

# Thermal and fluid flow modeling of the molten pool behavior during TIG welding by stream vorticity method

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**Abstract:** The present paper deals with the numerical simulation of weld pool development in Tungsten Inert Gas (TIG) process. A mathematical model is developed in order to solve the Navier–Stokes equations expressed in the stream–vorticity formulation coupled with heat equation taking into account the liquid solid phase change. Using the stream–vorticity formulation in incompressible fluid flow, the same problem is solved with reducing the number of transport equations. Therefore, only one transport equation (vorticity) and one Poisson equation (stream) are considered in this model. The FORTRAN programming and the numerical simulation are then achieved using appropriate discretization that ensures the convergence of the numerical methods to solve a large and sparse linear algebraic systems. Furthermore, to solve the radiation phenomena during welding described by the Stefan law, another method is proposed. The obtained numerical results are discussed and validated with experimental.

**Keywords :** Thermal and fluid modeling, TIG welding, Stream vorticity, 304L steel, Numerical simulation