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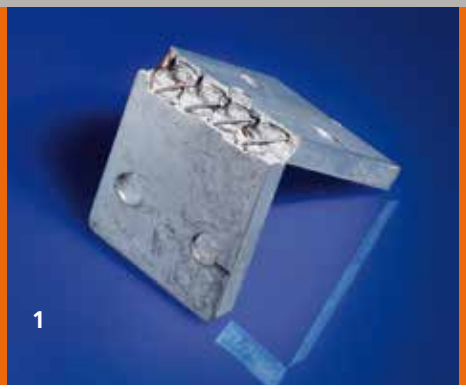

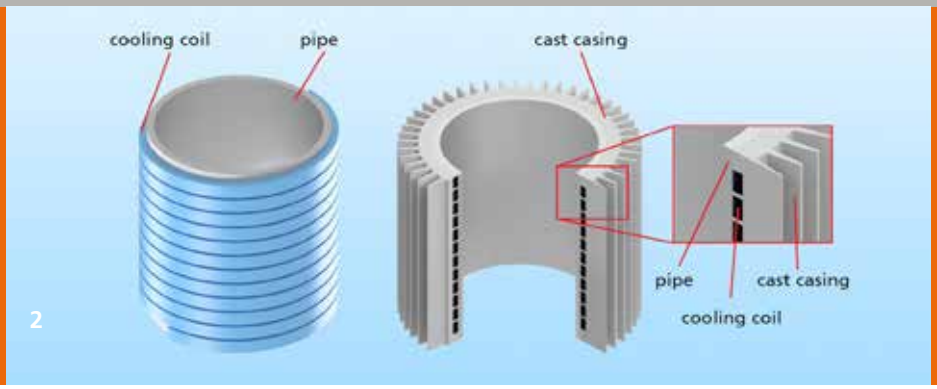

1 *A lightweight metal high-pressure matrix strengthened with a 3D wire structure.*
2 *Schematic of an e-motor housing with a cooling spiral with an aluminum profile and a surrounding geometry made from aluminum casting.*

METAL-TO-METAL COMPOUND CASTING FOR INNOVATIVE CAST COMPONENTS

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
– Shaping and Functional Materials –
Wiener Strasse 12
28359 Bremen | Germany

Institute Director
Prof. Dr.-Ing. habil. Matthias Busse

Contact

Casting Technology and Lightweight Construction

Dipl.-Ing. Jan Clausen
Phone +49 421 2246-273
casting@ifam.fraunhofer.de

Jonas Klei, M. Sc.
Phone +49 421 2246-7158
casting@ifam.fraunhofer.de

www.ifam.fraunhofer.de

Future-oriented material compound systems are increasingly coming into play in lightweight construction. Conventional metals retain hereby a very high importance in large series lightweight construction, and the motivation to find stress-resistant materials remains unchanged. Thus, with their individual properties, various metals can make a significant contribution to both lightweight construction and function integration.

Starting point

Components are usually fashioned from a single material due to the need for additional joining operations and to reduce the complexity. However, this means that the lightweight construction potential of the component often cannot be fully exploited. Conventional metal-to-metal joining concepts require a subsequent joining process through welding, gluing or mechanical joining. Due to such joints, the metal-to-metal compound casting concepts presented in the following are possible for various applications as they are directly integrated during the casting process of an aluminum component. This allows highly integrated and complex multi-material components to be realized with a reduction in the process steps.

Casting of profiles and plates

One approach enables the connection of an aluminum cast component with a metallic profile or plate structure directly during the manufacturing process of the casting. Hereby, the profile or plate structure made of, e.g., an aluminum wrought alloy or stainless steel, is placed in the casting die and partially covered by the die halves. The cavity in the die enables part of the profile or plate structure to become enclosed by the melt during the casting process. This creates a direct bond between the profile/plate

and the cast area. For the secure transfer of loads, form locking elements can be added to the profile or plate structure. This technological approach means that, above all, subsequent joining processes can be eliminated, which enables a time and cost saving to be achieved. Also, the combination with plate structures allows particularly thin-walled structures to be created within the components, which could not happen using the casting process alone due to the manufacturing technological restrictions.

Local strengthening of cast components

Through the use of wire or perforated plate structures in the cast components, certain mechanical properties can be locally improved, particularly for high-temperature strengths and the achievement of failsafe behavior. Also in this technology, pre-finished structures (preferably of stainless steel) are placed into the casting die and embedded during the casting process. The structure is hereby completely surrounded by the melt. The positioning in the die occurs either via core marks within the component or the strengthening structure is mounted outside the actual component. The advantage of this technology is the possibility to locally bring in structures that can improve the above-mentioned properties. So far, perforated plate structures have been found to be particularly suitable. Furthermore, it is possible to achieve a local strengthening that improves the failsafe behavior without the need for a thickening in the casting area.

Cooling channels and function integration

Furthermore, the technology can be used for the integration of various metallic semi-finished products with a focus on function integration in castings. Hereby, cost-effective standard materials such as an aluminum wrought alloy or stainless steel alloy can be used to, e.g., integrate cooling channels in components without the need for a core. In addition, the various material properties of semi-finished products and castings can be used to create a stress-resistant multi-metal composite directly during the casting of the component. Also, a reduction in demolding angles or material accumulations can be achieved with such compound casting approaches, which leads to an improvement in the casting quality as well as a reduction in the need for final processing. This enables a reduction of the costs through the decrease in both the machining and waste.

3 *Low-pressure casting die for the manufacture of small specimens for the characterization of a metal-to-metal compound casting.*

4 *Metallographic cross-section of a small sample for the characterization of metal-to-metal compound casting.*