

Economical, compact, reliable pipeline leak detection with the ultrasonic pig

By René Landstorfer

SUMMARY: For cost reasons, many pipelines are only rarely inspected with smart pigs, because shutdowns for several inspections per year would mean huge economic losses. Real-time monitoring systems are a good way to detect large leaks, but even those are often difficult to locate. At worst, several hundred meters (yards) of pipeline must be uncovered and inspected--a disproportionate effort.

Not just avoiding economic loss but also environmental protection is a top priority in pipeline operation. This means not only the search for the spilled liquid, but also the costs involved in disposing of it. After the leak is located, the pipeline must be repaired, and of course the contaminated soil has to be removed over a wide area and disposed of. Not least of the problems is the resulting loss of reputation for the operator -- a great disadvantage when it comes to acceptance by society.

THE GLD AND THE THIEVES

To fulfill all the requirements, Gottsberg Leak Detection has developed the GLD 202: a compact and robust leak detector, which can be deployed easily and often. Pipeline operation is almost unaffected during pigging, and even the smallest insidious leaks can be accurately detected and located. Another controversial issue in pipeline operation is increasing theft of the product. In parts of Central America, 20,000 barrels of oil per day disappear -- for the companies, a loss of a quarter billion dollars per quarter!

Due to ever-rising oil prices, this problem is no longer restricted to developing countries. Almost everywhere that petroleum and its refined products are extracted and transported, there is also theft today. So even now, there are special US FBI units to prevent, or at least reduce, the growing oil theft in Texas that causes millions in losses every year.

In most countries, the losses due to theft far exceed those caused by dilapidated old pipelines.

Often, the thieves who operate with more professional equipment drill into the pipelines, so the leaks can no long-



FIGURE 1: Cleanup and repair work after a pipeline leak (source: © ddpimages /AP Photo/Al Grillo)



FIGURE 2: Oil leaking from a pipeline (Source: Russ Widstrand/Workbook Stock/Getty Images)

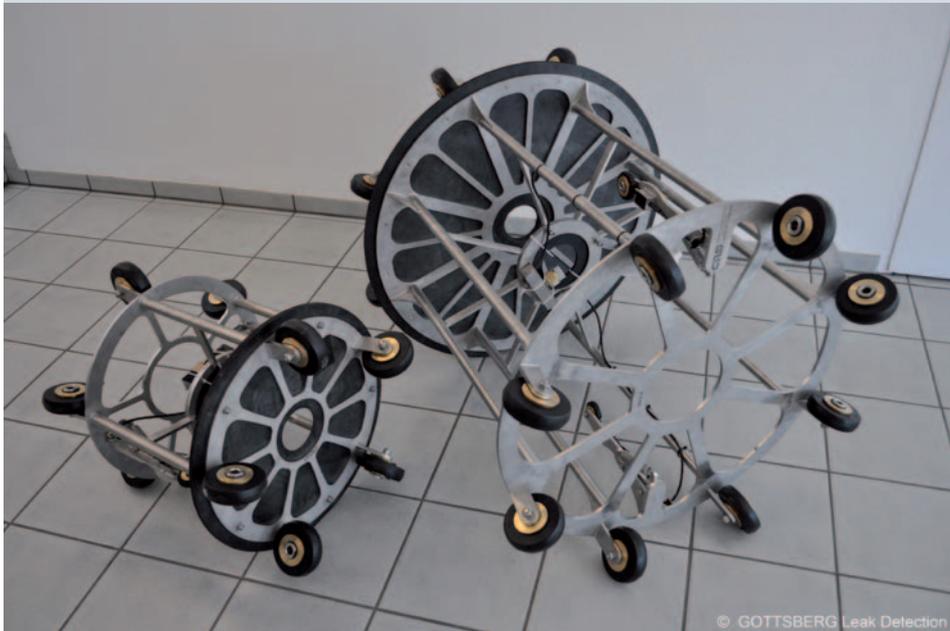


FIGURE 3: GLD 30x chassis for 24" and 36" pipelines

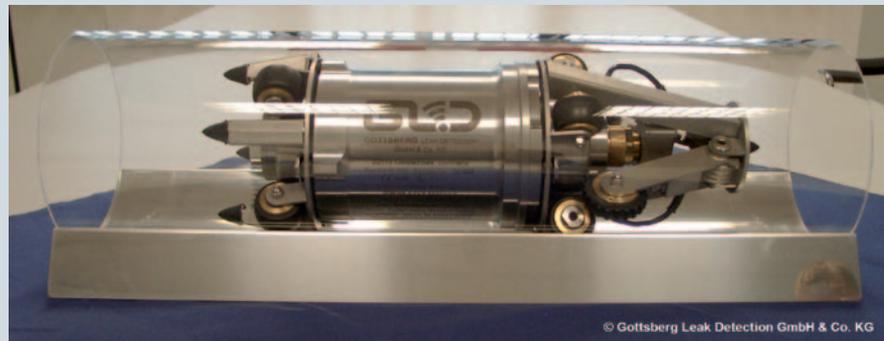


FIGURE 4: GLD 202 with chassis and odometers

er be detected by conventional measurement methods. The holes are too small, or the pressure and fluid losses are even offset by foreign substances. In that case, quantity measurement methods also fail.

For all of these problems, the product range of Gottsberg Leak Detection offers a reliable universal solution "made in Germany."

THE GLD EQUIPMENT IN FUNCTION

With the GLD 202, pipeline operators and service providers use a device for early leak detection, the world's only intelligent pig that -- thanks to its ATEX approval for Zone 0 -- can be used in any liquid pipeline, without compromising operation. The operator put the system into the pipeline, the run is performed, and the detector can be removed at any pig trap. After reading out the data, the operator get instant results on the condition of the pipeline. If the operator finds a leak, he can determine its location and size, and take prompt remedial action.

The GLD leak detection system works by using multi-spectral analysis of events, and records the noise during the entire pipeline run every second on 128 channels. This means that you will receive 64 channels of data each in the low and high frequency ranges, which are used for evaluation. The data are suitable for an analysis of potential leaks, and even

give other information on the condition of the pipeline (e.g. wax deposits on pipe joints, movement of sliders). The system can use virtual markers, which also facilitate location of any damage.

Depending on the type of pumped liquid, such as opaque crude oil, visual inspection in operation may not be possible. That leaves the difficult task of reaching conclusions about the state and leak tightness of the pipeline on the basis of acoustic signatures. Our North German company offers a very small inspection pig with unusual abilities. The heart of the system is the GLD 202 detector, which can be used in combination with the GLD 30x chassis in any pipeline with an inside diameter of 200mm (8") or more. This keeps the operator's costs to a minimum, because he merely needs to change the chassis to make the GLD 202 suitable for various pipe diameters (Figure 3). All defects in the pipeline, such as slow leaks, leaking valves or dirt, which generate any noise by flow around or through them, can be detected by multi-spectral analysis and can be reliably located using the GLD 700 analysis software.

With the GLD 202, inspection of pipelines is as easy as a child's game. Analysis of the data is largely automated, so after a few minutes of analysis, pipeline operators and inspection providers reliably know the state of the pipeline. For the first time, such pigging inspection can be carried out by non-experts. This is partly because the GLD 700 analysis software, running under Microsoft Windows, is very simple to use.

It converts the audio information into graphics. The aim of its development was the reliable location of leaks that conventional technology often failed to find, because noises were not reliably detected as false alarms and often led to shutdown of the system. These false alarms are a thing of the past, and noise is no longer a problem but a tool. Through the accurate identification of these sounds, they can be used as milestones that can help in evaluating the data for pig or leak location. If the operator uses the additional option of integrating the GLD 700 program with geographic information software from other companies, such as Google Maps®, he can get very accurate location of the noise sources and thus obtain additional information about the pipeline. These options are complemented by odometer wheels (**Figure 4**), which normally deliver the most precise values for position and speed determination to the chassis.

In addition to evaluating an inspection run, the GLD 700 analysis software (**Figure 5**) is responsible for communication between the GLD 202 detector and a computer.

Before each run, various starting parameters, such as duration of the run, pressure conditions, or odometer wheel diameter, are transferred to the pig, and a self-test can be performed. When the run ends, the record is read and can be immediately evaluated. All measured values are displayed both graphically and numerically. Search algorithms for distance markers and leak intensity, and self-definable settings, help users find interesting locations. Also, two records can be compared with each other by being presented horizontally,

one above the other, so comparison of conspicuous changes in the pipeline is possible.

CERTIFICATIONS

The GLD 202 detector and the GLD 30x have been approved by the TÜV (German certification agency) for use in Zone 0 highly explosive atmospheres:

- » EX II 1 G Ex d+e ib[ia] ia IIB T3
TÜV 07 ATEX 553393 X
- » EX II 1G c IIB
TÜV 08 ATEX 554661 X

Also, the GLD 202 Detector has been tested for function and suitability to task by TÜV Nord Systems GmbH & Co. KG. It fulfills the criteria under Section 11.5 of the TRFL (German pipeline regulations) requirements for leak detection and location.

Technical data:

- » Data acquisition and processing: Minimum detectable leakage rate 6.8 liters/hour (1.8 gallons/hour) (TÜV certified); Pressure; Temperature; Sound; Time; Distance; Battery voltage
- » Sound signal and frequency analysis: Analog bandwidth limits 100 - 60,000 Hz; Digital sample rate measurement 128,000/second; Data compression up to 1024 bytes/second; Multi-spectral analysis with FFT in 128 channels; Transient detection with classification (window

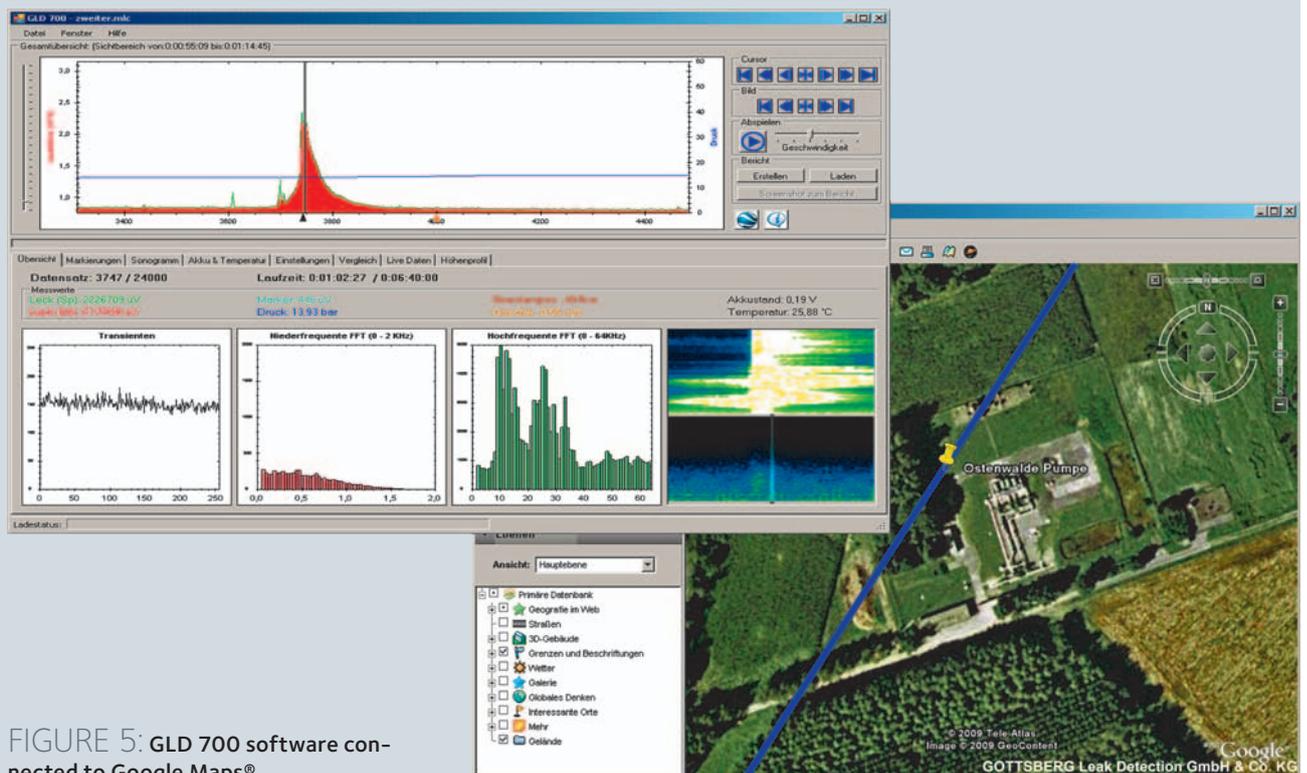


FIGURE 5: GLD 700 software connected to Google Maps®

width 4ms); Marker recognition of noise signals; Detection of virtual markers

Technical information:

- » Pipeline inside diameter: minimum 200mm (8")
- » Curvature radius: minimum 3 times diameter ($R = 1,5 \times d$)
- » Operating time: >200 hours (NiMH); Operating time: >100 hours (NiCd)
- » Permissible ambient temp. max. 40°C (104°F) (NiMH); Permissible ambient temp. max. 60°C (140°F) (NiCd)
- » Operating pressure: max. 100 bar/atmospheres (1470 psi)

Information needed for inquiries and orders:

- » Diameter and length of the pipeline
- » Maximum and minimum operating pressures
- » Maximum operating temperature

- » Minimum curvature radius
- » Approximate profile (slope/gradient)
- » Viscosity of the pumped liquid
- » Average flow velocity

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