Pipeline Leaks No More? Innovative Fiber Optic Leak Detection

by Jorj Sayde, Kleinfelder - November 2018

Was there ever a time when news headlines were not dominated by the subject of pipelines? The major concern the public has with pipelines is the potential for leaks and/or ruptures to occur, yet with emerging technologies, such as fiber optic sensing systems, leak detection capabilities have never been better.

Traditionally, pipelines were engineered with sensors that would measure key variables such as pressure, temperature, and material flow. These variables are measured conventionally from within the pipe, but external fiber optic sensing cables may be the ultimate technology for leak detection. Why?

Use of Light in Fiber Optic Sensing Systems Effectively Detects Pipeline Leaks

Fiber optic cables can be used to transmit light signals, and it is this property that is implicitly affected by a pipeline leak. Changes in thermal, pressure, or even acoustic profile all can impact the anticipated “light signature.” Differences between the anticipated light signature and actual one received may be indicative of abnormal pipeline activity. Process control engineers generally have to work on identifying events such as changes in pipeline operation, weather, surface vehicular traffic, and other disruptive events so the statistical algorithm does not produce false alarms. This testing and tuning function is inherently required with all leak detection methodologies.

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A key differentiating feature of fiber sensing technologies is their ability to use light wave speed in addition to GPS and pipeline routing information to pinpoint the location of the disruptive event, potentially a pipeline leak. Engineers would agree that regardless of the size of a pipeline leak (fiber cannot calculate the volumetric flow rate of a leak), a leak needs to be isolated without delay to avoid damage to personnel, environment, or other negative consequences. The speed with which fiber systems can detect, coupled with the ability to target the location of a leak along a pipeline, makes this promising approach highly useful. Traditional systems based on pressure, temperature, and material flow have a time lag, a latent feature of such systems which makes them less agile than promising fiber sensing technologies.

Cost Feasibility
Construction and installation of fiber sensing systems can be a costly compliment to pressure, temperature, and material flow-based leak detection systems which form the backbone of most pipeline detection systems. This cost is further exasperated when the pipeline asset is already constructed, as fiber systems generally need to be installed in the same trench as the pipe. Excavation can be labor intensive, costly, and introduce other unwanted risks. Engineers and corporate leaders need to evaluate the risks and rewards of deployment of fiber sensing technologies.
Benefits Outweigh the Cost
In addition to the speed and accuracy of detecting pipeline leaks, fiber optics may be a novel way for pipeline integrity teams to monitor pipelines: maintained assets at the end of their life cycle may benefit from a fiber deployment to protect against catastrophic leaks. Also, fiber optic sensing systems show exceptional promise in sensitive environmental areas, such as water way crossings or sub-sea assets. In such areas, fiber optic technologies can be used to monitor against other risks in addition to leaks, such as tampering or marine vessel anchor strikes. Fiber sensing systems will likely never replace traditional methodologies, but they promise to close the gaps associated with such traditional systems (e.g. lag, inability to pinpoint location of leaks). It is worth mentioning as well that such systems are generally maintenance free, but routine testing to check alarm response is an added cost typical of pipeline operations. Continuous tuning and improvement of such systems is anticipated of vendors and process control specialists that work with such systems; being inherently sensitive to variability, fiber systems require sufficient tuning to make them not generate false positive alarms.

The Future of Pipeline Leak Detection
Technology is rapidly changing, and the next generation of pipeline operators will utilize artificial intelligence, data analysis, and smart technologies to maintain the integrity of pipelines, plus avoid leaks of any size. This should further bolster the industry as a whole, resulting in greater confidence with pipelines as a contemporary means of transporting energy commodities. A compliment of leak detection platforms, similar to a web, can sufficiently address deficiencies in any one specific technology or methodology. It is this approach that will inevitably achieve the performance that the public demands of pipeline companies in the future.

Kleinfelder’s engineering team has significant experience with fiber optic sensing systems, including engineering, installation, and development of system testing protocols. We work closely with clients in the energy, petrochemical, midstream, and transportation industries to develop modern and innovative approaches for development, maintenance, and/or enhancement of their facilities and assets.

Where to go for more information?
If you have questions or want more information on fiber optics sensing systems and pipeline leak detection, please contact Jorj Sayde, P.Eng., PEO, at 587-463-3000 or jsayde@kleinfelder.com.

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