Zinc die castings: unlocking market potential

BY MARY HELEN YOUNT, INTERNATIONAL ZINC ASSOCIATION

The International Zinc Association is working to increase the market for zinc die casting alloys.

The Initiative Zinc/IZA display case, which shows the raw and finished Nespresso castings on the bottom shelf. The four winners of the 2018 Euroguss competition are on the top shelf

With nearly 60 per cent of all zinc consumed each year going towards protecting steel from corrosion, it is not a surprise that galvanised coatings dominate the discussion for zinc markets. Die castings, zinc's second-largest market, come in at a distant 15 per cent of annual consumption; however, the International Zinc Association (IZA) sees strong potential in the zinc die casting market, and has launched a campaign to bring it back into the global spotlight.

Die casting is a manufacturing process in which molten metal is injected at high pressure into steel molds. The molds – called dies – are specific to each individual project. Die casting can have significant advantages over other manufacturing processes, and it typically results in major cost savings. Casting enables the creation of complex net shapes, including external shapes, minimising secondary operations. The process also allows for multiple parts to be combined into one component, eliminating assembly operations and thus lowering labour costs. Aluminum, zinc and magnesium alloys are the most commonly used die casting alloys.

Reasons for choosing to die cast zinc over other metals include its strength, durability, cost-effectiveness and environmental integrity. The Ultimate tensile strengths (UTS) of zinc alloys surpass those of its common competitors, such as magnesium alloys, aluminum alloys and plastics. Zinc alloys have excellent heat and electrical conductivity, and due to its hardness and strength, it can withstand much higher impact energies than competitive casting metals. Additionally, zinc die casting generally requires less material and reduced assembly operations due to its high fluidity and ability to be cast in a single unit, thus significantly bringing down production costs. The process is sustainable and uses far less energy than a mass manufacturing process would, and any scrap produced along the way can be recycled. The low melting temperatures of zinc alloys allow for low cycle times, yielding a high production rate and a very long die life (typically up to one million shots).

Manufacturers can also depend on zinc die casting for accuracy and precision. The process delivers a precision accuracy of less than ± 0.1 per cent, and zinc alloys can be cast as thin as 0.5 millimetres. Perhaps the most appealing quality of zinc die cast products from a design standpoint is the high-quality, smooth surface rendered after casting, which allows for any type of finish that the user can think of. This characteristic, in combination with zinc's capabilities to be cast into essentially any shape, leave the user with virtually endless possibilities and creative liberties.

Designers of the KitchenAid Nespresso coffee-maker capitalised on these freedoms that zinc die casting permits. The machine itself feels rigid and durable, but weighs in at a sleek eight kilograms. The designers utilised zinc alloys for the majority of the machine's components, which weigh five kilograms, including the top cover and base. The product's creators ultimately chose to use die cast zinc because of the smooth surface quality achieved at the end of the process. This made it easy to finish, paint and customise the final product.

Besides the kitchen, you might also find zinc die casting alloys in your doctor's office. Medical technology is another prominent use for zinc die casting alloys, and this area will continue rising in importance due to longer life expectancies and the rise of home care for people around the world. Such products must be able to withstand daily sanitising detergents and cleaners, calling once again upon a need for a superior surface finish. According to IZA, 'The wide range of surfaces that can be achieved with die cast zinc means that a suitable solution can always be found, even in highly demanding environments'.

Accuracy and precision are other important factors for the creation of any type of medical equipment, and zinc fares favourably in these categories, as well. IZA notes, 'Zinc alloys are almost unbeatable for casting even complex filigree components without machining. There are very few processes with which parts can be produced this reliably and this accurately, often making mechanical machining unnecessary'. Common uses of zinc in the medical arena include blood-pressure monitors, inhalers and stethoscopes.

IZA is committed to building the market for zinc die casting through increasing awareness of zinc casting alloys at the designer, specifier and engineering levels. This entails developing and disseminating essential user property data, including mechanical and finish properties, and educating design and engineering students about zinc castings and their capabilities. The Association maintains a multi-language web-based collection of engineering properties, case studies, and design documents at www.diecasting.zinc.org. In addition, the Association hosts an annual design challenge among engineering and design students presently enrolled in a college or university. For details on this year's competition, visit www.interzinc.org. The winners of the design competition will be announced in June at IZA's biennial Zinc Die Casting Conference in North America. This year, the conference will take place in Chicago, Illinois, and will provide a platform for discussion, networking and learning centreed around the zinc die casting industry.

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The Association is also driving the development of new, improved technologies and alloys. Two promising new IZA-developed alloys have recently entered the zinc die casting arena and are expected to help the global market grow substantially in the coming years. The first is the high-fluidity alloy, which allows the manufacturer to cast even thinner walls (as small as 0.3 millimetres thick). This capability, in combination with zinc's natural protective properties against electromagnetic interference, will likely make it a positive impact on the automobile and electronic industries – or on a fusion of the two.

Martin van Leeuwen, IZA's Manager of Technology and Market Development, says that this is, and will be, important with more electronic features in cars and self-driving cars on the horizon. 'Zinc is already used for safety parts, such as steering locks and columns, in today's automobiles. The rise of electronic features in cars points to zinc as an ideal housing material to protect against outside interference. This will allow the technological components to do exactly what they are programmed to do correctly and safely,' van Leeuwen says.

The second important development for zinc die casting alloys has been improved creep resistance, particularly in applications with elevated temperatures. The origins of this arise from a US Department of Energy program managed by the North American Die Casting Association in 2000, for which the ILZRO (now IZA) was the principal investigator. The benefits of an optimised range of aluminum and copper was confirmed; several alloys have been commercialised in North America and Europe since then, of both dispersed hard particles. 'Improved creep resistance is ideal for housing, building, and hardware applications, such as door locks, hinges, and window closure systems where safety, precision, durability, and high surface quality are key features, and where zinc parts will maintain their dimensions while they are exposed to high external forces,' says Dr Frank Goodwin, IZA's Director of Technology and Market Development.