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Development of an active tool insert to improve the properties of aluminum parts in low-pressure die casting

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Highly stressed aluminum components, such as wheels and chassis parts, are often manufactured using low-pressure die casting. This is partly because the process results in a particularly low-oxide and low-porosity microstructure and therefore high strength and elongation at break. However, the increasing complexity of components and the desire to save weight also leads to challenges in low-pressure die casting. For example, thin walls of structural parts or rims can lead to cold runs and/or shrinkage porosity and thus result in an increased scrap rate or insufficient mechanical properties. To counteract filling and feeding difficulties, component areas are therefore often provided with greater wall thicknesses or feeder paths. The disadvantage of this approach is that it leads to higher melting costs (and a larger CO2 footprint), more post-processing work and longer cycle times. To meet these challenges, voestalpine is developing an active tool insert that supports the filling locally and produces a finer-grained solidification. This is made possible by an innovative combination of electric current and magnetic field, whereby the flow and solidification of the molten aluminum can be specifically influenced. Here, we demonstrate the benefit of the active tool insert in gravity die casting for a thin-walled test component made of AlSi7Mg. The results show a significant improvement in die filling as well as improved mechanical properties (higher tensile strength and elongation at break). According to the results to date, the technology enables scrap-reduced production of aluminum castings with thinner wall thicknesses and better mechanical properties. This technology can therefore lead to a significant improvement in the competitiveness and sustainability of low-pressure die casting.

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