

DIFFUSION PHENOMENA OF A COLD GAS IN A THERMAL PLASMA STREAM

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ABSTRACT

The present study involves both experimental investigation and mathematical modeling of the diffusion process of a cold gas injected into a main plasma stream. The cold gas (nitrogen or helium) was injected axially through a water cooled tube located along the centerline of an induction plasma torch. The 2-D distribution of the temperature, velocity and concentration profiles in the plasma flow were measured using enthalpy probe techniques. The results are compared with the predictions of a 2-D, LTE, turbulent mathematical model. The effects of the nature (composition) of the injected gas and its mass flow rate, and the energy density of the plasma, are investigated. The enthalpy probe measurements and the predictions of the model are in good agreement. The effective (turbulent and molecular) transport properties are estimated from a comparison of the measured and calculated profiles of the temperature, velocity and concentration fields. This study sheds light on the basic diffusion mechanisms involved in a widely used configuration of induction plasma reactors, i.e. in which the material to be treated is injected axially into the plasma, through a central water cooled tube.