltd. ● Masamichi Kawano

A casting die exerts a similar role to a heat exchanger. Heat from molten Al alloy to a die is dispersed by spray and inner-cooling. Therefore thermal conductivity of dies affects significant influence on cast quality and productivity. Higher thermal conductivity of a die leads to faster heat transfer then results in lower temperature and lower thermal stress at a die surface. Benefits are given on casting brought on the dies made of high thermal conductivity steel. In particular microstructure refinement of a cast, reducing the time of a cast cycle, prevent soldering and suppression of heat-checking. In addition avoid penetrating a crack from inner-cooling line is expected by reducing of thermal stress.

JD22-09

Prediction of Burr of Die-casting Molds

Ahresty Corporation ● Hiroko Iwahashi, Dr. Shinji Sannakanishi

This paper examines the burr prediction of die-casting molds using structural simulation.

The gap between the cover die half and the ejector die half is calculated by considering a mold thermal expansion, a mold clamping force and a casting pressure. The gap value of the simulation result was compared with the measured burr thickness, and the evaluation method of the simulation accuracy was examined. By investigating various products and dies, analysis for the accuracy of burr prediction simulation was performed by a lot of analysis condition. From the FEM models considered at this time and the obtained conditions and several knowledge, the object products available for burr prediction simulation were narrowed down. In addition, improvement of the prediction accuracy was also examined.

JD22-10

Evaluation of Flash-Boiling Atomization of liquid aluminum alloy containing air bubbles on die-cast process in fluid discharge

(Retired)Yamaha Motor Co., Ltd. ● Yamada Youji

The generation mechanism of flash boiling atomization in aluminum die casting alloy had not reached an advanced stage, advocated by W.V. Ohnesorge since 1936. However, two phase fluid mechanics of experimental studies and application oriented industrial practice of effervescent atomizer had been developed into multi-sectoral approach and many brilliant success. In this study, set up hypothetical discussions that fused aluminum alloy and air are two-phase flow, and tried to interpret and compare with effervescent flash-boiling atomization evolution mechanism get off casting porosity in aluminum die casting process. Additionally, design requirement of sprue and gate in die-cast mold induce atomization, and explained machine injection requirement by PQ2 diagram in machine conditions.

JD22-11

Wave Behavior and Tilting Speed of Ladle Pouring in Die Casting

Dept. of Mechanical Engineering, Graduate School of Engineering, Daido University

● Koki Takada, Toru Yamada,
Dr.Eng Yasuhiro Maeda
Dr. Eng Akihito Hasuno,
Yasushi Mochida

Ryobi Limited

The flow front turbulence of molten aluminum alloy in ladle pouring may cause casting defects by entrapment of air or oxide film. The slow pouring operation to suppress the disturbance of the flow front leads to a decrease in productivity and an increased risk of cold flakes formation. On the contrary, quick pouring is preferable for improving productivity, but the risk of air entrainment increases. In the present study, we investigate the variable tilting speed as a ladle pouring method that suppresses the disturbance of flow front and wave behavior. The falling position of the molten metal and the wave behavior in the shot sleeve after pouring were directly observed, varying the tilting speed of the ladle. Further, we also tried to reproduce the flow behavior by simulating a series of processes from ladle pouring to advancing the plunger in die casting using particle-based SPH simulation of "COLMINA CAE".



JD22-12

Development of new form minimum quantity spray type lubricant

MORESCO Corporation ● Hiroaki Tomimatsu, Takahito Tsujimoto, Teruaki Yokoo

There are many various forms of mold release agents used for die casting, such as water-soluble minimum quantity spray type, water-soluble diluted type, oil-based type, and powder dispersion type. These mold release agents contain various organic substances such as silicone oil, and the hydrocarbon-based and carbonic acid-based gases generated by the thermal decomposition of the organic substances adversely affect the internal quality of the casting. In order to meet these issues and the increasing quality requirements, productivity improvement, and work environment improvement in recent years, we have started to develop a new form of mold release agent containing organic acid salt as the main component. We would like to report on the development of a mold release agent that takes advantages of the high heat resistance and detergency of organic acid salts.

JD22-13

The material properties evaluation for aluminum die-casting alloys

AISIN KEIKINZOKU Co., Ltd. ● Mai Futazuka, Tomoo Yoshida, Shinichi Asai, Tomokatsu Arisawa
MRDC Co., Ltd. Dr. Mayuki Morinaka

Recently, various products are being considered for the environmental preservation and CO₂ emission reduction. For the products that require cooling performance, there is developing to improve cooling efficient. The conventional automobile products are cooling by heat dissipation by a heat sink or coolants in order to suppress the temperature rise. To achieve high cooling efficiency, it is required that large and complicated for the heat sink or strict requirement for the water channel.

In order to obtain high cooling efficiency, it is necessary the application of the excellent thermal conductivity materials for the die-casting products and going with advanced die-casting technologies.

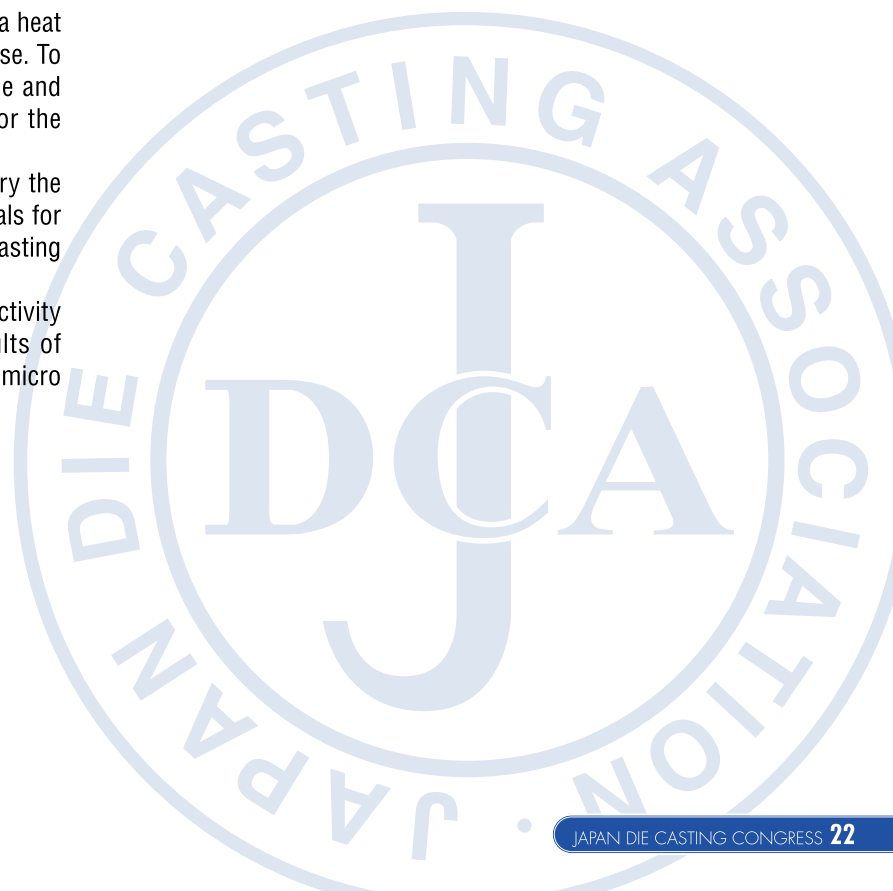
Therefore, we will report of the excellent thermal conductivity aluminum die-casting materials and evaluation results of them on the cast-ability, the chemical composition, the micro structure.

JD22-14

Alloy Solidification Morphology and Quality Characteristic of Die Casting

Institute of Technologist ● Naomi Nishi (Dr. Eng.)

There are roughly two types of solidification morphology of alloys: mussy type and skin formation type. The various properties of the alloy are greatly influenced by the solidification morphology. This paper discusses the effects of alloy solidification morphology on properties such as die casting mechanical properties, fluidity and casting defect formation. In aluminum alloys, ADC10 and ADC3 are mussy types, and ADC1 and ADC12 are skin-formation types. It is desirable to use both types alloy appropriately, depending on the application.





JD22-15

Research Trends of Non-Heat Treatment Al-Mg Alloy Die Casting for Automobile Body Parts and Activities of Aluminum Alloys Committee

Waseda university

Nikkei MC Aluminium Co., Ltd.

Daiki Aluminium Industry Co., Ltd.

Institute of Technologists

Mino Industry Co., Ltd.

Nissan Motor Co., Ltd.

Japan Foundry Engineering Society

Laboratory for Materials Science and Technology, Waseda University

Japan Die Casting Association, Japan Aluminum Alloy Refiners Association, Die Casting Aluminum Alloys Committee

Collaboration: Shibaura Machine Co., Ltd. TYK Corporation,

● Yoshihiro Nagata

Sanji Kitaoka Dr. Eng.

Naoto Oshiro

Naomi Nishi Dr. Eng.

Jyunya Uchida, Toshimitsu Oike,

Takayuki Koike, Naoki Nonaka

Kenji Hayashi

Hiroshi Kambe Dr. Eng. (g)

Technology, Waseda University

Makoto Yoshida Dr. Eng.

Al-Si-Mg alloy die castings have been increasingly used for automotive body parts. Recently, R&D of high ductility non-heat treatment Al-Mg die cast alloy have been conducted. Al-Mg alloys are more susceptible to hot tearing during casting than Al-Si-Mg alloys. The addition of Si reduces the hot tearing susceptibility of Al-Mg alloys. However, it also reduces the fracture elongation. In this study, we developed the non-heat treatment Al-Mg die cast alloy that has high ductility and has low hot tearing susceptibility (HTS) by co-adding a small amount of Si and Sr. The influence of addition of Si and Sr on HTS was systematically investigated by I-beam test. Moreover, both HTS and mechanical properties were evaluated by conducting high-pressure die casting of an automobile body part.

JD22-16

Improvement of the modified effects in aluminum die castings by beat vibration method

University of Toyama

Hitachi Astemo, Ltd.

● Dr. Seiji Saikawa, Yidi Wang,

Teiji Hiromura

Shinji Itabashi, Masanori Watanabe,

Tetsuya Uehara

The Al-Si system alloy ADC12 have a superior characteristic in the case of high pressure die casting (HPDC) process, it is widely used for the industrial field. For the purpose of improving quality near the casting surface, we investigated the effect of beat-vibration method on the casting parts by HPDC. Using a cold-chamber die cast machine with a clamping force of 350ton, the actual engine parts was cast on various kinds of beat-vibration conditions. In this case, the core pin in the die-cavity, which vibrated during solidification of the casting parts. At the last time in 2020 Japan Die-Casting Congress, we reported that the vibration stroke was more effective for the refinement of the -Al and eutectic Si phases in the crystal structure of cast parts, than the frequency of the vibrator.

In this study, due to improve the effect of crystal refinement

of the castings, more heavy weight and longer stroke in beat-vibration condition were investigated.

JD22-17

Lowering Solutionizing Temperature and Shortening T6 Treatment Time for Al-Si-Mn-Mg-Cr-Cu Alloy Plate Fabricated by High Vacuum Die Casting

Daiki Aluminium Industry Co., Ltd. ● Naoko Otsuji, Naoto Oshiro

In order to improve mechanical properties of aluminum alloy, T6 and T7 treatments are used in general. However, distortion occurs on thin die casting by T6 or T7 treatment. In the view points of energy saving and production efficiency, shortening treatment time is desired. We investigated high vacuum die casting samples of Al-Si-Mn-Mg-Cr-Cu alloy after T6 or T7 treatment. In order to reduce distortion, we processed low solutionizing temperature of T6 treatment and investigated distortion and mechanical properties of water or air quenched samples. In this report, the distortion of the sample after T6 tempering was the smallest when solutionizing (440 -3 hour) was carried out in air quenching and when the tool for reducing distortion was used. The elongation and the 0.2% yield strength of this sample were 16.4% and 139MPa. Regarding air quenching, we shortened each treatment time to one hour and investigated mechanical properties.

JD22-18

Technical innovation by the measurement in the cavity and the artificial intelligence for the realization of the smart factory

TOYOTA MOTOR CORPORATION

● Tomohiro Koyama,
Takashi Aoyama

We work on the innovation for the smart factory while we are said to be the change period once in 100 years.

We push forward two technology development. As for one, it is developed the working point measurement technique. It is necessary to look at the working point to see a quality and a phenomenon definitely. We developed the working point construction that We could measure in a mass production easily. The second is development of the distinction technology of ripple data by the artificial intelligence. Conventionally, the person that the difference of the ripple which acquired it was distinguished for expert knowledge hung time to us and distinguished it. Much loss occurs with a part such as time lag and the distinction accuracy before finding it in this. We build a system of the loss destruction through two development mentioned above.