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Thermophysical Properties of Fe30Mn4Al0.9C: A Coupled Computational-Experimental Approach

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Abstract

Due to their low density and high toughness, compared to traditional steels, high manganese austenitic steels are outstanding candidates across several industries like defense and automotive. Over the past few decades, modeling tools have found their way into foundries worldwide. Nonetheless, for these codes to provide trustworthy predictions, accurate input properties are required. For the composition studied (Fe30Mn4Al0.9C1Si0.5Mo), thermophysical properties are scarce in the literature. Hence, a coupled computational-experimental approach was used to determine the needed property data as function of temperature. Key properties like phase transitions, enthalpy, density, fraction solid, heat capacity (CP), latent heat, and viscosity were determined using a commercially available thermodynamics calculation package. These properties were first calculated for known systems (304SS and A356) and the calculated results were compared to results from literature. Thermophysical properties for the system of interest were then calculated. Validation for CP and liquidus and solidus temperatures was performed via differential scanning calorimetry (DSC). Mold filling and solidification simulations were performed and compared with actual castings.

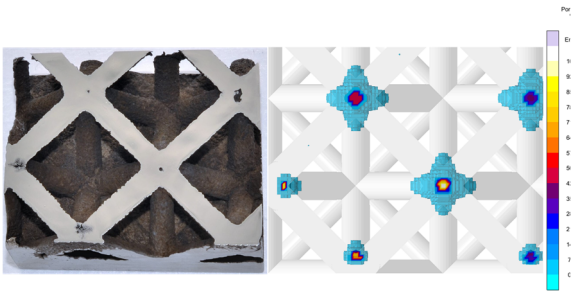

Figure 1 Comparison of porosity result with a section of the final casting. Location and severity were in good agreement.

Biography

Manuel Umanzor is a PhD candidate in the Materials Science and Engineering Program, he received his BS degree in Mechanical and Industrial Engineering from the National Autonomous University of Honduras in 2004. After graduation, he served the heavy equipment industry for 10 years, during this time he worked on product support, logistics and applications engineering. In 2014, Manuel decided to pursue a MSc degree in Mechanical and Nuclear Engineering, completing his program at Virginia Commonwealth University in 2016. During his journey through graduate school, Manuel has been involved in several research efforts: nuclear materials, powder metallurgy and metal casting. He is advised by Dr Alan Druschitz and is expected to graduate on Fall 2021. Manuel conducts his research at the Kroehling Advanced Materials Foundry, where he uses state-of-the art equipment to produce his complex castings, and he also employs computational tools to model, predict and improve performance of these structures. This work is currently under review for publication in the International Journal of Metalcasting.