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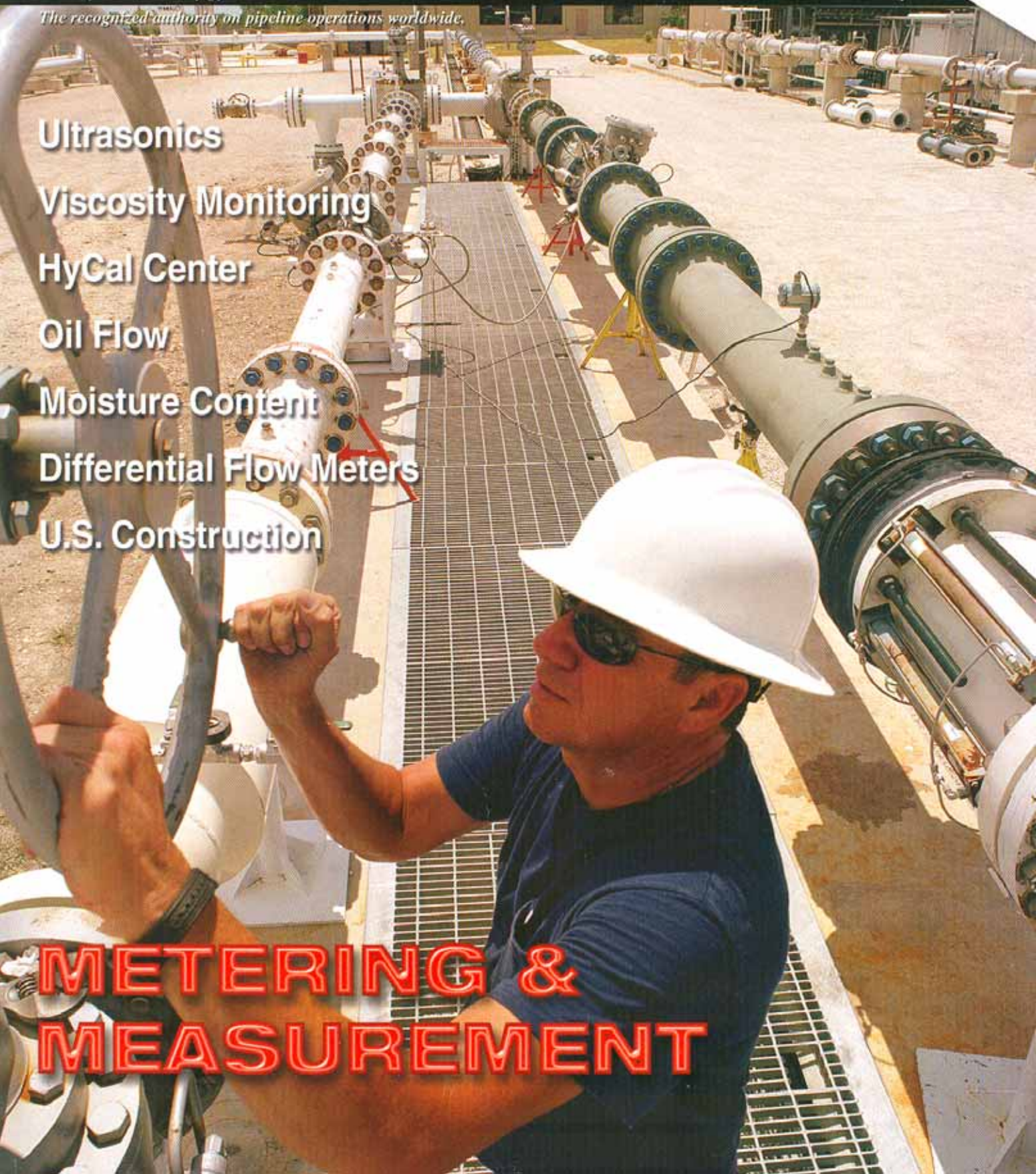

Ultrasonics

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METERING & MEASUREMENT

NASA-Based Technology Keeps Moisture Out Of Gas Pipelines

Special to **Pipeline & Gas Journal**

Reliable NASA-based gas analyzer technology is keeping producers aware of moisture content in their natural gas before it enters the El Paso Natural Gas Company (EPNG) pipeline, blocking formation of problematic carbolic acid and helping the producers avoid expensive shut-ins.

Tunable Diode Laser

Tunable diode laser (TDL)-based technology developed by NASA's Jet Propulsion Laboratory (JPL) now promises more accurate and dependable detection of contaminants — including moisture — in a natural gas analyzer that enables producers and pipeline operators to prevent "wet gas" from entering the pipeline system.

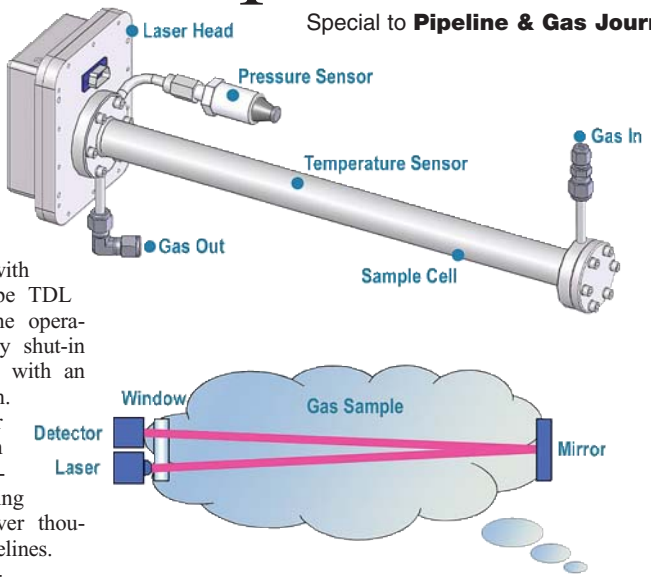
In the past, natural gas producers, processors and distributors have relied on direct-contact, surface-based electrochemical and crystal sensors for measurement of residual moisture or other contaminants in gas pipelines. However, that technologically old sensor technology has at times proven highly unreliable - producing false data that can result in unwarranted shut-ins or contaminated gas getting through pipelines.

"If we were to shut-in a producer due to a false moisture reading, millions of cubic feet of gas could be delayed and possibly incur unnecessary dehydration costs," says Melvin Yancey, a field measurement technician at EPNG's San Juan District in the Four Corners area. "On the other hand, if the gas does not meet EPNG's criteria for quality, as required in our tariff, we would not take the gas and the gas may have to be vented."

To avoid those possibilities and meet quality standards of pipeline gas, EPNG has installed new TDL-based (also known as "laser-based") analyzers where each of its 16 major producers in the San Juan area joins the pipeline. Companies such as SpectraSensors, Inc. manufacture TDL-type analyzers. The California-based company is one of the leading developers and producers of optical-based sensors. It manufactures "bread box-size" sensors that provide non-contact measurement of moisture, carbon dioxide, and other corrosives and contaminants in natural gas pipelines.

Because pipeline operators have multiple producers flowing large volumes through a common point, they must immediately and accurately know the "point of concern" where unacceptable impurities such as moisture are entering the system in order to notify or shut-in only the input at fault. By providing real-time communications with producers who are unknowingly shipping over-spec (wet) gas, pipeline operators can provide significant savings and keep the pipeline full.

At the same time, with a SpectraSensors-type TDL analyzer, the pipeline operator can automatically shut-in individual producers with an over-spec gas problem. This allows the other producers to maintain their flow requirements while improving system reliability over thousands of miles of pipelines.



Trustworthy and highly reliable, the high spectral purity of a laser-based analyzer enables the detection of specific gases - such as water, ammonia, and carbon dioxide in natural gas pipelines.

This advanced analyzer technology also saves on pipeline maintenance costs. By blocking the formation of carbolic acid (from water combining with the CO present in natural gas), resulting corrosion and erosion of pipeline is prevented, thereby saving substantially on associated maintenance expenditures.

The ever-increasing use of TDL analyzers by the natural gas industry has consistently shown that they are fast, highly accurate and much more flexible than their electrochemical predecessors. They are also proving to be cost-effective as well. While initial purchase price is somewhat higher than surface-based sensors, even the most conservative evaluation of this advanced technology indicates that maintenance saving alone (e.g., calibration, replacement sensor heads, service labor) will also provide a return on investment in a relatively short period of time.

El Paso feels that pipeline operators and producers alike are in need of ongoing and accurate gas analysis. "If there were faulty or bad readings," says Yancey, "then the customer is going to dispute why I shut them in. Let's say a producer is piping 400 million cubic feet of gas. So, if I shut in that producer, the cost could be immense."

Readings Are Shared

So that each producer can monitor El Paso's gas analyzer readings, they are capturing the electronic signal from El Paso's unit via a SCADA system and viewing the readings at the producer's control room.

Considering the downside risk from moisture in the gas, and that TDL analyzers are monitoring the quality of gas worth tens of millions of dollars per day within this area of EPNG's transmission operations alone, it is reasonable to conclude that this laser-based sensor system could pay for itself in a brief period of time.

For example, transmission pipeline operators have frequently relied on electrochemical sensors as gas analyzers to monitor moisture. These sensors incorporate a coated surface and a higher electrical capacitance across the surface indicates higher water content. However, these capacitance sensors are susceptible to contamination by glycols or amines in the gas, which can cause exaggerated readings or a failure to detect. An erroneously high reading could force the operator to temporarily shut down the pipeline, costing the company tens or hundreds of thousands of dollars.

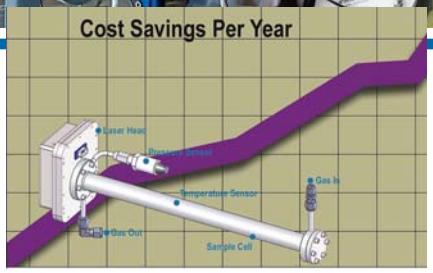
The gas producer may choose to over-process the gas to ensure that it is within the tariffs imposed by the pipeline operator. The TDL analyzer responds quickly and provides a reliable measurement that will not drift. It can be used in a closed loop to control the blending of dry and wet gas, allowing the producer or the pipeline to optimize costs by staying just within the tariff.

The high spectral purity of the TDL enables the detection of specific gases — such as water, ammonia, and carbon dioxide. Measurement intervals are as frequent as every two seconds, giving far more timely responses than the

several-minute (sometimes hours) readings of contaminant-vulnerable quartz crystal and electrochemical sensors. And those must be frequently cleaned and replaced.

Because a laser system never comes into contact with the contaminants present in natural gas — as do electrochemical and crystal gas sensors — the laser-based gas analyzer practically eliminates maintenance and operational costs. Studies have shown that the cost of operating and maintaining "conventional" electrochemical sensors continues to escalate annually, including labor, recalibration and rebuilding, back-up sensor heads as well as unnecessary gas dehydration and tariffs — all of which are obviated by the laser-based gas sensor.

It is not unusual for electrochemical sensors to carry with them cumulative annual expenses exceeding $50,000 per unit, most of which can be avoided through the use of a more dependable laser-based technology that provides more timely information and eliminates maintenance headaches. ***P&GJ***



SpectraSensors natural gas sensors provide significant savings to companies who use them. Their NASA-based laser technology is fast, accurate, and reliable with extremely low maintenance cost.

Software Provides 3D CAD From Ordinary Photos

By **G. Walter Hill, Strategic Reach PR,** Denver, CO

When Shan Pehlman consults with oil refineries on replacing aging piping systems, he might get as-built drawings of the old infrastructure. Then again, he might not. Even if he does, he generally considers them poor counterfeits for the real-world fittings.

"Everyone knows as-built drawings are just an imperfect world," says the CDI Corporation design engineer. "With equipment that is 30 or 40 years old and the modifications thrown in, the drawings are not going to match what's there. Everyone involved realizes this is a major difficulty, so they hire an outside firm to take care of it."

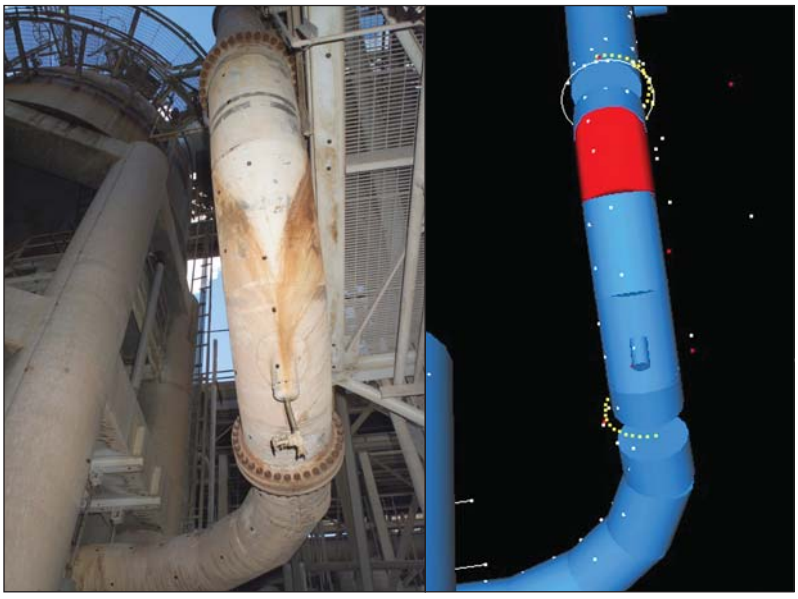
To deal with the refitting of a stretch of 20-inch diameter piping system in a Corpus Christi refinery that rambled through the facility, up a four-story tower, through walls and between plant equipment, Pehlman first measures what's there. He says the real pipe differs from the original as-built plans because when it was installed it was likely altered to in-the-field contingencies to create a seamless fit of segments and obstacles.

Among the many possible methods of measurement, Pehlman chooses the quickest way to collect the data in the field and the most direct way to generate new 3D CAD models. His technique is to take ordinary photographs. From these, he is able to derive highly accurate measurements through a desktop software called PhotoModeler.

"There are other options," Pehlman said, "but PhotoModeler offers the most accurate way of conducting a survey. We can do it by hand with a measuring tape, but it is more difficult with large bore pipe inside a multi-story facility. We can use a laser survey machine, but that's not as accurate when there are a lot obstructions."

PhotoModeler, developed by Eos Systems, requires only a minimum of two photographs of an object from multiple angles in order to recreate the 3D dimensions in CAD. The method automates the old techniques of photogrammetry — measurement from photographs.

The technology has attracted many organizations specializing in industrial measurement and reverse engineering. The non-contact method has numerous advantages: It is not limited by the size or shape of the photographic subject and can measure sub-centimeter flows in manufacturing inspection and generate CAD for cathedral spires. The application also comports with most common CAD system formats, so the models integrate with other design work. Perhaps most importantly, the PhotoModeler solution does not require a substantial investment in measuring instruments — most people have a camera lying around.



Pehlman says PhotoModeler is also ideal for the industrial environment since large, sometimes hazardous, equipment can be documented at a safe distance. "I've used PhotoModeler in the past for industrial units as hot as 700 degrees, in congested areas and up a 200-foot tower, as in this case. A lot of companies will go straight to laser measurement and think it's an all-end solution to their needs. In essence, it's not. Photogrammetry often is much more economical and faster."

Precision CAD From Photos

After a camera captured every bolt, flange, miter cut, and curve on a 60-foot stretch of oil pipeline in the Corpus Christi refinery, Pehlman was ready to process the digital photos into 3D CAD.

He began by matching corresponding points on the images after uploading the photographs into PhotoModeler. Once enough matching control points had been established, the program adjusts the photographic scene into a 3D axis, accurately drawing the real-world parts into a CAD model.

The photogrammetric analysis uses the camera parameters to solve measurement units in the photographic scene. A special cylindrical shape feature in PhotoModeler allows Pehlman to outline the exterior lines of the bore and the program automatically extrapolates the 3D surface. A 3D voluble model of the configuration then exports to engineering CAD systems, ready for fabrication.

Ultimately, Pehlman's photo model proved accurate within one centimeter. PhotoModeler can provide tighter accuracy by increasing the number of photos and points matched in the project.

Because the new pipe is set in place with the help of a crane and a crew of workers, the lack of modifications and readjustments saves a great deal of costly downtime. ***P&GJ***