STABILIZED FINITE ELEMENT SOLUTION TO HANDLE COMPLEX HEAT AND TURBULENT FLOWS IN INDUSTRIAL FURNACES

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ABSTRACT

The development of efficient methods to understand and simulate conjugate heat transfer for multicomponents systems is one of the most engineering challenges and still a need for industrials, especially in the case of the heat treatment of high-alloy steel by a continuously heating process inside industrial furnaces (see figure 1). The thermal history of the load and the temperature distribution in the furnace are critical for the final microstructure and the mechanical properties of the treated workpieces and can directly determined their final quality in terms of hardness, toughness and resistance. In this paper, a heat treatment furnace simulated using Computational Fluid Dynamics is presented. CFD simulation provides a useful tool to predict the temperature evolution in the furnace and within the walls and the support grid. The model consists of turbulent flow, thermal radiation and conjugate heat transfer. A 3D stabilized finite element methods is developed and used to solve the conjugate heat problem. An immersed volume method (IVM) is applied to heat and treat the fluid-solid interactions. Temperature measurements were carried in different location and are compared to the experimental results.

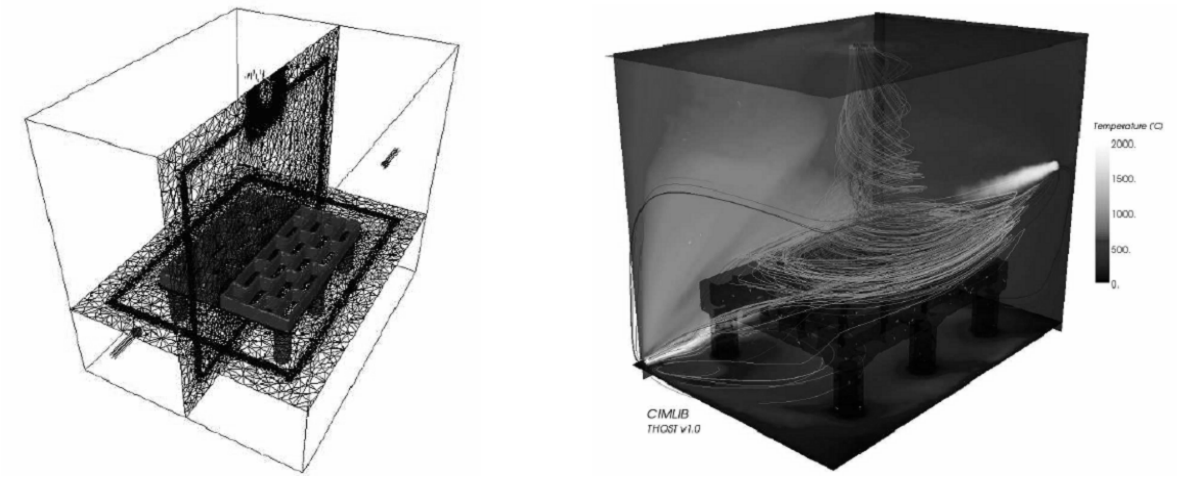

Figure 1: The final mesh (left), streamlines and isotherms inside a $1m^3$ furnace (right)

References

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