A Look At Lick Back Beyond Pour Tube Tip Erosion

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Abstract

The phenomenon of "lick back," or "wetting up" the atomization pour tube tip and, perhaps, reaching the nozzle itself, is costly because it can adversely affect the powder size distribution and cause damage to the atomization nozzle and other atomizer components. To overcome this problematic condition, interference with nozzle exit gas flow can be incorporated, but this can degrade the gas flow energy available for disintegration. Atomization nozzle bench testing was done to develop subtle pour tube tip modifications to suppress lick back conditions with minimal gas flow disruption. Matched and varying interference conditions were investigated both on the test bench and in a research scale close-coupled gas atomizer to find a balance between retained gas stream energy (atomization efficiency) and pour tube and nozzle tip life extension. Schlieren imaging was used for direct observation of gas flow wake patterns.

Introduction

The Ames Laboratory operates two close-coupled high pressure gas atomization systems. These atomizers are designed to produce both fine and coarse spherical metal powders (in the range of 5μ to 500μ diameter) of a wide array of different metals and alloys. [1] Generally the experimental scale atomizer can produce up to 5 kg of powder whereas the pilot scale system can produce up to 25 kg depending on the charge composition and density. These atomizers employ the technique of close coupled gas atomization, where the stream of molten liquid metal is interrupted by a gas stream immediately upon exiting the melt containment crucible and pour nozzle. Figure 1 illustrates the basic atomization system and its components, including the close coupled gas nozzle. Figure 2 contains photographs of each of the atomizers. Each atomization system is contained in a stainless steel vacuum chamber. The metal charge is melted in a crucible by an induction heater. The crucible may be made of alumina (Al_2O_3), zirconia (ZrO_2), steel, or graphite. The crucible has a hole in the bottom through which a pour tube is inserted to drain the melt when the stopper rod is lifted. This pour tube guides the molten metal through the atomization gas nozzle where the stream is broken up into droplets by high pressure gas in a close-coupled fashion.