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Trends and developments in HPDC-tooling

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High-Pressure Die-Casting is the most important process in light-metal casting for mass production especially in the automotive sector. The process is well established for a wide range of components all over the vehicle from engine and drive train components over gear boxes and electronic housing to body in white components and subframes. Due to recent trends and legal restrictions the industry is currently undergoing a comprehensive transformation process. As the “classical” components and traditional mass products which have been used in ICE-vehicles will decrease within the next decade, new components will increase their market shares. There is clear trend towards large scale components with a high degree of functional integration such as battery housings or car underbodies.
These developments bring along huge challenges in HPDC-tooling. On the one hand the size of tool inserts become larger and larger leading to new concepts for hot working steel producers as well as for the tool makers and – last but not least – the producers of HPDC-machines. On the other hand, functional integration in HPDC-cast parts involves challenging components in which both thin-walled and thick-walled areas are combined, which have to be handled both in terms of filling and solidification technology. Modern toolmaking has to handle die inserts of large sizes produced from bulk material in combination with sub-inserts produced in additive manufacturing in order to realize effective cooling systems to avoid solidification defects or die soldering in the thick walled sections of the cast parts. PVD-coatings or structured surfaces are commonly in use to improve the flow length of the metal and reduce abrasive wear at the tool’s surface.
As thermo-mechanical fatigue is the most important factor when it comes to the question for the longevity of the HPDC-tool, steep temperature gradients at the surface have to be avoided. As in the past the thermal management of the tool during production was adjusted via (excessive) surface spraying with water sprays today this method is more and more replaced by micro spraying where only a thin release agent layer is applied onto the tool surface, which reduces tensile stresses and heat checking but presents tool designers with the challenge of ensuring adequate temperature control of die inserts during the design process. Innovative simulation techniques and sophisticated sensor technologies are therefore becoming increasingly important in process planning, tool design and during the process. In addition, digital approaches such as neural networks or machine learning are becoming increasingly important. The European die casting industry can only succeed in the increasingly difficult global market environment if all these challenges are successfully mastered and a high level of innovation is maintained.

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