Penetration and Breakup of Liquid Jet in Transverse Free Air Jet with Application in Suspension-Solution Thermal Sprays

Mehdi Jadidi, Sara Moghtadernejad, Ali Dolatabadi

PII: S0264-1275(16)31052-8
DOI: doi: 10.1016/j.matdes.2016.07.145
Reference: JMADE 2149

To appear in:

Received date: 24 March 2016
Revised date: 26 July 2016
Accepted date: 29 July 2016

Please cite this article as: Mehdi Jadidi, Sara Moghtadernejad, Ali Dolatabadi, Penetration and Breakup of Liquid Jet in Transverse Free Air Jet with Application in Suspension-Solution Thermal Sprays, (2016), doi: 10.1016/j.matdes.2016.07.145

Penetration and Breakup of Liquid Jet in Transverse Free Air Jet with Application in Suspension-Solution Thermal Sprays

Mehdi Jadidi[a], Sara Moghtadernejad[b], Ali Dolatabadi[c]

Department of Mechanical and Industrial Engineering, Concordia University, Montreal, Canada.

[a]email: m_jadi@encs.concordia.ca, [b]email: sa_mogh@encs.concordia.ca, [c]email: ali.dolatabadi@concordia.ca

Abstract

The penetration and breakup of water jets in transverse free air jets are experimentally studied at room conditions. After coming out of an orifice and forming a cylindrical jet, water interacts with a free air jet and disintegrates. In the current work, the effects of the instabilities of cylindrical liquid jets, the distance between the liquid orifice and gas nozzle, and the ratio of liquid orifice diameter to the gas nozzle diameter, on the breakup mechanisms and liquid structure are investigated. Moreover, general correlations for spray trajectory and location of the liquid column breakup point are developed. Experimental results indicate that the breakup mechanisms are mainly controlled by the gaseous and liquid Weber numbers. Like other studies, four breakup regimes, namely capillary, bag, multimode, and shear breakup are observed. It is found that, due to the presence of instabilities on the cylindrical liquid jet, large ligaments are formed close to the interaction point of liquid and gas flows. Furthermore, results indicate that the location of liquid column breakup point are mainly dependent on the momentum flux ratio, and perturbations on the liquid jet. This fundamental study is essential to investigate the spray structure of a suspension-solution jet in plasma spray.