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Metal Powder Handling In Additive Manufacturing Application

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Extended Abstract

Although additive manufacturing (AM) has been used as a material-processing method for more than 20 years, it has only recently been considered an important commercial manufacturing technology. The AM process can involve various materials such as metals, ceramics, or composites. However, metal products are most widely used in industrial applications. Metal-based AM processes typically operate on a powder bed, meaning that they use a deposition method to spreads a powder layer on a substrate plate via a coating mechanism. A significant portion of the operating costs of commercial metal AM equipment is due to the metal powders used in the additive manufacturing process [1-2]. Therefore a few AM-equipment manufacturers have developed recycling systems to recycle the extra overflow metal powder or the unused powder. However, in all of these recycle system for AM equipment, the powder is transported from one subsystem to another. For this, fine powders have been conveyed long distances in the recycle process by pneumatic flow. This technology (pneumatic conveying) is widely used in the industrial field and has the advantages of high safety, low operation cost, simple installation and low maintenance cost. Hence, for conveying metal powders for additive manufacturing processes, pneumatic conveying is more efficient than other types of conveying, with less impact on powder quality. In this application, when a mixture of gas and powders flow into the pipe bend, a double-vortex-flow structure is generated in the gas phase, and a significant phase separation in the particle phase is caused by the centrifugal force within the curved geometry [3]. However, there are only few studies on the two-phase flow characteristics of high-density metal powders in elbow pipes. Therefore, in this study, a numerical study is conducted on the dynamics of conveying flow with IN718 metal powder under the pneumatic conveying process. Corresponding experimental verification is also carried out to verify the simulation results of metal powder flow. The results are demonstrated that the numerical simulations and experimental observations are generally in good agreement. This framework will potentially aid in investigating recycling processes for AM applications under large metal-powder loadings.

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