EXPERT SUPPORT
IN OPTIMIZATION OF THE SHRINKAGE AND FEEDING BEHAVIOR OF THE ALLOY A226

The alloy AlSi9Cu3(Fe), also well known as A226, is a universal alloy for the production of various components and is a preferred choice due to its good casting characteristics. The wide tolerance limit of the alloying band according to the standard DIN EN AC-46000 allows low production costs. However, this can result in a wide range of the alloy property profile and thus lead to unidentified and unwanted variances in the manufacturing process. This was already reported in past editions of AluReport [1, 2, 3].

As in addition to the mechanical properties it is the casting characteristics of an alloy that are of particular importance for the foundry people, AMAG has lately concentrated specifically on the shrinkage and feeding behavior of this alloy in dependence on chemical composition. This is motivated inter alia by a desire to minimize rejects caused by porosity and shrinkage failures. Investigations have clearly shown the significant influence of the main alloying elements on the shrinkage and feeding behavior with additional interdependencies [4, 5, 6]. The obtained results thus relate exclusively to the tolerance band of AlSi9Cu3(Fe), allowing a direct reference to practical experience.

For the analysis, two different methods were used: First, a test specimen commonly known as "Tatur sample" in the foundry industry. Additionally, a test specimen which has the shape of an hourglass with rising casting was used to estimate feeding behavior. By using these two technological samples, conclusions can be drawn concerning the dependency of the shrinkage and feeding behavior on the chemical composition [7]. This was then incorporated in the mathematical model TCAD.

Results

The investigations have shown that the alloy A226, at different chemical compositions within its tolerance limits, exhibits very different shrinkage behaviors during solidification. Figure 1 shows a section of three investigated alloy variations within the tolerance limit of A226. Here a significant and measurable difference in the formation of sink marks, macro and micro shrinkage and feeding behavior can be clearly observed.

The experimental trials indicate that the silicon content has an essential influence on feeding behavior and the formation of volume deficits. Furthermore, the feeding behavior is particularly affected by the iron content due to the formation of high-melting phases. Depending on the chemical composition, the morphology of these phases is plate-shaped. This morphology can be changed by the addition of manganese and thus leads to a good feeding behavior even at higher iron contents. However, elements like copper and magnesium lead to the formation of microporosity.

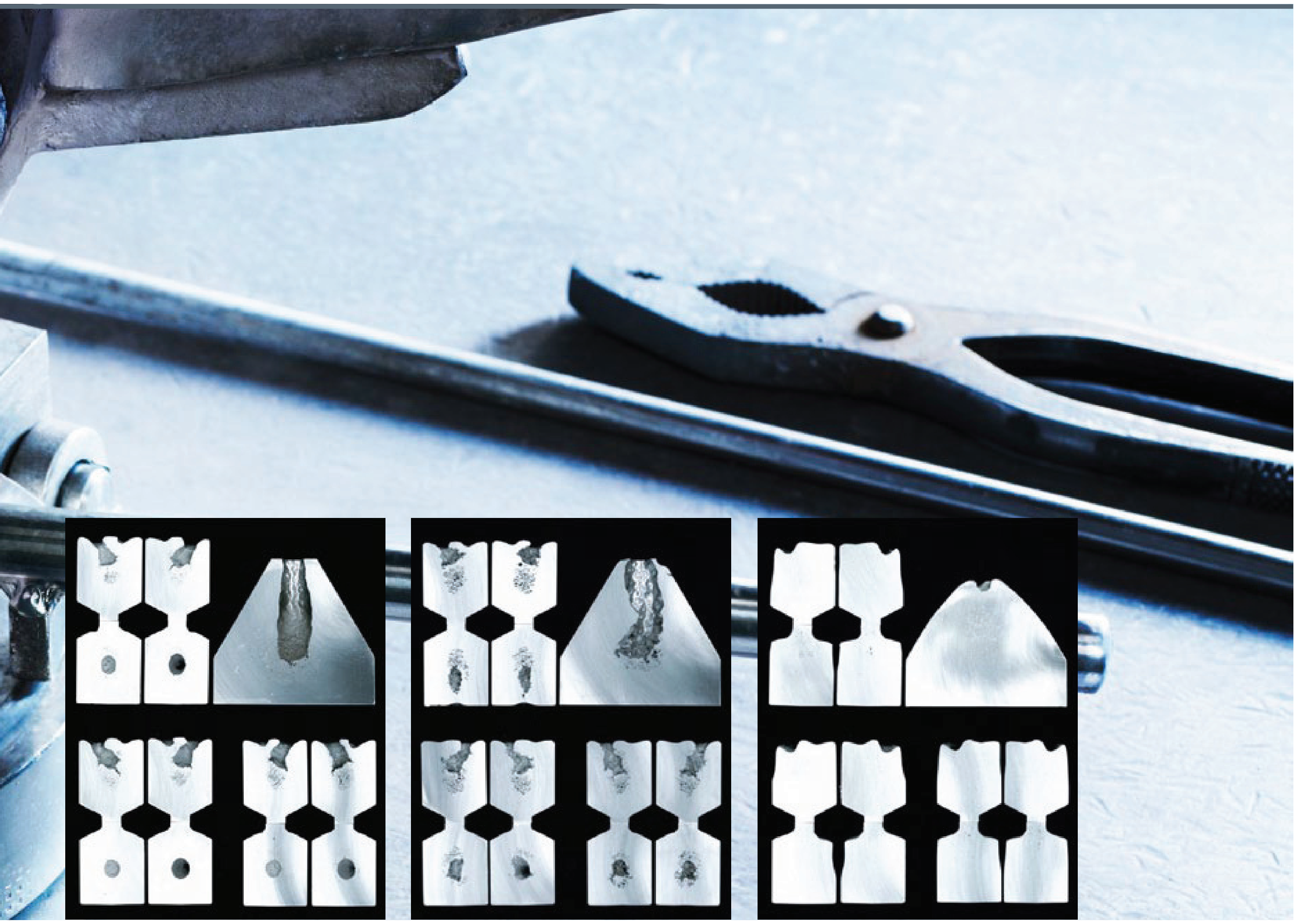

Figure 1: Comparison of the formation of volume deficits with Tatur and hourglass sample, depending on the alloy composition within the tolerance limits of A226

In addition to this qualitative conclusion, also a quantitative analysis of the influence of the chemical composition on the shrinkage and feeding behavior has been made. Based on the experimental results, regression formulas were therefore developed which were implemented in the software tool AMAG TopCast Alloy Designer (TCAD). The tool now allows a prediction of the property profile, not only regarding mechanical properties but, more importantly, also regarding casting properties, depending on alloy composition. Further reading has been published. [3, 6]

Customer benefits

Due to the wide tolerance limit of the standard AlSi9Cu3(Fe) A226, the mechanical and casting characteristics can vary quite significantly. Among other things, this means that problems with feeding and shrinkage behavior are not only dependent on process parameters but on alloy composition. Especially in existing, already approved and bound processes with fixed component geometries and gating systems the optimization of the casting process on the alloy side with the TCAD can lead to a better performance and furthermore to a competitive advantage. AMAG would be glad to demonstrate how we can support you in solving your practical problems and looks forward to your call.

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Literature:
[1] Alureport AMAG (1/2009), [2] Alureport AMAG (1/2010), [3] Alureport AMAG (2/2010), [4] 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. [5] 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. [6] P. Pucher, H. Antrekowitsch, H. Böttcher, H. Kaufmann, P. J. Uggowitzer: Computerunterstützte Vorhersage Mechanischer Kennwerte von A226. Giesserei 11 (2010), S. 42 – 49. [7] P. Pucher, H. Böttcher, J. Hübler, H. Kaufmann, H. Antrekowitsch and P. J. Uggowitzer: Einfluss der Legierungszusammensetzung auf das Speisungsverhalten der Recyclinglegierung A226 (AlSi9Cu3) im Sand- und Kokillenguss. Giesserei 7 (2011), S. 26 – 37.