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PROCEEDINGS

Leakage Diffusion and Monitor of Hydrogen-Blended Natural Gas Pipeline in Utility Tunnel

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ABSTRACT

The supply of hydrogen-blended natural gas to civil and industrial users can assist downstream firm to achieve carbon emission reduction, and ensure energy security as an alternative gas source. This application mode has been widely concerned by urban gas enterprises. This paper focuses on the leakage problem of hydrogen-blended pipelines in utility tunnel due to corrosion and other reasons. Using dimensional analysis method, a model experiment is designed to verify that the three-dimensional compressible fluid model coupled with transport equations can effectively simulate the concentration change of hydrogen-blended natural gas after leakage in the utility tunnel. The CFD model was used to simulate the diffusion process of leakage under different hydrogen-blended ratios, pressures, leakage apertures, and leakage directions. The spatiotemporal evolution law of gas concentration was obtained. The research results indicate that for hydrogen-blended natural gas that has already been uniformly mixed, there will be a faster diffusion rate of hydrogen after leakage. However, for engineering problems, the difference in diffusion rate is negligible and can be ignored. The concentration of gas probe located on the ventilation downwind side of the tunnel is directly proportional to the pressure of the pipeline and the square of the leakage hole size when a small hole leakage occurs in the pipeline, while being independent of the hydrogen-blended ratio; From this, the minimum ventilation frequency that prevents the concentration of gas in the tunnel from exceeding the lower explosive limit can be derived from the concentration change rate of the probe. The research in this paper can provide technical guidance for the security operation of hydrogen-blended natural gas pipelines and help development of the industry.

KEYWORDS

Hydrogen-blended natural gas; pipeline transportation; utility tunnel; leakage and diffusion

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