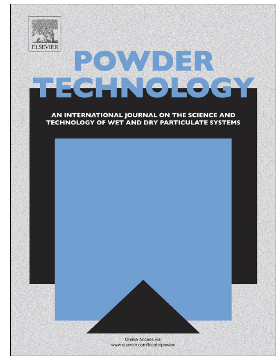

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CHARACTERIZATION OF THE INTERACTING GAS-PARTICLE DYNAMIC SYSTEM IN COLD SPRAY NOZZLES IN DIMENSIONAL AND NON-DIMENSIONAL FORM

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ABSTRACT

In order to study fundamental particle and gas dynamic behavior in the cold spray process, a simplified model was created assuming all dependent process parameters to vary in the streamwise x-coordinate only. This model resulted in a coupled system of ordinary differential equations describing gas and particle interactions in terms of basic conservation principles for mass, momentum and energy within a converging-diverging nozzle. The system of ordinary differential equations along with a prescribed set of initial conditions for all dependent variables at x=0, forms an initial value problem which was integrated in the x-direction using a 4th order Runge-Kutta method to determine the velocity and temperature of the gas and particle phases. The numerical solutions from the model were then validated by comparison with steady, axisymmetric, two-dimensional computational models incorporating the relevant PDE's using the CFD software. To obtain additional insight into the dynamic and thermal behavior of the coupled system, applicable scales were chosen to cast the simplified dimensional governing equations in non-dimensional form. One of the significant results of this simplified one-dimensional study is the parameterization that falls out naturally from the scaled equations, thus conferring a more general means to characterize (in non-dimensional terms) the relative gas-particle momentum and energy exchange in higher dimensional problems. From the scaled results it was also discovered that there is no advantage in using lighter, more expensive carrier gases such as helium to accelerate larger, heavier particles, and thus considerable cost savings can result through the use of compressed air.