Use of computational modelling for investigation the Effect of melt delivery nozzle tip length on gas flow separation in supersonic gas atomization

Shahed Motaman *, Andy Mullis, Duncon Borman, Bob Cochrane
Institute of Materials Reserch (IMR), University of Leeds, United kingdom,
pmsmo@leeds.ac.edu and a.m.mullis@leeds.ac.uk

Abstract

In this paper, the effect of different melt delivery nozzle tip length on gas flow separation for annular-slit gas atomization, in gas-only flow, was numerically simulated by solving the compressible Navier-Stokes equations. Gas flow separation in the vicinity of the melt delivery nozzle during operation of the supersonic gas atomizer causes a back-flow of melt from the melt delivery nozzle tip along its outer surface, leading to very poor atomization performance and finally will result in aborting of the run. The melt delivery nozzle tip length plays a crucial role in preventing this problem during operation. Four different melt delivery nozzles with the tip length of, 10, 8, 7 and 3mm were numerically modeled in the confined-feed annular slit geometry with gas pressures of 0.5, 1, 1.5, 2, 2.5,3 and 4MPa. The results indicate that the nozzles with 8 and 10mm melt tip length are very sensitive to flow separation even in at a low gas pressure of 1MPa. With increasing atomization gas pressure the flow separation moved forward to the melt nozzle tip and at the gas pressures of 3MPa and above, flow separation was completely suppressed. In addition, no flow separation was seen on the two other melt nozzles at any gas pressure. These results specify that the flow separation occurrence is a function of melt delivery nozzle tip length and atomization gas pressure.

* Corresponding author: pmsmo@leeds.ac.uk