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PROCEEDINGS

Lifetime Prediction of Polyethylene Pipe Due to Aging Failure in Hydrogen-Blended Natural Gas Environment

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ABSTRACT

In the low and medium pressure urban gas pipe network, transporting the hydrogen-blended natural gas through polyethylene pipe is an important means to realize the large-scale delivery and utilization of hydrogen-blended natural gas. However, due to the characteristics of polymer material, polyethylene pipes will experience aging phenomenon, which will lead to the deterioration of performance and eventually result in brittle damage and failure. Therefore, it is of great significance to analyze and predict the lifetime of polyethylene pipe due to the aging in the hydrogen-blended natural gas environment to ensure the safe transportation. In this study, the aging experiment of polyethylene pipe at different temperatures and times is carried out in the hydrogen-blended natural gas environment with different hydrogen blending ratios through the high-pressure autoclave. Then, the oxidation induction time of polyethylene pipe after aging is measured by differential scanning calorimetry, and the lifetime of polyethylene pipe is calculated based on the Dakin lifetime prediction model and time-temperature equivalence principle. Results indicate that the oxidation induction time of polyethylene pipe decreases with increasing temperature and prolonging time, but there is no significant change with increasing hydrogen blending ratio. Through the processing of the high temperature and short time experimental data, it shows that the lifetime of polyethylene pipe at room temperature is more than 50 years, which meets the service requirements. The conclusions show that it is feasible to transport hydrogen-blended natural gas through polyethylene pipes from the perspective of aging failure.

KEYWORDS

Polyethylene pipe; aging; hydrogen-blended natural gas; oxidation induction time; lifetime prediction

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