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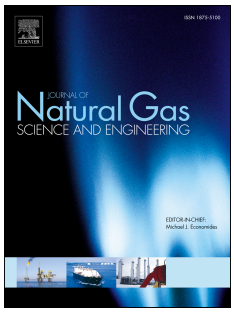

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Performance analysis of liquefied natural gas storage tanks in refueling stations

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Abstract

Liquefied natural gas (LNG) could replace diesel in the transportation sector. However, fugitive emissions including boil-off gas (BOG) across the LNG supply chain have revealed uncertainties on the overall environmental benefits of such replacement. In this study, time-dependent thermodynamic models were developed to study the LNG holding time of storage tanks in refueling stations before BOG releases to the atmosphere. Previously overlooked factors, such as the thermal mass of storage tanks and the actual operating conditions at refueling stations, were included explicitly in the models. The effect of the thermal mass of storage tanks on holding time is illustrated by an analysis of 57.20 m^3 storage tanks filled with LNG at -150°C and -126.5°C. The tank with the lower temperature fills show 3.7-times longer holding time. Further investigations highlight the importance of the ratio of heat transfer surface area to the LNG volume as a key factor in proper sizing of storage tanks to maximize the holding time. Finally, the modeling of a 57.20 m^3 storage tank with a heat transfer coefficient of 0.022 W/m^2K shows that fuel delivery rates as low as 1.89 m^3/day are sufficient to maintain the tank pressure within allowable limits.

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