Session Chairperson Institute of Technologists
Professor Naomi Nishi

JD18-8

Developments of Ti matrix composite-used shot sleeve for higher performance

TYK CORPORATION
●Sadayasu Takayama, Shinji Kajita, Yukie Kaku

Our shot sleeve "TC sleeve" has good heat insulation property so that reduction of cold flakes is expected and actually achieved it in aluminum alloy die-casting process. Main wear area of the sleeve is impact area under the mouth poured from the ladle. Thermal deformation of the sleeve can add this mode so that instability of shot speed and abnormal wear are assisted by them and the life of sleeve is decreased. On this time, we report developments of material and partial cooling for higher performance decreasing the above matters. The good performance of TC sleeve has been shown by the machine with 350ton die-locking force and under. Especially it has been checked mostly in laminar flow casting process. These developments will assist the applications to high speed injection and the machine with stronger die-locking force.

JD18-9

Evaluation of Soldering on Surface-treated Specimens with both actual Die-casting Test and Dipping Test

Daido Steel Co., Ltd.
●Masamichi Kawano, Masakatsu Tatsutani, Satoshi Uno

Soldering behavior of surface coating was investigated on die-casting test and dipping test into molten Al-alloy. Core-pins and specimens were treated by carbo-nitriding or PVD process. On die-casting a core-pin was mounted in close to gate and 730˚c molten Al-alloy was injected. Lubricants used are water emulsion type and oiliness type. Maximum temperature 1mm below surface of a core-pin is 470˚c. After 18 shots, die-casting soldering of a core-pin was evaluated. Soldering was almost the same regardless of surface coatings or lubricants. Fe/Al compound layer could not be observed at soldering part. On dipping test a specimen was dipped into 750˚c molten Al-alloy. After 30 seconds dipping which temperature reached to 720˚c specimen was raised then soldering was evaluated. Carbo-nitriding was tends to be more superior than PVD for anti-soldering performance. It is not necessarily match of soldering behavior between die-casting test and dipping test.

JD18-10

Characterization of Dissolution Resistance of Ferrous Materials to Molten Aluminum Alloys using Pseudo Binary Phase Diagrams

Graduate School of Engineering Science, Akita University
● Ph. D. Ikuzo Goto, Ph. D. Setsuo Aso
Iwate Industrial Research Institute Ph. D. Hiroyuki Ike
Konishi Chuzo Co., Ltd. Nobuo Konishi

Dissolution of ferrous materials such as shot sleeves becomes a problem in the die casting processes. The dissolution resistance is estimated using dissolution tests in a molten aluminum alloy. However, there are not enough systematic reports about the effect of the both compositions on the dissolution behavior. Meanwhile, the formation of intermetallic layers at the contact interface is one of the dominant factors influencing the dissolution behavior. The intermetallic that exist in the Al-Fe binary phase diagram are formed at the interface between pure molten aluminum and pure iron. Thus, the dissolution behavior is likely to be quantitatively characterized by constructing the pseudo binary phase diagram of aluminum alloy-ferrous material system. In addition, the optimum sleeve materials for each alloy may be suggested. In this study, we conducted the dissolution test in the various molten alloys, in which the formation behavior of intermetallic layers was examined, and also constructed the respective pseudo binary phase diagrams. On the basis of the results, we investigated the feasibility of the dissolution resistance characterization.

JD18-11

Nonoxidation melting aluminum ingot -melting inside molten aluminum-

TOUNETSU CO., LTD.
●Tomihiro Iwamoto, Yuto Umemoto, Shintaro Higuchi

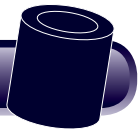
A conventional ingot melting system scorches ingot directly with a gas burner and heats the atmosphere, ingot and inside of furnace body altogether. However, it should absorb oxygen and/or hydrogen in the air while melting ingots and generates oxides and/or the other inclusions. These alien substances cause a long term problem as it would be considered as reasons to lower the quality of molten metal and its productivity. Our method is melting ingot inside the molten metal in nonoxidation state. In addition to that, we use a high power burner that utilizes in our experience of immersion heating technology and that makes it possible to rise molten metal temperature in a short time. The effect should accelerate molten metal temperature equalizing and raise the quality and its productivity for the sake of high heat efficiency. This system could contribute for an era of electric vehicle (EV).

JD18-12

The development of the oxidation restraint furnace (The melting furnace which does not need cleaning work)

Kajitani Co., Ltd. Tsuyoshi Kajitani, Suehiro Iwane
Nippon Crucible Co., Ltd. Tamio Okada, Makoto Ikusawa, Ryuun Paku, ●Masato Masuda

The aluminum alloy rapid melting furnace with the jet heating method was developed in 1972, and this type of melting furnace continues to be used to the present day. The conventional rapid melting furnace has the demerits of oxidation loss due to the generation of aluminum oxide, and it requires great labor for removing and cleaning such aluminum oxide. As countermeasures of those demerits are: 1) Melting with no-oxidation melting process. 2) Reduction of gas absorption and oxidation in the metal with the protection of the oxide film. Based on the above concept, we worked on the development of the oxidation restraint furnace. As a result, we succeeded in reducing metal aluminum loss in 1% or less (whereas 3-5% with conventional furnaces) and reducing to 1-2 times of cleaning frequency of holding chamber in 1 year (whereas 500-900 times with the conventional furnace/year). In addition, we have achieved better aluminum molten metal quality (less hydrogen gas and inclusion contamination, accurate temperature control) by reducing oxide generation. We report the details of development process of the oxidation restraint furnace and the result of the furnace with less oxidation in this paper.



Session Chairperson AHRESTY CORPORATION
Dr. Shunzo Aoyama

JD18-13

Development of furnace for high-speed aging prescription

AISIN KEIKINZOKU Co., Ltd.
●Kouta Tokunaka, Shinichi Asai, Tomoo Yoshida, Naoto Fukutake, Satoshi Nishikawa

In recent years, needs of increase in fuel efficiency as well as reduction in exhaust gases emission have been grown against the background of global environment reservation and CO_2 emissions reduction, which, therefore, accelerates replacement of steel components with high-strength and high-ductility aluminum alloy ones in order to reduce vehicle weight. Recently,much higher levels for strength, ductility and dimensional accuracy have been carried out, there are quite big problems concerning cost and space, because both of them need heat treatment such as T6 or T5. Thus various kinds of experiments on T5 heat treatment method were carried out in order to consist higher dimensional accuracy with mechanical property. An example of practical furnace which can rapidly T5 heat treatment and is compact enough to be set up in manufacturing line will be reported.

JD18-14

Development of the Microcapsule Lubricant

Aisin Seiki Co., Ltd.
●Kazuhito Maehara, Tetsunori Hayafuji, Tatsuyuki Kobayashi

The method of spraying a water-based lubricant to die surface while the dies are open is commonly used for die casting. In contrast, we are working on a technology that pressure-feeds a moisture-less powder lubricant and makes it adhere directly to the die surface while the dies are closed. This technology prevents the lubricant from scattering around the dies to improve the die-casting environment compared to general lubricant spraying. The technology also brings about effects such as shorter cycle time by the combined use of enhancing technology of internal dies cooling. However, conventional powder lubricants are solid and readily accumulate when adhering to the dies. This has caused them to be cast into the product surface during die casting, resulting in harmful residues. Water-based lubricants are liquid and readily form a uniform releasable film when adhering to the dies, preventing the problem described above. We have recently developed the microcapsule type of new powder lubricant that can form a release film just like water-based lubricants while maintaining applicable characteristics as the power lubricant.

JD18-15

Visualization method of die lubricant film using hyperspectral camera

Yushiro Chemical Industry Co., Ltd.
●Genta Nakamura, Mikinori Suzuki, Masaki Hosokawa, Yasumasa Ohashi, Seiji Takahashi
EBA JAPAN Co., Ltd.
Ph. D. in Medical Science Yohei Takara
Fuminori Ando, Naoki Noro

In recent years, water-soluble, low-volume spray die lubricants have advanced rapidly in the aim of improved die cast factory environmental conditions, increased product quality, and reduced cycle times. Accompanying this, die lube film visualization has come to be regarded as important as a method to confirm if die lubricant is efficiently coating dies. A method currently utilized to achieve visualization is application of excitation light from a black light to a die sprayed with lubricant containing a fluorescent additive, while simultaneously using a detector (RGB camera) to screen the resulting phosphorescence and convert it to data. To bring further development to this method several problems must be addressed: 1.) Insufficient thermal stability of the fluorescent additive. 2.) Conventional RGB cameras also detect ambient light and excitation light from sources other than phosphorescence from the fluorescent additive. To resolve these problems, we have researched 1.) Development of a water-soluble low-volume spray die lubricant containing a fluorescent additive with high thermal stability, and 2.) Use of a hyperspectral camera and high-precision evaluation index NDSI analysis to extract only phosphorescence emitted from the fluorescent additive. In this presentation we report our research on a method for quantitative measurement of die lubricant film distribution that can be used in bright environments.

Session Chairperson RYOBI Limited
Ph. D. Ryusuke Izawa

JD18-16

Automatic Optimization of Casting

Katori Office Sadao Katori, ●Yasunori Hori

Automatic Optimization technology of casting process was not developed for any standardized products or fixed pattern of production. Recent AI technology which is depending on deep learning can only applicable for such fixed process. On the other hand, Optimization based on genetic algorism (GA) is immediately applicable for newly developed products, advancing ability of manufacturing tools or any changes of boundary conditions. It starts from DFM (Design for Manufacturing) which takes only a few minutes but can look ahead of whole process or even predict probability of problems in the beginning of designing. Then, DOE (Design of Experiments) filters variables for particular purposes for the final optimization by GA based Optimization. Recently, conventional computers provide results of parallel calculation in a day or 3, which took a few months in the past.

JD18-17

Added Value of Process Modelling in Development of Automotive Die Casting Parts

Groupe Renault, France ●Nicolas De Reviere
Calcom ESI SA, Switzerland Loic Calba, Badarinath Kalkunte

Porosity in high performance castings can reduce mechanical properties and consequently degrade both component life and durability. Automotive Market increasingly requests High Performance Castings with high structural integrity and good mechanical properties. These requirements are typically obtained with Gravity and Low Pressure Die Castings. High Pressure Die Castings, due to the process itself is not completely suitable to deliver such increasing requirements. However, because of the possibility of mass production with reduced shot times and hence costs, several innovations and technologies have kept evolving around this process, making it a competitive and lucrative process for industries to consider. Process Modelling provides a wide scope to test several of these technological advancements virtually and be an integral part in the development of the die casting parts. This would then enable the casting engineers to be able to both predict defects in advance and take actions to improve the process/design.

JD18-18

Analysis of distortion factors of the aluminum thin housing using IoT

MINO INDUSTRY CO., LTD.
●Ph. D. Naoki Nonaka, Hiromasa Yamasaki, Michiaki Kieda, Hideyuki Kondo, Takanori Yamamoto, Takayuki Koike, Tomofumi Imai, Masami Ito

One of our main die-casting products, Not only the weight reduction but also near-net shape is important quality for aluminum housing of electronic parts mounted on automobiles, one of our main die-casting products, because thin and less distortion are needed for heat dissipation. In recent requirement for higher quality, there are some models which are difficult to maintain capability with both conventional die casting technology and approaches of good product condition control, and also from the standpoint of productivity and quality, further improvement of the suppression technology against distortion in die casting is urgently required. We examine and verify the distortion generation process based on the dynamic data acquired by using IoT etc., changing from the trial & error-like distortion countermeasure approach up to now, and identify the good quality conditions influencing the dispersion of distortion. We are also advancing the practical application of new control methods in order to improve its control level, and this time we will introduce some of the concrete examples.