June 23, 2016

New Inorganic Material for Molds Developed by Taiheiyo Cement for Additive Manufacturing Using 3D Printers

Taiheiyo Cement Corporation ("Taiheiyo Cement") is pleased to announce its successful development of a highly heat-resistant inorganic material for casting molds using a three-dimensional molding machine ("3D printer") which was achieved by the collaboration with the Industrial Research Institute of the Industrial Technology Research Department of the Hokkaido Research Organization ("the Hokkaido Research Organization Industrial Research Institute").

The Hokkaido Research Organization Industrial Research Institute has been studying a technology to manufacture casting molds using 3D printers, and has found that cementitious materials with heat resistance would be highly applicable to the technology. However, in metal casting with high molten metal temperatures exceeding 1200°C, some components of the material of a mold can form gases and cause blow holes (Photo 1), or, in case of spheroidal graphite cast irons, surface defects may result from inhibition of the formation of graphite nodules. Such problems need to be addressed before putting this technology into practical use.

Being aware of the importance of the three-dimensional molding as one of the frontier technologies with future potential, Taiheiyo Cement was willing to provide solutions to these problems through its own technological expertise in the design and manufacture of cement and other inorganic materials. With the knowledge about the properties and reactivity of inorganic materials applied, close investigation was made on the components and compositions from new perspectives. As a result, an innovative inorganic powder was developed successfully which could yield a desirable bending strength for 3D printer molding without causing any material-related problems. Test molds were manufactured using the inorganic powder with a 3D printer (Photo 2), and molten iron heated to about 1600°C was poured into the molds. The obtained castings had smooth surfaces, without any defects due to gases, demonstrating its high level of practical applicability (Photo 3). A report of these results will be presented jointly with the Hokkaido Research Organization Industrial Research Institute at a biannual nationwide meeting of the Japan Foundry Engineering Society to be held in Kochi City in September 2016.

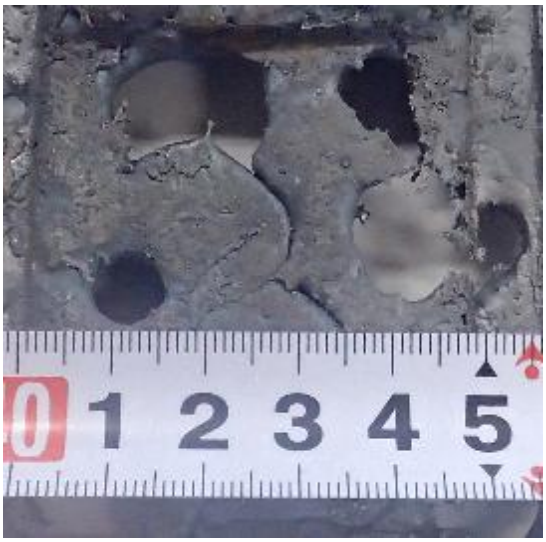
The combined technology of the inorganic powder and 3D printers will find a wide range of application including molds for high-temperature molten metals and various special molds with complicated shapes. Taiheiyo Cement continues to work with the Hokkaido Research Organization Industrial Research Institute for improvement and optimization of the performance of the inorganic powder, specifically through preparation and provision of samples of the material, pursuing the earliest possible launch of the product to the market.

Glossary

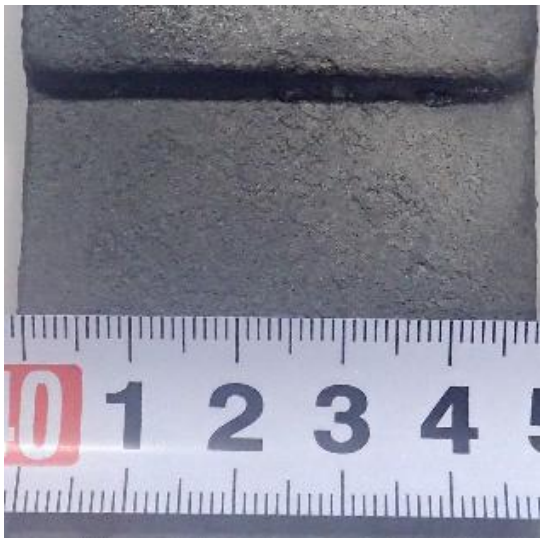
- Casting (process): a process of melting solid metal into liquid form at high temperatures, pouring it into a mold, and allowing it to cool and solidify, to obtain a product of the desired shape
- Casting (product): a metal product formed by the casting process
- Mold: a form made of a highly heat-resistant material for the use in the casting process
- Pouring: a process of transferring molten metal into a mold
- Cast iron: an alloy of iron with a carbon content greater than 2%
- Spheroidal graphite cast iron (ductile iron): a type of cast iron that contains round-shaped (nodular) graphite for enhanced strength and ductility

- Bending strength: one of the mechanical properties of a material which is a stress level determined by a bending test from the force of load where the specimen has broken or fractured

Photo 1

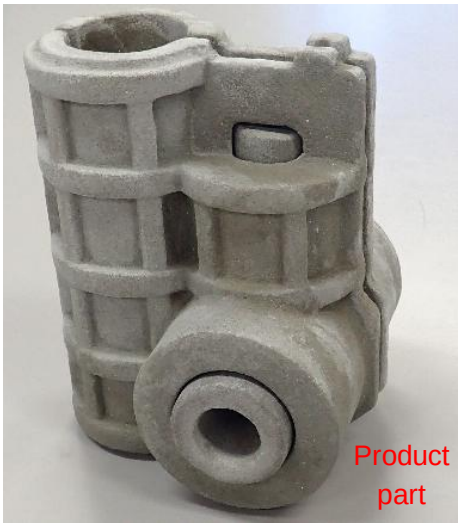


A casting with blow holes



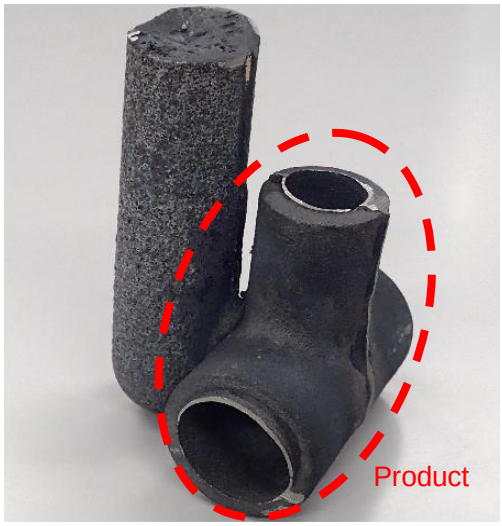
A casting without blow holes

Photo 2



A tee mold manufactured by using the new inorganic powder and a 3D printer.
Adequate strength and dimensional stability were ensured.

Photo 3



Appearance of a casting of iron poured at molten temperature of 1600°C.
Smooth surface was obtained.