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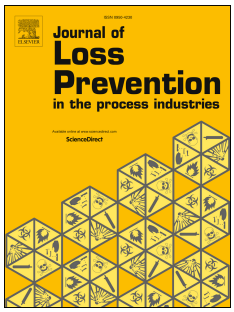

Effect of size on methane-air mixture explosions and explosion suppression in spherical vessels connected with pipes

Kai Zhang, Zhirong Wang, Chen Yan, Yiqing Cui, Zhan Dou, Juncheng Jiang

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Effect of size on methane-air mixture explosions and explosion suppression in spherical vessels connected with pipes

Kai Zhang, Zhirong Wang*, Chen Yan, Yiqing Cui, Zhan Dou, Juncheng Jiang

Jiangsu Key Laboratory of Hazardous Chemicals Safety and Control, College of Safety Science and Engineering, Nanjing Tech University, Nanjing 210009, China

ABSTRACT: An experimental apparatus was set up to demonstrate the effect of size on methane-air mixture explosions in spherical vessels connected with pipes. Two spherical vessels and pipes were used to constitute different-sized linked vessels. In this paper, gas explosions and explosion suppression were studied. Under the condition of the vessel size being changed and the pipe length not being changed, the maximum explosion pressure is almost constant, while the maximum explosion pressure rising rate decreases with increasing vessel diameter. A larger vessel with a longer pipe will lead to a safer explosion environment. When a large spherical vessel is connected, there exists a certain length to keep the pipe terminus safer. However, for a small spherical vessel, the pipe terminus becomes more dangerous with increasing pipe length. When wire-mesh is added between the pipe and spherical vessel, the maximum explosion rising rate in a small vessel decreases much more than without wire-mesh. However, for a large vessel, the change of the maximum explosion rising rate is not clear. Generally speaking, wire-mesh has a positive effect on explosion suppression in a vessel; however, in a pipe terminus, it has only a positive influence when a small spherical vessel is connected. The conclusions provide an important reference for the safety design of explosion venting and explosion resistance.

Keywords: Gas explosion; Explosion suppression; Size effect; Wire-mesh

1. Introduction

In the process industry, storage vessels and equipment filled with flammable and explosive gases are often connected using pipes. Once a flammable gas explodes in a vessel, the explosion flame and shock wave spread through the pipeline. This can cause fire and explosion accidents, resulting in great casualties and loss of property. However, the sizes of the vessels and the connection style of vessels and pipes are various in different technical processes, which can lead to different accident consequences (Wang et al, 2014; Yang et al, 2011). The explosion characteristics of gas or dust change with the vessel and pipe size, which is called the size effect of gas or dust explosions. The size also has an effect on explosion suppression (Zhang et al, 2014; Kristoffersen et al, 2004).

Some models and experiments (Bartknecht, 1981; Di Benedetto and Salzano, 2005, 2010; Larsen & Eckhoff, 2000; Nie et al, 2011, 2015; Phylaktou & Andrews, 1993; Zhang et al, 2014) have been presented in the literature, showing that the intensity of the pressure piling of interconnected vessels is affected by the pipe length and volume ratio. Bartknecht (1981) explored the effect of volume on

* Corresponding author. Jiangsu Key Laboratory of Urban and Industrial Safety, College of Safety Science and Engineering, Nanjing Tech University, Nanjing, 210009, China.
E-mail address: wangzhirong@njtech.edu.cn (Zhirong Wang).