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Lightweight Ceramic Foundry Tools Thrive on Contact with Molten Metal

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Glenn Connor, a blacksmith in Charleston, West Virginia, observed, "Tools don't make the blacksmith, the blacksmith makes the tools." While forging or fabricating metalworking tools by hand is an essential job at a smithy, it can be a wasteful and time consuming chore at foundries and die casting shops. Nevertheless, many metal casters regularly require their maintenance staff to fabricate a variety of hand tools for use in melting operations. These include slag and dross skimmers, scrapers, sampling spoons and stirrers, all cobbled together from scrap iron and steel. But there is a better way.

Foundry tools manufactured using advanced ceramic materials are available for a wide variety of melt shop tasks and offer important advantages over metal tools in almost every application. Unlike metal tools, ceramic tools for foundries and die casters are engineered to perform well in contact with molten metal. They are not melted nor deformed by high temperatures, they resist slag and dross buildup and they are light weight. Moreover, unlike metal tools that require frequent replacement, ceramic foundry tools provide a long service life. Also, when the real cost of producing and maintaining metal tools in-house is calculated, ceramic tools offer a lower overall cost.

A small ladle bowl is used to collect and pour a metal sample.

Among the most useful and versatile ceramic hand tools are ladle bowls. These are manufactured in sizes and shapes ranging from small bowls for taking molten metal samples to large bowls suitable for ladling metal into moulds. Because of their non-wetting characteristics, i.e., their ability to resist surface penetration by molten metal and slag, they remain free of dirt and contamination allowing for cleaner samples. In the case of larger bowls used for filling small moulds, they ensure cleaner metal pours. The thermal properties of the bowls' clay-graphite material also helps maintain the correct temperature for pouring accurate samples and moulds.

A large ladle bowl effectively removes slag from an induction furnace.

Ladle bowls also are available with a drain hole that makes them highly effective in removing slag and dross from the surface of the metal bath in a furnace or ladle. Unlike conventional metal slag skimmers, ladle bowls efficiently collect and remove slag and dross without requiring large amounts of coagulants. Because of their light weight for their capacity, ceramic ladle bowls are particularly better than metal skimmers where large quantities of material have to be removed over an extended period of time.
Other ceramic tools for working with molten metal include small dip samplers with integral handles, stirrers designed to produce more homogeneous alloys, plain and paddle-bladed rods and scrapers for removing slag and dross.

Ceramic tools and components are available in a wide range of shapes configured for many specialized purposes.

Using many of the same highly developed materials used for modern crucibles, today's advanced ceramic products for use with molten metal are characterized by exceptional resistance to erosion caused by metal and slag, high resistance to thermal shock and by the ability of their non-wetting surface to resist penetration by molten metal and slag. They also offer very high thermal conductivity. These special properties make advanced ceramic materials ideal for a broad range of foundry products used in molten metal production. In addition to the ladle bowls and other tools discussed above, they include ceramic launders, pyrometer and thermocouple protection sheaths, heater sheaths, tubes, porous degassing lances, plunger mixers, ladle stoppers, nozzles, needle valves, downspouts, filling funnels, converter segments and cements and

coatings.

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Pre-formed ceramic launders are available in varying shapes and sizes to precisely match specific requirements for transferring molten metal between furnaces and from furnaces to casting ladles. Ceramic launders offer reduced maintenance requirements and longer service life than refractory cast or lined launders.

Because of the material's high thermal conductivity, ceramic sheaths are widely used to protect pyrometers and thermocouples where accurate and responsive temperature measurement is required. Similarly, ceramic heater sheaths are used with electric resistance and gas-fired furnaces for the efficient transfer of heat to the metal in the furnace.
Ceramic tubes have numerous uses in the foundry including forming the teapot spout in ladles, cupola receiver entries and spouts and cupola slagging box siphons. They are also used for transferring metal from the furnace to the ladle or from ladle to mould.
Tubes with a threaded end for attachment to a gas supply adapter are used in aluminium degassing applications to pass nitrogen it the metal bath to eliminate dissolved hydrogen that would cause porosity in casting. A range of ceramic degassing lances incorporates a porous end for smaller bubble size and better distribution of the nitrogen or argon gas when used in continuous degassing applications.

Ceramic plunger mixers also are used in degassing and in metal treatment applications. They are used to plunge treatment tablets into brass or aluminium and for stirring in the reaction products in the production of ductile iron.

Ceramic ladle stoppers, needle valves and downspouts and refractory nozzles are manufactured to close tolerances for use in bottom pour and continuous casting applications. These products help ensure an effective, non-stick, seal and reseal process without leaks when closed. Other ceramic foundry products include filling funnels, used in dosing furnaces; ductile iron converter segments; thermally conductive and high performance cement; and zircon refractory coatings to protect refractory materials and metal tools against molten metal attack.

All molten metals present serious challenges to the materials used to melt, hold, process and transfer them. But modern ceramic materials provide an inherent ability to withstand the high temperatures associated with all molten metals. Together with their resistance to erosion and chemical attack, their high thermal conductivity, their physical strength and their ability to resist thermal shock, these materials are providing foundry operators and die casters with the tools they need to meet these challenges.