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ACuZinc

Improved Zinc Alloy for Die Casting Applications

The most significant advancement in the die casting process in many years has been the introduction of ACuZinc5 to the family of zinc alloys. Developed by co-inventors M. David Hanna and M. S. Rashid, Metallurgy Department, General Motors Corporation Research and Development Center, ACuZinc is a ternary zinc-copper-aluminum alloy. ACuZinc maintains the die casting characteristics of the traditional zinc alloys, but is much stronger, harder, and more creep and wear resistant. Its physical and mechanical properties makes it suitable for applications where the traditional zinc alloys were unacceptable and more costly materials and processes had to be employed.

Because of its superior mechanical and physical properties, components made of ACuZinc can be used for structural applications and those at elevated temperatures. This opens up new opportunities for the design engineer to evaluate zinc and the hot chamber die casting process for components typically made of powdered metal and brass, as well as steel stampings, machinings and fabrications.

ACuZinc is composed primarily of zinc, with a copper content of 5 to 6% and an aluminum content of 2.8 to 3.3%. The copper content is substantially higher than Zamak 3, Zamak 5 and ZA-8, while the aluminum content is lower. It should also be noted that the copper content of ACuZinc is controlled to a range of less than 1%, maintaining the properties for specific die casting processes. The ACuZinc-5 formulation used in hot chamber die casting contains about 5% copper, whereas the formulation of ACuZinc-10 for the cold chamber process contains about 10% copper.

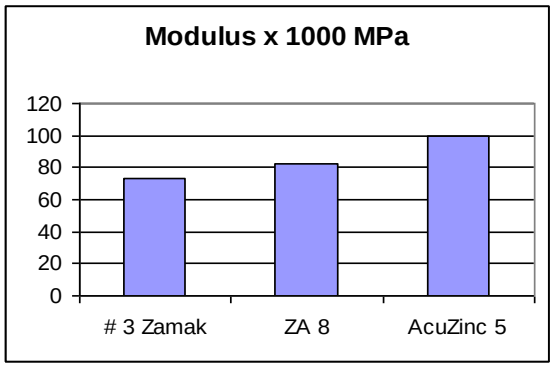
This controlled, high copper content gives ACuZinc its enhanced tensile strength. In high stress, high load applications, Zamak and ZA alloys will deform, or relax over time, resulting in less than normal yield strength. Both tensile strength and creep resistance can be further enhanced by incorporating design features such as uniform wall sections, and fillets and radii into components.

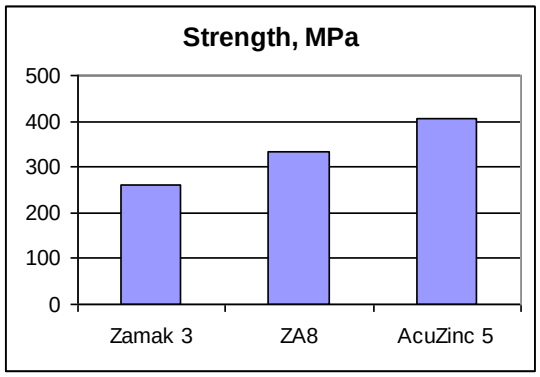
The Brinell hardness of ACuZinc at 118 makes it harder than other zinc alloys, as well as aluminum and magnesium. It can be considered a candidate for the replacement of brass as it is 25 points harder. ACuZinc's high copper content also makes its wear characteristics comparable to bearing bronzes, as well as 356 Al + 5% SiC and 339 Al which are regarded as high wear resistance materials. With a low friction coefficient of 0.06 against itself, ACuZinc can be considered for bearing applications and provides the potential of a low cost replacement for bearings and bushings.

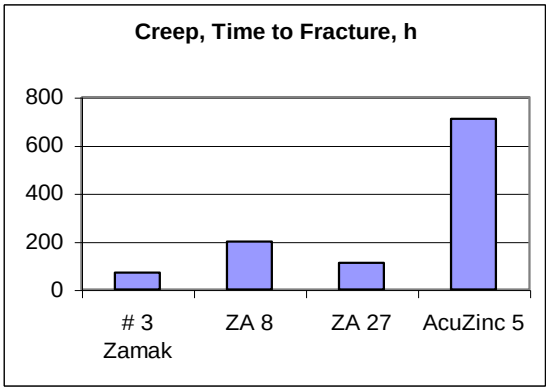
Superior Material Properties

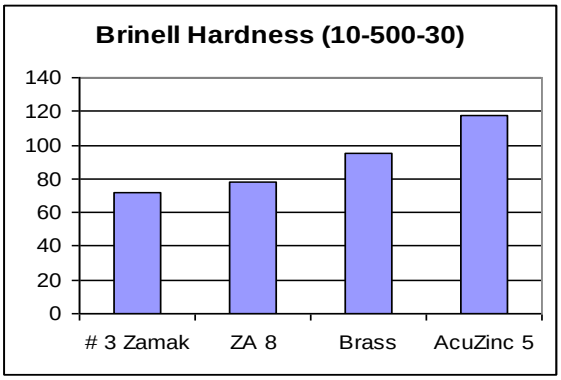
ACuZinc's superior properties include:

- Greater strength and hardness
- Better creep resistance
- Enhanced corrosion and damage resistance
- Higher service temperatures
- Improved bearing and wear characteristics
- Reduced porosity









Net-Shape Die Castings Through DFM

Because of its unique, patented formulation, ACuZinc extends zinc die casting into higher-performance, structural applications - without requiring modifications to current production machines.

With ACuZinc, parts can be made net shape to final dimensions at high production rates. This offers tremendous opportunities for the application of Design for Manufacturability (DFM) concepts and parts consolidation - which can result in substantial cost savings.

Using ACuZinc in concert with DFM techniques yields:

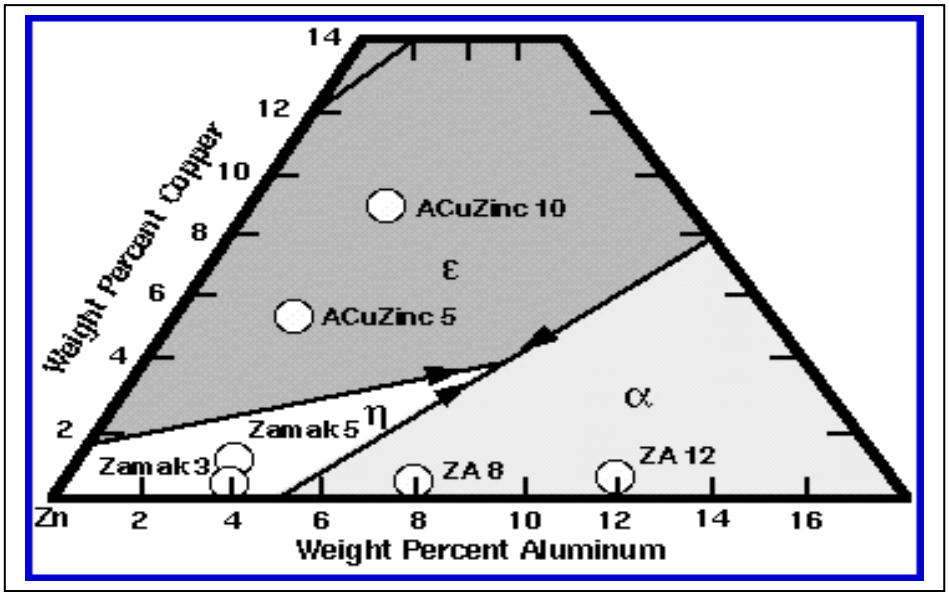
Manufacturing Advantages

- Higher production rates
- Close tolerance; complex details
- Thin-wall castability
- Dimensional reproducibility
- Parts consolidation
- Increased design flexibility
- Accepts standard finishes

Environmental Advantages

- Recyclable
- Less energy required to produce and recycle than iron or aluminum
- Minimal scrap

Zinc, Aluminum, Copper Phase Diagram



ACuZinc Applications

ACuZinc has been used by GM's Delphi Automotive Systems to make steering components, distributor terminals, and seat components. To date, use of the material has enabled GM to realize millions of dollars in material and production cost savings.

ACuZinc Processes

ACuZinc parts can be cast using the ACuZinc 5 alloy for the hot chamber die casting process or the ACuZinc 10 alloy for the cold chamber process. Both processes have been optimized to produce die castings with superior properties compared to other commercial zinc die casting alloys.

Access to ACuZinc

The GM specification number for ACuZinc, which is now commercially available, is GM3913M. ACuZinc can also now be licensed for use by other business ventures requiring low-cost, high-performance die castings.

Source:

GM Research and Development Center