

Accepted Manuscript

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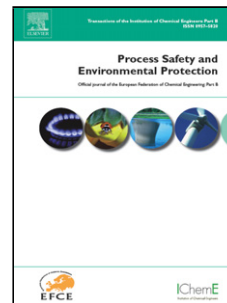
PII: S0957-5820(18)30023-5
DOI: <https://doi.org/10.1016/j.psep.2018.01.020>
Reference: PSEP 1285

To appear in: *Process Safety and Environment Protection*

Received date: 24-9-2017
Revised date: 29-12-2017
Accepted date: 28-1-2018

Please cite this article as: Tan, Wei, Li, Chaojie, Wang, Kang, Zhu, Guorui, Wang, Yang, Liu, Liyan, Dispersion of Carbon Dioxide Plume in Street Canyons. *Process Safety and Environment Protection* <https://doi.org/10.1016/j.psep.2018.01.020>

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Dispersion of Carbon Dioxide Plume in Street Canyons

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Highlights

- The wind tunnel experiment and the Computational Fluid Dynamics method were applied in studying the transport and dispersion of carbon dioxide plume in a long street with an intersection.
- The numerical simulated results using the SST $k-\omega$ model agreed well with the experimental data.
- The flow field in street canyons was characterized by the lee eddy drawn into the canyon of low pressure.
- The entire releasing and dispersing process can be divided into two stages in street canyons in accordance with the force condition.

Abstract

When road tankers or pipelines fail in a city, the released gas generates cloud in street canyons. The toxic heavy gas cloud pollutes the environment and harms the living being's life. The concentration distribution and trail of the cloud are very important parameters for the emergency response. The wind tunnel experiment and the Computational Fluid Dynamics (CFD) method were applied in studying the transport and dispersion of carbon dioxide (CO₂) plume, which was a typical type of heavy gas, in a long street with an intersection. The numerical simulated results using the SST $k-\omega$ model were in acceptable agreement with the experimental data. The stationary pre-release flow field in street canyons was characterized by the lee eddy generated on the sharp edges of the building top and sides. In this work, the entire releasing and dispersing process of CO₂ can be divided into two stages or two regions. The motion of CO₂ cloud was primarily determined by the jet speed and slightly affected by wind in near-source region. The next stage began with the collapse of CO₂ cloud. The gravity and wind together influenced the concentration distribution of CO₂. Both leakage rate and wind speed had significant impacts on CO₂ distribution pattern within an urban street canyon.

Keywords: Street canyon; Wind tunnel; CFD; Dispersion; Carbon dioxide; SST $k-\omega$ mode

1. Introduction

With the accelerated industrialization and urbanization, chemical plant and gas storage have been part of the cities, which can cause accidental release of hazardous gases from road tankers or pipelines in urban areas (Pontiggia et al., 2011; Hanna et al., 2009; Pontiggia et al.,

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