Fiber Optics Aim To Improve Leak Monitoring With Distributed Temperature Sensing

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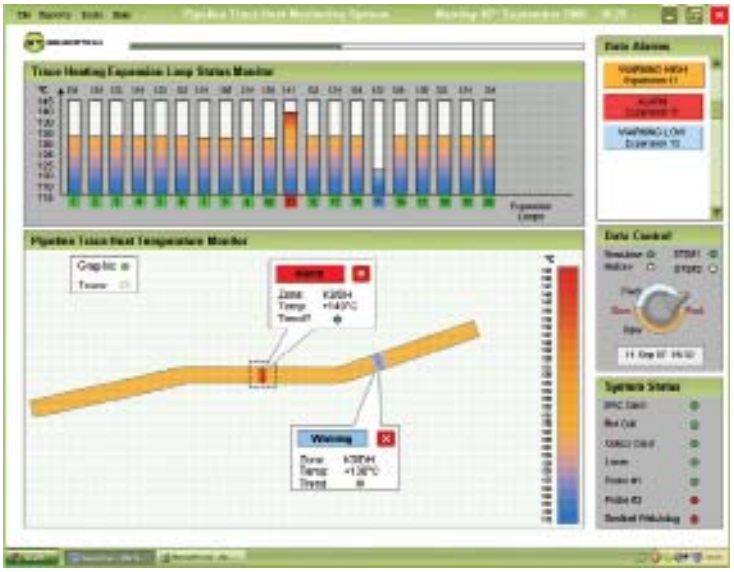
Fiber optic-based distributed temperature sensing (DTS) is a technology solution that was introduced more than 20 years ago. To date, DTS has been used in downhole oil and gas applications to a much greater extent than in pipelines, yet the technology offers significant benefits for pipeline monitoring that operators are starting to recognize. Environmental leaks, flow assurance and tampering continue to persist as major pipeline issues. As a mature, cost-effective technology that addresses these issues, DTS is well-positioned for widespread adoption among pipeline operators.

History Of DTS

DTS is a temperature sensing solution that employs a standard telecommunications-grade fiber optic probe to make adjacent temperature measurements every half meter across many kilometers. By measuring temperatures with such pinpoint accuracy, DTS allows operators to quickly locate and address problems within an asset.

DTS technology was developed at Southampton University in England in the early 1980s, gaining significant market acceptance over the last 10 years. The first markets to embrace the technology were in the energy sector - with applications in oil and gas well and power cable monitoring. Recent technical and market advances such as lower costs, better reliability, customized application-specific software and innovative fiber deployment techniques have now made widespread adoption possible.

SensorTran, North America's only DTS developer, originated in 1998 as a division within a technology R&D company that develops new unique technologies and transitions them into integrated business solutions for sale into key markets. In 1996, the company engaged with NASA on a Small Business Innovation Research (SBIR) contract to help develop a digital thermal sensing solution to monitor the cryogenic tanks on the X-33. The X-33 was a program inside NASA aimed at creating a replacement for the space shuttle, one which private industry could supply to help dramatically reduce the cost for putting payloads into space. Although the X-33 program was cancelled in 2001, the R&D company delivered the DTS 33 in 1998, after which SensorTran was formed as a subsidiary focused on developing new commercial and industrial applications for the technology.



By 2000, SensorTran had begun to sell the DTS 33 into downhole oil and gas, electrical power cable, process/pipelines, and structural integrity monitoring applications. Today's iteration of the product is the SensorTran DTS 5100, which was released to the market in late 2004. Less than two years later, SensorTran was spun off in August 2006 so that the company could expand its marketing and sales efforts as a stand-alone company.

DTS And Pipelines

DTS technology enables precise and accurate temperature measurements to be rapidly and continuously collected across distances typically in the range of 1 to 40 km. The technique calls for a fiber optic probe--either armored or standard telecommunication grade - to be installed on or near the asset being monitored. In the case of a pipeline, the probe may be located inside a cable bundle banded to the outside of the pipe, built into the outer casing, or buried alongside the pipeline. This probe is then attached on one end to the DTS hardware unit that contains a pulsed laser and requisite software.

To make a measurement, a laser pulse is propagated through the fiber, backscattering light into several components that reflect changes in density and composition as well as reactions to molecular and bulk vibrations. The components of the backscattered light are then analyzed by the DTS software and translated into temperature information. This data is often presented in visual form and tied to alarm conditions.

DTS technology is of particular advantage in the monitoring of pipelines because (1) a single fiber optic probe can take the place of thousands of point sensors; (2) there is no need to predict where incidents may occur as the whole length of the asset is covered by the probe; (3) fiber optic-based measurements are not corrupted by electromagnetic noise; (4) DTS monitoring does not pose a spark risk in volatile environments; and (5) the optical fiber is non-corrosive.

DTS technology allows for continuous temperature monitoring across long spans with 0.5-m sampling resolution with temperature resolution well below 0.1°C and accuracy in of +/- 0.5°C. For the longest-range systems, the temperature resolution is approximately 0.5°C with accuracy of +/- 1.5°C. For pipeline applications, with linear fiber deployment, this means that the location of a temperature event (leak, etc.) could be pinpointed to within 0.5m.

For highly critical applications, where better spatial resolution is required, customized fiber schemes (i.e. spiral wrapping) can be deployed to provide more specific location information.

The installed base for DTS solutions includes applications such as pipeline monitoring, concrete cure for dam construction, LNG leak detection and tank monitoring, process vessel monitoring, environmental monitoring and power cable monitoring. DTS use continues to grow in traditional oil and gas applications such as the monitoring of thermal recovery processes, subsea monitoring and water breakthrough monitoring.

DTS Today

While DTS has been used traditionally for oil well monitoring, the recent development of long-range capabilities has led to an increased acceptance in applications related to pipelines and power cables.

In the past, the DTS industry was viewed as a niche market understood only by a small group of "white glove" scientists and highly skilled technicians. Specifically, the DTS industry had been unable to grow rapidly due to the product's complexity, especially during deployment and calibration of the systems. Moving DTS setup, calibration, operation, and ongoing analysis out of the hands of those same "white gloves", and into the "leather gloves" in field crews is a critical shift that is now making DTS technology more accessible to all of these industries. Over the last year, the components were introduced to create an active plug and play solution for DTS, which features the following capabilities:

The ability for field engineers to install and calibrate the DTS on site without needing an expert — the system calibrates itself; The ability of the system to react to and adjust for fiber attenuation caused by a shifting pipeline; andAuto-correcting and continuous verification, allowing the system to operate with little/no operator involvement.

New Standards Organization

While DTS operation is increasingly simplified, understanding the intricacies of the specification process and performance parameters can be confusing to newcomers. Several first-of-their-kind industry initiatives, including the creation of a standards organization are under way. For example, SensorTran and J-Power Systems (a subsidiary of Sumitomo Corp.) have joined together to create the International Distributed Optical Performance Testing Standards Association (IDOPTS). The goal of IDOPTS is to help buyers and users understand what the key specifications are, how they compare across manufacturers, and how the specifications are formulated to create standard testing procedures.

Future Of DTS

As DTS technology becomes a standard component for large asset monitoring applications — pipeline monitoring, oil and gas thermal recovery and implementation of the Smart Grid — manufacturers are continuing to add functionality and capabilities that ease installation and provide more value. Within the next year, advances in distributed fiber optic monitoring technology will enable the measurement of strain, corrosion and temperature using a single fiber probe. Being able to monitor multiple conditions with a single cable installation and a single interrogation unit will drive up ROI and promote efficient, consolidated data collection.

Also on the near-term horizon are networked, lower-power, small footprint versions of DTS systems, which are specifically designed for pipelines and similar applications where groups of units are to be deployed outside in remote areas. These DTS systems are solar powered — allowing for outdoor mounting — can be run remotely and are autonomous. This means no operator intervention is required to collect, analyze and transmit decision-support information.

To achieve widespread adoption, providers must continue to push the DTS technology envelope. Bringing scientific breakthroughs into the marketplace at a rapid pace will fuel sustained growth within the industry. ***P&GJ***

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