Outside, looking in

Maintaining your pipeline infrastructure with video inspection

By Richard Lindner

It's no secret that the slightest disruption in plant systems can cause challenges ranging from scheduling and delivery problems to lost profits and unwanted downtime. Increasingly, plant mangers are avoiding emergencies by using a variety of technologies and methods that not only solve problems, but help to identify them before they occur. This is especially true with inspection of the pipelines that supply the life's blood for many manufacturing, processing and power facilities.

In recent years, the need for pipeline inspection has spawned many innovations, allowing maintenance personnel to capture crisp video imagery from pipe of any condition, size, material and layout.

Among these innovations are push cameras and inspection crawlers, as well as zoom survey tools and sidewall scanning technologies. Each technology offers a combination of benefits that's sure to address unique facility needs, as well as budgetary and manpower constraints. The trick is understanding each technology and making an informed investment decision based on in-depth field tests and on-site demonstrations.

Seeing from afar

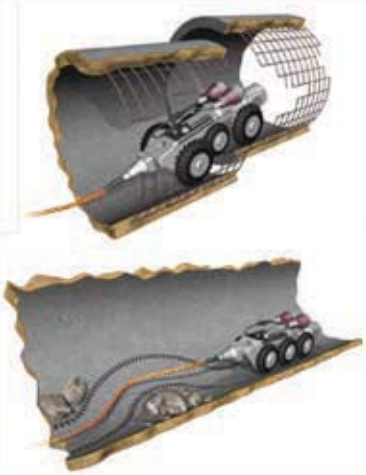

Figure 1. Push cameras can maneuver to overcome common pipeline obstacles.

Customized eyes

Figure 2. Crawlers with interchangeable parts adapt to perform in a broad range of pipe sizes, materials and conditions.

The traveling camera

Over the years, delivery mechanisms have emerged that carry cameras deeper into pipelines, while capturing increasingly better images. At the lower end of the market are push cameras, which televise pipelines using a self-leveling camera head and shadowless LED illumination, both mounted to the end of a semi-rigid push pole.

Push cameras (Figure 1) can televise as much as 200 ft. of pipe, and are optimized (and often are the only suitable alternative) for lines smaller than 4 in. In recent years, push cameras have evolved to incorporate text writers, which allow an operator to make onscreen annotations, as well as digital storage media such as DVD writers and flash card bays. Higher-end push cameras offer the option of panning and tilting the camera, a feature that proves useful when a pipe dead-ends into a tank, vessel or mainline.

On the more sophisticated end is the video inspection crawler, a remotely-operated vehicle designed to carry a robotically articulated camera hundreds — even thousands — of feet into pipelines to identify corrosion,

Real-time convenience

Figure 3. Scan segments to be unfolded and stitched together as they're captured. The operator can view the scan as it is generated, and immediately transmit it to an analysis team.

deposits, foreign matter, cracks, deformations, offsets and erosion.

However, even with the most advanced crawlers, you need to determine the right tool for the job. For instance, the crawler size must be consistent with the size of the pipeline and the flow rate in the line. Specific applications require specialized crawlers. Fortunately, most inspection work involves line sizes between 8 in. and 24 in., and most crawlers target these applications.

But, questions still arise as to size when choosing the appropriate crawler. As a result, many plant engineers have chosen more compact designs that have the flexibility to tackle a larger range of applications. Many crawlers are fully modular (Figure 2), and can be easily reconfigured to various line sizes via interchangeable wheels, lamps, cameras and camera elevators. Another benefit a compact crawler provides — especially those with a short wheelbase and six-wheel drive — is an ability to maneuver around protruding pipe taps, over thick patches of sediment, up offsets and in tight spaces.

Furthermore, while bulk is often associated with sturdiness, size and weight can work against a crawler. In contrast to their larger counterparts, compact crawlers use less tension to pull their lightweight cables, and steerable crawlers require no periodic yanking to get them back into alignment. Reducing such sources of cable strain reduces the frequency of cable maintenance, the most common service procedure. Moreover, when service needs arise, smaller crawler systems are less expensive to ship, maintain and repair.

Pipeline zooming

A pipeline inspection technique called zooming delivers quick, comprehen-

Flexible viewing

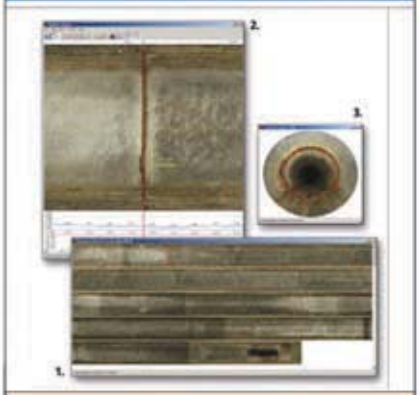

Figure 4. Software allows quick scan navigation, analysis and annotation.

sive information about pipe conditions using inexpensive equipment and few personnel. Zooming's goal is a rapid classification of infrastructure as either satisfactory or in need of maintenance, repair/replacement, or additional CCTV inspection. These classifications allow you to confidently prioritize maintenance activities, committing maintenance resources — inspection crawlers, cleaning trucks, cutters/rodders, GPS surveyors, and grouting and relining crews — exactly where they're needed most.

Inspection crawlers can't be matched for their detailed, 360° pipe inspection, but they move slowly, require substantial investment and demand considerable manpower and overhead. By contrast, zooming allows a single operator to make a rapid visual pipe assessment using an inexpensive, ultra-portable zoom inspection camera.

Zooming's simplicity is its power. A typical zoom inspection system consists of a camera, lamps, a positioning pole and a video display. Grasping the pole, an operator orients the camera to look down a section of pipe. Starting with a wide-angle view, the operator slowly increases zoom so the camera's view advances down the pipe. In this manner, an operator inspects the entire length of the pipe for anomalies, and then classifies its condition accordingly. Zoom inspection cameras also are ideal for inspecting tanks and vessels that provide limited access, helping avoid the hazards of confined space entry.

Another benefit accrues to cleaning crews, which often work more efficiently with zoom inspection cameras. With a quick glance down a line before cleaning, and then again afterward, an operator can judge the effectiveness of cleaning, or even monitor the efficacy of a specific cutter or nozzle, in real time.

Manhole inspection is an integral part of infrastructure assessment, and some zoom cameras can be adapted for wide-angle viewing. A wide field of view allows a camera to see larger regions of a manhole wall or other up-close target. It also allows an operator to capture the entire circumference of a manhole wall from a downward-looking vantage point. Commonly, use of a wide-angle lens for pipeline zooming requires a lamp diffuser to produce more uniform illumination.

Flexible viewing

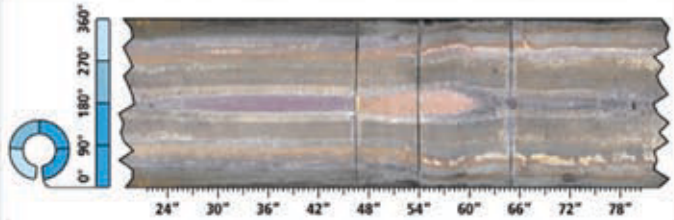

Figure 5. The high-resolution digital scan captures the entirety of a pipe wall interior.

Sidewall scanning

Digital visual sidewall scanning (DVSS) relies on the proven inspection crawler platform to gather visual data from within a pipe (Figure 3). However, unlike traditional video inspection, DVSS uses digital image processing to deliver information about pipeline condition in a format that's easy to analyze. DVSS uses signal processing to convert video frames into a flat digital scan. This scan resembles a long mural or scroll, and it bears an image whose length corresponds to the length of the pipe, and whose height represents the pipe's inside circumference. These scans capture a level of detail greater than conventional video, while presenting it in a format that's easier to review and analyze.

Rather than sitting through hours of inspection video, an analyst can review an entire length of pipe at a time, quickly pinpointing problem areas and making notations and measurements directly on the scan itself. Special client software further aids this review. It provides a thumbnail version of the entire scan (resembling a film strip) allowing quick navigation to specific regions of the scan (Figure 4 and Figure 5). Drawing and annotation tools also allow analysts to mark up the scan, while identifying pipe features and highlighting regions of concern.

The empirical approach

Ultimately, there are many innovative alternatives for improving a facility's pipe inspection capabilities. Fortunately, the decision doesn't have to be entirely academic. Explore the options firsthand by requesting field demonstrations on your most challenging pipelines.

This will allow you to throw all the curve balls you want — partial collapses, protruding taps, curved inverts, offsets, debris, roots, grease, flow — and let the best technologies for the job reveal themselves. In this way, the true winner in the end will be the facility itself.

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