THE AMERICAN OIL & GAS REPORTER®
AUGUST 2006
The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

Drilling Fluids

Page 56

Jon Callen
President KIOGA
"The markets seem to be completely disconnected. There is a lot of anticipation built into the futures price that does not make sense in the physical markets."
Page 106

Jerry Barnes
Chairman PAW
"As chairman of PAW, I would like to see Wyoming become the second-largest gas producing state in the country."
Page 120

Fred Fesenmyer
Chairman POGAM
"To have the industry come back to the degree that we are enjoying even now is exciting."
Page 128

Bob Eberhart
President EKOGA
"The cost of doing business is way up. We are handling more money, but we are putting more money out."
Page 133

Industry Benefits From NASA's Ideas

By Brian Schaible
Special Correspondent

DENVER–Perhaps the most famous technology spin-off originally developed for the National Aeronautics and Space Administration is the no-stick material Teflon™ developed by DuPont, which is used in everything from frying pans to clothing. But space-age technology also is finding its way into the oil and gas industry to improve safety, efficiency, and environmental protection in very challenging environments.

It's hard to imagine a more forbidding and hazardous environment than the low-gravity vacuum of space. The difficulties encountered by astronauts performing structure assembly and repair operations prompted NASA to design Robonaut, a humanoid robot, to work side-by-side with the astronauts, or alone in conditions too hazardous for humans. NASA engineers equipped Robonaut with human-looking, dexterous hands, complete with five fingers to accomplish its tasks.

During the Robonaut development process, NASA soon discovered the need for an advanced sensor system to measure the movement and forces exerted by its forearms and hands. The agency awarded a research grant to Astro Technology Inc. (ATI) of Houston, which developed a sensor system based on fiber-optic technology that can measure the bending of the fingers, tactile forces at the fingertips, and tendon forces in the forearm. Astro Technology engineers miniaturized and strengthened the sensor system so it could be used not only for Robonaut, but for solid rocket motor testing and to evaluate fatigue on subsea pipelines and risers.

Strain Sensors

The industry is completing many undersea oil and gas wells in waters deeper than 7,500 feet. Production risers frequently are more than a mile long and are unsupported from the wellhead to the water surface. Water currents flowing past the pipeline create a vortex-induced vibration that ultimately can cause fatigue damage and possible pipeline failure. ATI is using fiber-optic sensors to provide real-time measurements and monitoring of strain, vibration, and fatigue of pipelines and in some cases drilling equipment. In one offshore project in the Gulf of Mexico, hundreds of sensors were placed along a 7,500-foot riser at 500-foot intervals. Connecting the sensors is a single cable that contains only 20 fiber-optic strands.

ATI President David Brower says the deepwater production risers form a big part of the demand for his company's sensors. Critical points for monitoring are near the sea surface and at the ocean floor.

"In the top zone, the riser is subject to vortex-induced vibration," he explains. "Then, in the touchdown zone, where the riser bends and meets the sea floor, you find extremely high stresses. These two areas are of most concern to the industry, so that is where we focus most of our attention."

With rising U.S. demand for natural gas has come an increased interest in, and demand for, liquefied natural gas. Most LNG is imported to the United States by ship and offloaded to pipelines that connect to onshore facilities. Brower says larger LNG transportation ships are being built that will require transportation pipelines to be extended into deeper water. ATI has developed fiber-optic sensor systems to help monitor critical pipeline operations.

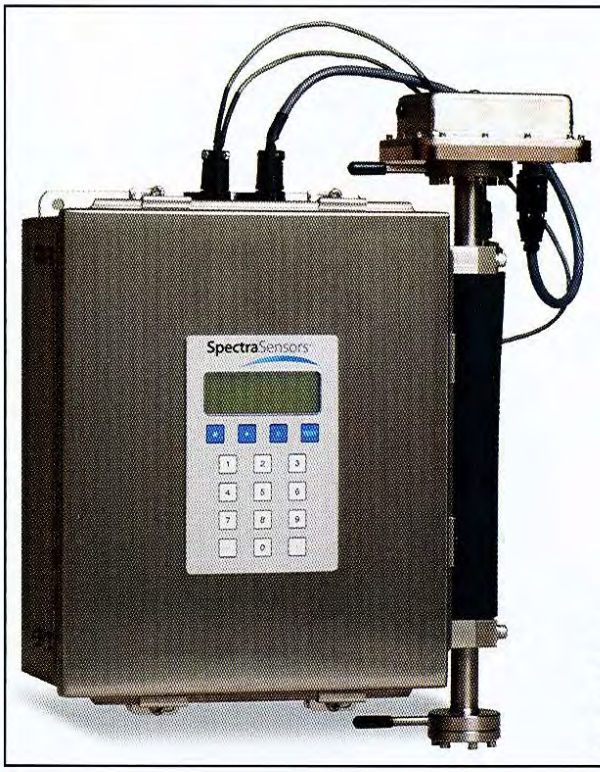
"We are working with the industry to monitor the pipeline temperature to ensure the insulation is working properly or to detect a leak, either of which could cause regasification in the pipeline," Brower says. "Parameters measured include strain, temperature, pressure, and heat flux along the entire length of the riser, which could be 10-15 kilometers long."

The entire length of the fiber-optic cable serves as the sensor in these applications, Brower observes.

"Using our system, we can identify the location of any leak within a few meters," he indicates. "We also will be using this technology on extremely long LNG pipelines in the North Sea and Barents Sea as they become available."

Brower says a third oil and gas application for ATI's fiber-optic sensors is to detect the buildup of hydrates in a pipeline. The company first identifies pipeline points that are particularly susceptible to hydrate buildup. Sensors would be deployed to measure temperature and pressure at these locations. Once a buildup has been detected, the sensors can trigger corrective action.

"If hydrate formation is detected, you could start corrective action right away–either activating a heating element or trig-



Using technology developed by NASA, SpectraSensors Inc. offers a TDL sensor that natural gas distributors can use to quantify levels of water vapor and carbon dioxide in pipelines.

gering the injection of inhibitors," Brower explains.

Laser Sensors

Another NASA sensor, the tunable diode laser (TDL), originally was built to measure the composition of the atmospheres of Earth and Mars. The technology was so promising that NASA's Jet Propulsion Laboratory spun off a separate company to commercialize use of the sensors for everything from aircraft safety and wafer fabrication in the semiconductor industry to pipeline monitoring.

In the oil and gas arena, SpectraSensors Inc. has developed a TDL sensor that is being used by natural gas distributors to quantify levels of water vapor and carbon dioxide in their pipelines. Sam Miller, SpectraSensors' director of marketing for energy products, says the measurement process is a form of spectroscopy.

"The sensor receives gas from a pipeline through a stainless steel tube," Miller explains. "A laser shoots through the gas stream, bounces off a mirror on the other side, and is reflected back to a detector. The electronics of the sensor then determine the amount of target gas or moisture by measuring the amount of light that is absorbed at a specific wavelength."

Miller says a small laser diode produces light at the narrow and specific wavelength of the target gas molecule. The light energy being absorbed at the target gas frequency then is compared to light energy at surrounding frequencies. The sensor continuously monitors parts per million of moisture and contaminant levels in the gas stream, making it possible for the pipeline or its suppliers to instantly change the gas composition or shut in the flow if problems arise.

"Companies route the sensor output to a computer that can sound an alarm when moisture content is too high, or can actually control the process by changing the gas blend or closing a valve," he says.

The constant monitoring is important because gas transporters usually have a moisture limit in the contract with a producer. If moisture levels exceed the limit, the flow is shut in. Companies also can change the mix of gas through dehydration processors to increase the amount of dry gas and ensure moisture levels stay below contract levels, Miller says. Monitoring moisture levels also is important from a safety standpoint, since water can combine with other chemicals in the pipes to cause corrosion.

Refineries and petrochemical companies also are using the TDL sensors to measure and control various elements in their process streams, according to Miller.

"Refineries can use sensors to measure moisture levels and contaminants in gas streams, feedstocks, and fuel gases," he relates. "The measurement also is important in determining gas composition of emissions to ensure they meet Environmental Protection Agency standards. Here they would be measuring levels of ammonia, hydrogen sulfide, or other contaminants."

Microbe Treatment

Encapsulation technology developed and used by NASA's Marshall Space Flight Center and the Jet Propulsion Laboratory is being put to use by Universal Remediation Inc. in a completely natural process designed to help naturally occurring microbes in soil or water degrade petroleum and other hydrocarbon products.

UniRem Vice President of Operations Gary Dalrymple says his company manufactures tiny hollow spheres of treated beeswax (PRP) that serve as nutrients. The spheres can be sprinkled on oil or other hydrocarbons by hand or mechanical spreader. When the beeswax spheres come in contact with a spilled hydrocarbon, they bind with the substance and stimulate microorganisms from the immediate environment to biodegrade the spilled hydrocarbon. He says over time the PRP will absorb and remediate more than 20 times its weight.

"The spheres range from five to 50 microns in diameter and are manufactured in layers like paper maché," he explains. "They are hollow and very absorbent. When you apply the PRP powder to oil, diesel fuel, benzene, or any other hydrocarbon, there is immediate absorption. The beeswax is basically a nutrient for the microbes. Put the two together, and the microbes create an enzyme which biodegrades hydrocarbons."

Originally, UniRem encapsulated hydrocarbon-munching microbes within the beeswax spheres. But the company soon found that each spill location had its own unique set of microbes that were well adapted to local conditions. Instead of trying to match local microbes, UniRem decided to leave the beeswax spheres hollow and use them to feed and encourage whatever microbes might be in a spill area.

Dalrymple says PRP powder also is used in absorbent pads, socks, rings, bio and well booms to biodegrade petroleum products as well. The combination is being used very effectively at refineries, gasoline stations, gas and electric vaults, and other locations where there is concern about