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Abstract

An innovative methodology is presented to precisely and efficiently determine the size and location of a leak in a pipeline based on field measurements of the pipeline fluid pressure and flowrates.

A deterministic bisection numerical technique is used to bracket the leak location in an accelerated pace. A leak is simulated at a location initially assumed at the middle of the leaking pipe. The pressure is calculated at the measurement locations on both sides of the leak. A logic is used to determine whether the leak is at the assumed location, upstream or downstream of it. If the leak is determined on either side of the assumed location, the next leak location is assumed in the middle of the pipe segment bounded by the last assumed location. The procedure is repeated until the difference between the calculated and measured pressure and flowrate falls within an acceptable criterion.

The presented methodology was demonstrated to locate and size a hypothetical leak in a gas network comprising of more than 180 km of pipelines. A hypothetical leak was simulated at an undisclosed location in the network by a third party. A hydraulic model was developed to calculate the pressure and flowrates in the network at certain production conditions with and without the hypothetical leak. The leak was located in a short time within only 4 trials along a 164-km pipeline at KP 30.75 km. Initial leak location was assumed at KP 82 km (i.e. middle of the pipeline). The corresponding estimated leak locations for trials 2 through 4 are KPs 41 km, 20.5 km, and 30.75 km respectively. The hypothetical leak was set at KP 27 km demonstrating an accurate and efficient methodology.

Unlike existing procedures, the presented leak locating methodology quantifies the deviation between calculated and measured pressure and flowrate in a leaking pipeline. The bisection numerical technique is then applied to narrow down the leaking location in an accelerated pace until the difference between calculated and measured pressures and flowrates falls within an acceptable criterion. The presented methodology is patented by the U. S. Patent Office under patent No. 11,263,374.