Modeling and simulation of die casting process using OpenFOAM

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Montupet is an aluminum casting company which has long been recognized as an industry leader in the manufacture of complex cast aluminum components for the automobile industry worldwide. Montupet uses the gravity die casting process in which the molten metal is poured into a metallic mold cavity containing sand cores which enable the casting of parts with very complicated inner shapes. In fact, numerical tools have an important role on casting process optimization by improving the quality of products and by reducing the time and cost of process development.

The aim of this presentation turns around the use of OpenFOAM for modeling and simulating phenomena occurring during die casting process. Montupet has used OpenFOAM to develop its own customized numerical tool for simulating casting process since years ago. A multi-regions & multi-phase solver has been developed to simulate the physical & chemical phenomena occurring during the casting process. In addition, a model for sand core gas emission, occurring due to the thermal decomposition of organic binder which is in contact with hot molten metal, is developed in this study. The gas emission model has then been coupled to mold filling model containing the heat transfer phenomenon happening in the cast parts and the die. The developed tool was used to perform many simulations whose results are compared to experimental data. It is shown that the simulation results of die casting with sand core gas emission phenomenon are in good agreement with the experimental ones. Today, the developed tool can deal with the coupled multi-physics problems involving gas emissions in sand core, multiphase flow coupled with heat transfer in casting part and heat transfer in the die.

This presentation summarizes briefly the models and their implementation into OpenFOAM. Both simulation and experimental results, validating the models, are presented and perspectives for future developments are outlined.