Liquid Solid FAST

Photo: BMW

AMAG TopCast® FAST Innovative Cast Alloys for Chassis and Structure [1)]

Many years' experience in aluminium recycling for the production of cast and wrought aluminium alloys as a basis for sustainable material supply for use in chassis and structural parts.

For over 30 years, AMAG has proved to be a professional and reliable supplier of recycled cast alloys. AMAG has expanded its product portfolio and additionally offers aluminium cast alloys for chassis and structural components.

These components can be manufactured from primary and/or recycled aluminium and delivered in form of ingots or as liquid metal. Our team of technologists has the necessary expertise and extensive process know-how while customers benefit from liquid-metal delivery by saving metal losses, energy and logistics cost, and current assets. Additionally, short-term adjustments in customer requirements can be met by liquid aluminium, which increases productivity and reduces costs. AMAG provides appropriate technical and logistical services to its customers to ensure that they get only high-quality starting materials.

[1)] „FAST" is an acronym formed from the German words for chassis and structure, „FAhrwerk und STruktur"

In the early 1990s, our focus was already on producing high-quality aluminium alloys with a significant share of recycled material at the Ranshofen location. In recent years, we have scientifically investigated the potential of recycled cast alloys and demonstrated that, if the composition is carefully selected, these alloys are comparable to primary alloys both in ductility and heat resistance [1, 2, 3, 4, 5, 6].

On the basis of these results, we have proven that AMAG's recycled alloys can be used in chassis and structural components that must be crash-resistant. This group of alloys meets high standards for ductility, strength and formability and has been internally termed „AMAG TopCast® FAST" (alloys for chassis and structure).

In practice, we have learned that alloys for chassis and structural applications cannot always be made from scrap only, primarily because the narrow tolerance bands of most of these alloys correspond to those of primary alloys of the AlSi7Mg, AlSi11Mg, AlSi9MnMg and AlSi10MnMg groups. These groups have substantially larger carbon footprints because of the little amount of recycled material. The narrow tolerance limits specified by the customer (required limitations of the contents of iron and copper, and other trace elements) however do not always lead to the desired results, though, and sometimes may even be counterproductive. Jointly with our customers' experts, AMAG's developers have recently succeeded on several occasions in using recycled cast alloys and even achieving improved casting properties by specifically modifying the tolerance limits. On the basis of that productive collaboration, we can increase the current narrow tolerance limits for the trace elements, often even within given standards, since these narrow limits were not an issue to be considered because we had used purely primary alloys up to that time. To achieve the highest possible recycling rate, though, it essential to separate materials by type and carry out specific alloy-to-alloy recycling using a B2B solution (customer – AMAG). This is the only way to generate optimum value added and to be largely independent of the scrap market.

If the alloy composition cannot be adjusted for recycling, the task is to use primary metal produced in a resource-efficient manner. AMAG uses primary aluminium from the Canadian Alouette smelter, in which AMAG holds an interest, thus providing another ecological element. At the Alouette smelter, the electrolytic cells run on electricity generated by hydropower.

Consequently, AMAG can offer alloys for chassis and structural components that are produced with a high scrap portion and/or from primary material (using electricity generated by hydropower), which minimizes the carbon footprint of the material. This was a deciding factor for AMAG's qualification as a liquid-metal supplier for the production of chassis and structural components for the BMW i3 (Fig. 1).

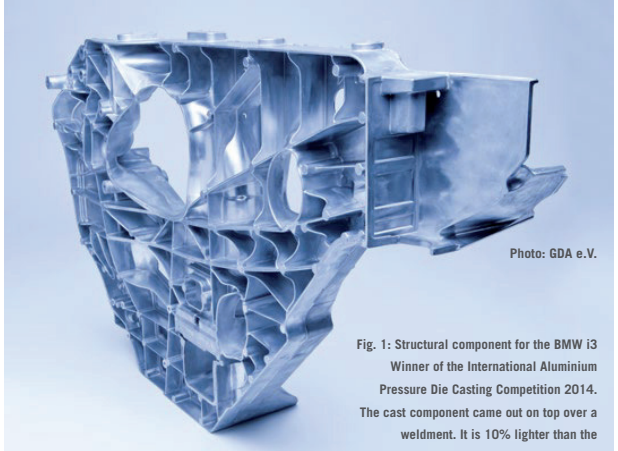

Photo: GDA e.V.

Fig. 1: Structural component for the BMW i3 Winner of the International Aluminium Pressure Die Casting Competition 2014. The cast component came out on top over a weldment. It is 10% lighter than the best weldment and costs 10% less.

AMAG TopCast® FAST in the BMW i3

AMAG was involved as early as in the development process for an adequate aluminium alloy to be used for the production of chassis and structural components at BMW's Landshut light-metal foundry.

The components had to meet structural and dynamic as well as sustainability requirements. The minimum content of recycled material in this alloy is 20%, and the remainder consists of alloying metals and primary metal produced using at least 97% electricity generated from hydropower.

As a result of that cooperation, a long-term agreement was signed for the supply of liquid aluminium as a raw material for the production of high-quality, sustainable structural components for this trend-setting electric vehicle. ■

Trend towards cast structural sheet

German automotive industry conferences held recently have shown a clear trend towards (die) cast structural components. Many papers, especially those presented by premium manufacturers, emphasize the advantages of such solutions [7, 8, 9, 10, 11, 12, 13].

The advantages of cast components are clear: A high level of functional integration, allowing several components of a group to be reduced into one single part, state-of-the-art die casting machines (up to 4500 t closing force) allowing you to produce components with unprecedented sizes and to design components in nearly any way, using inserts, slides and cores-all this creates vast potential for lightweight construction since the components are thin-walled yet extremely rigid because they can be stiffened by ribbing.

Alloys must also satisfy ever-increasing requirements, even when the parts are appropriately engineered and designed. AMAG has established its reputation among automotive manufacturers as a development partner for starting material through its alloy expertise and knowl edge of heat treatment processes.

In particular, it is of vital importance to have detailed knowledge of the interaction of various alloying elements for alloys with a large scrap portion [14, 15]. We have deepened that knowledge through several dissertations, cooperation with universities and industrial development partners, performing simulation and verification by practical tests. For example, it essential to know the dissolution and precipitation processes going on in alloys for chassis and structural applications during heat treatment and natural aging because such components are almost always heat-treated to maintain optimum alloy properties.

Due to external circumstances (reduction of distortion, parameters of downstream processes, energy-saving measures), it is not always possible to set optimum heat treatment parameters, and this is where AMAG's alloy expertise can help meet component requirements by taking material-related measures.

LITERATURE

[1] P. Pucher, H. Antrekowitsch, H. Böttcher, H. Kaufmann, P. J. Uggowitzer, "Influence of ompositional variations on microstructural evolution, mechanical properties and fluidity of the secondary foundry alloy AlSi9Cu3", International Journal of Cast Metals Research 23 (2010), S. 375 – 383.

[2] P. Pucher, H. Antrekowitsch, H. Böttcher, H. Kaufmann, P. J. Uggowitzer, „Einfluss der Legierungszusammensetzung auf die mechanischen Eigenschaften der Sekundärlegierung A226 (AlSi9Cu3) im wärmebehandelten Zustand", Gießereipraxis 11 (2009), S. 354 – 358.

[3] P. Pucher, H. Böttcher, H. Kaufmann, H. Antrekowitsch und P. J. Uggowitzer, „Einfluss der Legierungszusammensetzung auf die mechanischen Eigenschaften und das Fließvermögen der Sekundärlegierung A226 (AlSi9Cu3)", Gießereipraxis 3 (2009), S. 71 – 78.

[4] F. Stadler, H. Antrekowitsch, W. Fragner, H. Kaufmann, P. J. Uggowitzer, „The effect of Ni on the high-temperature strength of Al-Si cast alloys", Materials Science Forum, Materials Science Forum Vol. 690 (2011), pp 274-277.

[5] F. Stadler, H. Antrekowitsch, W. Fragner, H. Kaufmann, P. J. Uggowitzer, „The effect of main alloying elements on the strength of Al-Si cast alloys at elevated temperatures", International Journal of Cast Metals Research, eingereicht 2011-09.

[6] F. Stadler, H. Antrekowitsch, W. Fragner, H. Kaufmann, P. J. Uggowitzer, „Der Einfluss von Nickel auf die Warmfestigkeit von AlSi-Gusslegierungen", Gießerei, Vol. 98, 08/2011.

[7] J.-M. Ségaud, „Funktionsintegration bei gegossenen Fahrwerksteilen, Chancen und Grenzen", VDI-Spezialtag Gießen von Fahrwerks- und Karosseriekomponenten, 07. Februar 2013.

[8] P. Ragnarsson, „Aluminium Penetration in Cars", European Aluminium Congress, 25. – 26. November 2013.

[9] J.-M. Segaud, "Raising Competitiveness of Die-Cast Structure Components in Body Making", European Aluminium Congress, 25. – 26. November 2013.

[10] H. Eibisch, „Steigerung der Wettbewerbsfähigkeit von Druckgussbauteilen im Karosseriebau", VDI-Spezialtag Givon Fahrwerks- und Karosseriekomponenten, 07. Februar 2013.

[11] J. Bösselmann, "Body-in-White Lightweight Design at Mercedes-Benz; Effects on Material and Assembly Concepts of the new S-Class", European Aluminium Congress, 25. – 26. November 2013.

[12] D. Bösch, H.-W. Höppel, M. Göken, M. Hummel, P. J. Uggowitzer, „Sekundäraluminiumgusslegierungen für Strukturanwendungen in der Karosserie", Große Gießereitechnische Tagung 2012, Salzburg, 26-27. April 2012, Tagungsband, Seiten 52-53.

[13] D. Bösch, "Aluminum Alloys Based on Secondary Material for Die-Cast Applications in Car Bodies", European Aluminium Congress, 25. – 26. November 2013.

[14] W. Fragner, „Hochwertige Recyclinglegierungen für Struktur-Anwendungen im Automobil", Metall – Fachzeitschrift für Metallurgie, 12/2013, Seite 560.

[15] W. Fragner, „Hochwertige Recyclinglegierungen für Struktur und Fahrwerk", Gießerei, Ausgabe 100, 12/2013, 106-112.