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Smart Pigs

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SMART PIGS

Mechanical – Internal Pipeline Assessment Technology

THE NEED

Smart Pigs are inspection vehicles that move inside a pipe line pushed along by the flowing material. They have been in commercial use since 1965, primarily for the detection of wall thinning caused by ordinary corrosion. Until recently other types of defects - cracks, coating disbondment, dents and gouges were not detectable with pigs (Willke; 1998). The industry is demanding smart pigs that could pass along multidiameter pipelines and bends, that could detect the precise location of any problem, and that does not interfere with or need the flowing material to still be operational.

THE TECHNOLOGY

Smart Pigs use different technologies to locate problems along the pipelines. Magnets have been used to detect corrosion where the most common technology is the Magnetic Flux Leakage (MFL) that detects corrosion on thinning walls. Another detection technology uses ultrasonic sensors to detect coating disbondment, cracks, dents and gouges. The Global Positioning System (GPS) technology is being adapted to smart pigs to obtain the exact location of any problem in the pipe or to map the pipe itself. Some of these new Smart Pigs have a collapsing characteristic that allows them to get into multidiameter pipes and gate valves (Willke; 1998). Pipetronix Inc. offers several Smart Pigs with different technologies: (Pipetronix web site);

FIGURE 1 CALSCAN SMART PIG - PIPETRONIX INC

- The CalScan pig that can locate and measure geometric deviations. It works during the running operation of the pipelines, producing only an insignificant throughput loss. The CalScan pig can detect deformations from 0.6% up to 25%.

FIGURE 2 CALSCAN: DETECTING DENTS - PIPETRONIX INC

- For detecting pipeline corrosion Pipetronix designed the MagneScan HR system, which is based on the principle of magnetic flux leakage. This Smart Pig can differentiate between internal and external corrosion and detect changes in nominal wall thickness. A magnetic field is induced in the pipeline steel. If a flaw is present, part of this magnetic field escapes the wall. Extremely sensitive sensors detect and measure the resultant leakage field and allow the detection and sizing of metal loss and corrosion.
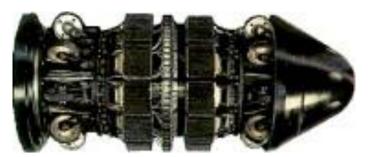

FIGURE 3 MAGNESCANHR: MFL TECHNOLOGY - PIPETRONIX INC

- An alternative to the MFL technology is the UltraScan Pig, which also monitors pipelines for corrosion.

FIGURE 4 ULTRASCAN SMART PIG - PIPETRONIX INC.

It uses ultrasonics to determine the pipe wall thickness. The UltraScan pig analyses the whole surface and length of the pipeline for traces of corrosion. This technique can be applied while normal operation of the pipeline is maintained without any significant reduction in pipeline flow. The UltraScan system allow the determination of the extent, location, depth, and internal/external position of the corrosion.

FIGURE 5 ULTRASCAN: ULTRASONIC TECHNOLOGY

Pipeline Integrity International Ltd. has developed special crawler pigs capable of propelling themselves through a pipeline when the product itself is unable to force the device through the line, or when there is no flowing material (Puyear; 1998).

FIGURE 6 GEOPIG SMART PIG - NOWSCO

Nowsco Well Service Ltd. offers the Geopig tool which measures pipewall deformations using differential GPS surveying equipment. This provides pipeline anomaly location (dents, buckles, wrinkles, and bending strain) within an accuracy of 1:2000 from any known reference point. It also allows the assessment of the dynamics associated with slope instability, subsidence, overburden, frost heave, river crossings, free spanning, overburden, and temperature and pressure changes. Comparison of repeat Geopig survey data will determine pipeline movements as small as one inch and differential bend curvature strain to +/- 0.02%. (P&GJ; 1997 and Nowsco web site).

THE BENEFITS

High resolution intelligent pigs (smart pigs) can accurately detect, size, and locate corrosion or any other anomalies in pipelines. Once the problem is detected the information can be used to develop a pipeline de-rating schedule, implement a repair or replacement program, determine if re-inspection is necessary, and evaluate effectiveness of a corrosion inhibitor program. (Jones, Dawson, and Brown; 1995)

Transcontinental Gas Pipe Line Corporation (Transco) used a collapsible pig and realized an estimated savings of about $2 million by avoiding the cost of replacing valves in a pipe line section. "Transco believes a conservative estimate of its own savings over the next 10 years from use of this device could be $50 million." (GRI; 1997)

STATUS

"The Gas Research Institute (GRI), PRC International, the Canadian Energy Pipeline Association and British Gas are sponsoring the improvement of a collapsiple pig called "Elastic Wave Vehicle", for a 24-inch diameter pipe that could be resized for pipe diameters of 20 to 30 inches. Currently, the device exists only in sizes for 30 to 36 inches.

T.D. Williamson Inc. and C.W.Pope & Associates are developing smart pigs using electromagnetic acoustic transducers to detect stress corrosion cracking along pipes. This technology uses ultrasonics to detect cracks but employs a different method for generating energy into the pipe wall and interpreting information.

The U.S. Department of Transportation is working with the GRI and Tuboscope Vetco Pipeline Services to design an in-line inspection device to detect and quantify mechanical damage to pipelines." (GRI; 1997).

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Web site: http://www.varco.com

Pipetronix Inc.

Phone: (800) 324-7633.

The list of manufacturers and distributors http://www.piggingassnppsa.com/Consultancy-Services.htm

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REVIEWERS

Peer reviewed as an emerging construction technology

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