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The effect of heat transfer coefficient and cooling schedule on porosity sizes of low-pressure die casting aluminium alloy wheels

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Abstract. Wheel is one of the most important parts of road vehicles sustaining all static and dynamic loads. Thus, wheel manufacturing must conform to rigorous quality requirements and safety standards. Shrinkage porosity plays a critical role in casting quality of aluminum alloy wheels since it dramatically reduces the mechanical properties of the wheels. The porosity formation results from the effect of solidification shrinkage. It is certain that the heat transfer coefficient (HTC) and the cooling schedule are two major parameters affecting the solidification of aluminum alloys. This paper presents the effect of HTC and cooling schedule on porosity sizes of A356 aluminium alloy wheels using the low-pressure die casting (LPDC) process. Numerical simulation is employed using ProCAST, a finite element solver. The shrinkage porosity field is employed to predict the porosity size and distribution. The HTC is increased at each 1,500 W/m^{2}K interval from 12,500 to 21,500 W/m^{2}K. The start time of the cooling system is initially operated at 140 seconds after the mould is completely filled with molten alloys, then it is gradually delayed up to 200 seconds. It shows that porosity sizes become smaller when the start time of the cooling system is retarded. The variation of HTC has more influence on porosity sizes for an earlier start time. Last, the start time of the cooling system has more influence on porosity sizes of A356 aluminum alloy wheels than the HTC.

Keywords: Shrinkage porosity/ Computational fluid dynamics/ Casting simulation/ Heat transfer coefficient/ Cooling schedule