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Computational fluid dynamic simulation of leakage acoustic waves propagation model for gas pipelines

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When leakage occurs for natural gas pipelines, acoustic waves generated at the leakage point will propagate to both ends of the pipe, which will be measured and processed to detect and locate the leakage. When acoustic waves propagate in the gas, the amplitude will attenuate and the waveform will spread, which decides the installation distance of acoustic sensors. Therefore, a computational fluid dynamic (CFD) simulation research on the acoustic waves propagation model is accomplished and verified by experiments to provide foundation for acoustic leak location method. The propagation model includes two parts: amplitude attenuation model and waveform spreading model. Both can be obtained by the established CFD simulation model. And the amplitude attenuation model can be verified by the experiments. Then, the simulation method is applied to conclude the propagation model under variable conditions including different flow directions, Reynolds numbers and diameters. Finally, the experimental demonstration of the leak location based on the propagation model is given. The results indicate that not only the gas viscosity but also the gas flow can influence on the propagation model and leak location method based on propagation model is effective. Conclusions can be drawn that CFD simulation on the propagation model for natural gas pipelines is an efficient way to carry out research and provide theoretical basis for acoustic leak location method application.

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