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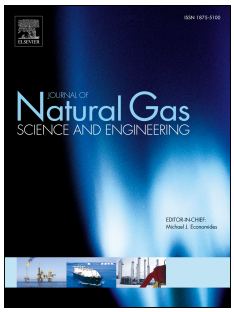

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Correlations for Estimating Natural Gas Leakage from Above-ground and Buried Urban Distribution Pipelines

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Abstract

A numerical method is developed to investigate leakage in above-ground and buried urban distribution natural gas pipelines. The main aim is to develop a few equations to estimate leakage form above-ground and buried urban natural gas pipelines. The equations are developed by considering the impact of various parameters such as the pipeline and hole diameters. A computational model for steady, compressible turbulent flow is built to model leakage. The natural gas as working fluid is treated as an ideal gas and soil considered as a porous zone. The results indicate that for holes with small diameters, discharge speed reaches to the sound speed and at the so-called, choking occurs in the flow. Also based on the result, the volumetric flow rate of leaked gas have a linear relation, second order relation and fourth order relation with pressure of initial point, diameter of hole and ratio of the hole diameter to the pipe diameter, respectively. In the case of buried pipes, permeation depth of gas into soil at the small diameter holes is more than large holes but volumetric rate of leaked gas is lower. Also after permeation of natural gas into the soil, and hitting the soil particles and the air moving through soil, a pair of vortex is created inside the soil. Finally two new correlations have been proposed to calculate the natural gas leakage from a small hole located on the lateral surface of the above-ground and buried distribution gas pipelines. Results show that, the percentage of relative error between simulation results and correlation values is below 5% which implies high accuracy of the presented correlations.

Keywords

Natural gas distribution pipelines, Leakage hole, Amount of leakage, Buried pipe, Numerical simulation.

1. introduction

Pipelines are the common and comfortable method of transporting and distributing fuels and dangerous gases such as natural gas (NG) [1]. Pipelines are often subjected to various damages such as third party activities, corrosion, mechanical or material failure and natural