

Overspray Characteristics and Droplet Density Distribution of Low Pressure Shear Coaxial Injector

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Abstract

An HVLP (high-velocity-low-pressure) injector configured with a liquid-center and gas-outer nozzle can be extensively used in many industries, including automobile refinishing, wood furniture finishing and so on. The main problem of spray painting is overspray. Overspray produces much VOC (volatile organic compounds) which can cause bronchitis in an operator and waste paint or coating fluids. So, the aim of the present work is to reduce overspray and increase transfer efficiency. An HVLP injector with a gas post of 2-stages are designed and built to conduct spray characteristics as well as to increase transfer efficiency. This efficiency is critical to the spraying and coating from both a cost and an environmental regulatory standpoint. Droplet diameters are measured by laser diffraction methods considering the ratio of refractive indices inside and outside of the liquid sphere.

Experimental studies have been carried out to use the HVLP injector under various momentum ratios and Weber numbers. A higher momentum ratio and Weber number can achieve better atomization characteristics, but it can cause the super-pulsating phenomena which offers bad performance to painting process with film thickness. The experiment results show that the main effect of liquid jet break-up is governed with gas jets of the inner-stage. Additionally, gas jets of the outer-stage also contribute atomization at the far-field spray region and droplet transportation to the object. As gas jets increase, droplet mean diameters decreased and transfer efficiency increased due to the outer gas post which makes an air-curtain near the spray jets so that impinged droplet cannot overspray to the outer region of the spray jets. However, atomized droplets are dropped down to the bottom region due to the gravitational force. As expected, there is a strong dependence of outer gas injection to reduce overspray to the far field. So, the transfer efficiency increases with the effect of the air-curtain.

Keywords: Overspray, HVLP, SMD, Impinging, Transfer efficiency

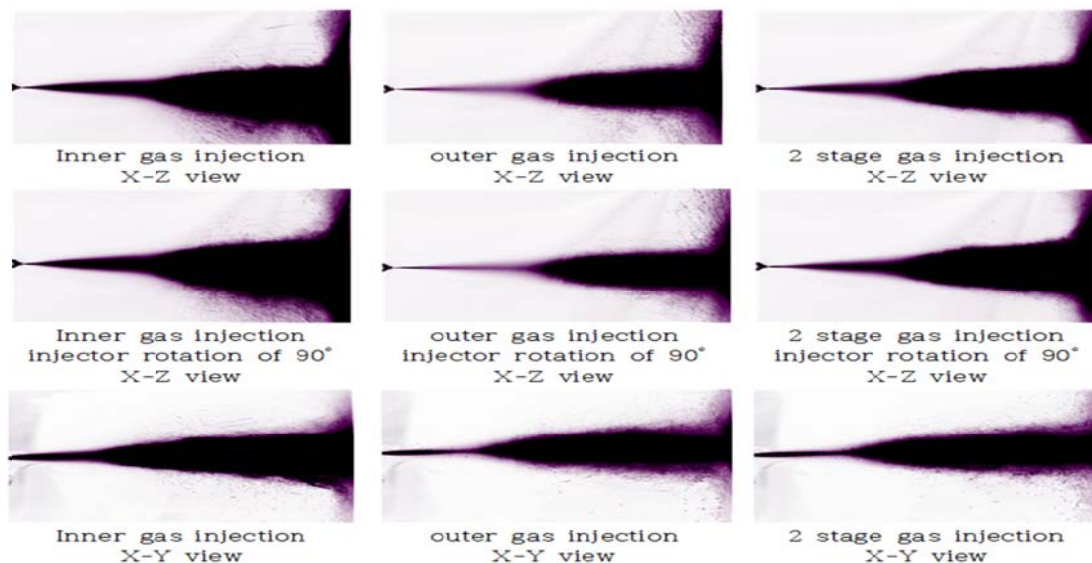


Figure Cross-sectional spray images of inner-stage, outer-stage and 2-stage gas injection