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Chronic Leak Detection in an Oil and Gas Transportation

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Extended Abstract

The objective of this study was to investigate the ability of various digital sensors such as dynamic pressure, differential pressure, differential temperature, and differential flow rate to identify leaks in a gas pipeline or wellbore system as a combined approach. This approach will lead to an extended real-time transient monitoring (e-RTTM), which would be an efficient methodology for leak detection with reliability, accuracy, and robustness avoiding any false alarms. An experimental setup was utilized to carry out experiments in the laboratory at Texas A&M University at Qatar. The ID of the pipe was 1.575 cm. The total length of the pipeline was 4.2 meters, so the fully developed flow was maintained. Several trials were carried out with varied system pressures ranging from 0.5 to 2 bars. The leak sizes were 0.05 inches, 0.07 inches, and 0.09 inches. The results revealed that the dynamic and differential pressures decrease suddenly once a leak is detected in the system. An artificial leak event was created to mimic an internal abnormal flow condition that looks like a leak event. The dynamic pressure measurement indicates identical pressure profile with the presence of a real leak and an artificial leak. Therefore, multiple measurements are required to identify a real leak and an artificial leak preventing a false alarm. Dynamic pressure measurement was taken with changing time. Downstream dynamic pressure is lower compared to the upstream dynamic pressure due to the pressure loss in the pipe wall and leak. Dynamic pressure indicates a sudden drop of the pressure of about 0.1-0.2 bar due to the initiation of a leak in the system. We have developed several correlations for differential pressure and differential temperature changing input pressure, and leak size. The change in differential pressure is greater as compared to the change in differential temperature for similar input pressures. Leak size has a higher impact on the change of differential pressure as compared to the input pressure. We have also developed a number of correlations for leak flow rate with changing input pressure and leak size. The impact of input pressure is higher on leak flow rates as compared to the leak size and the presence of multiple leaks. We have developed a non-dimensional analysis using the Buckingham-Pi theorem. We have developed a graph based on Reynolds number (*Re*) and Euler number (*Eu*). Reynolds number increases with the increase of Euler number. The non-dimensional analysis shows a promising way to upscale the lab-scale experimental results to the field scale. We will also discuss the recent developments in leak detections, including numerical model development and multiphase flow phenomena in offshore applications.

Keywords: Leak detection, dynamic pressure, differential pressure, gas pipeline, false alarm.