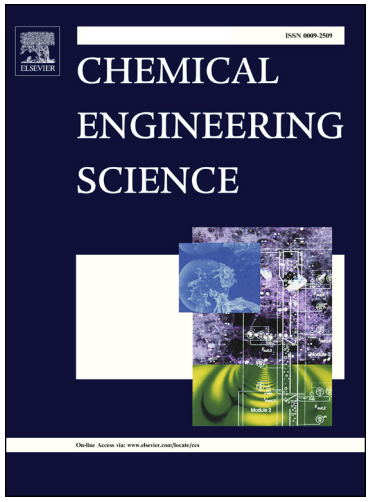

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PII: S0009-2509(17)30133-1
DOI: http://dx.doi.org/10.1016/j.ces.2017.02.024
Reference: CES 13442

To appear in: *Chemical Engineering Science*

Please cite this article as: A. Rajabi, M.R. Morad, N. Rahbari, Stability and breakup of liquid jets: effect of slight gaseous crossflows and electric fields, *Chemical Engineering Science* (2017), doi: http://dx.doi.org/10.1016/j.ces.2017.02.024

Stability and breakup of liquid jets: effect of slight gaseous crossflows and electric fields

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Abstract

Instability and breakup of a liquid jet under the influence of a gaseous crossflow in the presence of an electric field is investigated. A dispersion relation for disturbances on the jet surface is derived for the combined effects based on pioneer linear stability analysis for low speed limits. Effects of Weber, Bond and Ohnesorge numbers on the growth rate of disturbances are studied. The theoretical analysis developed for breakup length is used for comparisons with experimentally obtained breakup lengths. Measured breakup lengths were predicted satisfactorily by the linear theory in the region of low crossflow velocities (0-4 m/sec) and electric field intensities (0-3×10^5 V/m).

Keywords: Liquid jet, Breakup length, Gaseous crossflow, Electric field

1. Introduction

Liquid jets appear in many natural and industrial phenomena (Eggers and Villermaux (2008)). Free surface liquid streams tend to obtain a circular cross section in order to minimize the surface energy, while disturbances grow on the round liquid jet and eventually break it up into droplets. Liquid jet behavior is influenced by surronding forces such as aerodynamic force of a flowing gas, either parallel or normal to the jet axis. When a liquid jet