■ **Limits of Leak Detection** *from page 19*

- The leak rate would be defined at the operating condition of the storage system to take into account the widely varying pressures in different storage-system components (e.g., bottom of tank, top of tank, pressurized piping).
- While I still believe that secondary containment holds the most promise for very sensitive leak detection, we have learned that, in some cases, secondary containment is part of the problem rather than the solution. (See "Pipes and Sumps—As I See Them" below.) Monitoring both walls of secondary-containment systems will help to ensure that these systems achieve their promise of fully containing petroleum releases from storage systems.

The Bottom-Line Leak

We sense that the existing leak-detection standard of 0.2 gph is too permissive. But if we are going to tighten up leak detection then we need to have a rational standard for the size of leak to be detected and some clearly drawn parameters to describe the acceptable leak rate.

Our king's vision of a no-leak kingdom is unachievable because our modern-day ability to measure impossibly small quantities leads to a scenario where all things are declared to be leaking. The ministers' approach of determining the size leak that it makes sense to detect, carefully defining this leak, and then letting the engineers do their work to find ways of reliably detecting this leak seems an eminently more practical solution to the problem. ■

What do you think?

Pipes and Sumps—As I See Them

Thoughts from a Florida UST Inspector

by Ernest M. Roggelin

Because of space constraints and because it will be more helpful if you view the photos for this article in color, we have chosen to make all 65 of the photos Ernest provided to illustrate this article available to our readers on the NEIWPCC Web site at: *www. neiwpcc.org/lustline/sumpandpipingphotos.htm.*

Since the mid-1990s there has been an increased level of interest, or perhaps just more active reporting and sharing of information, among state and federal UST inspectors regarding the deterioration of storage tank system components, specifically nonmetallic underground piping and containment sumps.

Nonmetallic piping includes two types: rigid (thermoset) and flexible (thermoplastic). How do you tell these types or brands of pipe apart? First, get to know the contractors in your area—visit their shops, ask questions, and get your "hands on" experience. Second, the Internet is a wonderful tool, and most manufacturers offer a wealth of detailed information for the curious (go to www.pei.org *for links to most manufacturers' Web sites). The sumps of concern are located at the tank top (piping sumps), beneath dispensers (dispenser sumps), and where piping goes from an abovegrade to a below-grade location (transition sumps).*

So let's have a look at pipes and sumps. The photographs used to illustrate this article come from a variety of governmental agencies throughout the United States.

First the Piping

■ **Thermoset Piping**

Thermoset or rigid fiberglass-reinforced plastic (FRP) piping has been around for at least as long as I have been inspecting tank facilities. Typically, someone has to "do" something foolish or deliberate (e.g., step on it, drill through it, score it, impact it), improperly install it, or have it be subjected to ground movement (i.e., shearing) to create a problem. I have not observed any deterioration of thermoset materials from exposure to petroleum products.

■ **Thermoplastic Piping**

Thermoplastic piping, especially the polyurethane and early polyethylene flexible compositions, have been subjected to intense scrutiny over the past several years. Following the introduction of polyurethane-based piping in the early 1990s, Florida began seeing microbial growth and degradation in the outer jacket of some single-walled piping within three to five years of installation. (See Figure 1.) Manufacturers typically replaced the affected sections and often the entire run at a given station with the latest version of the pipe. There was no mandatory recall of the initial pipe. Replacement was apparently based on the individual behavior or response of the pipe.

FIGURE 1. *Black mold growth; degradation of single-walled pipe's external cover*

Fast-forward five to seven years, or approximately 10 years from installation, and we've found that an increasing number of thermoplastic piping systems at Florida facilities have been experiencing a variety of pipe-deterioration conditions. In retrospect, most of the initial product lines manufactured had a 10-year warranty. A warranty refers to the expected lifetime of any given product. This is not to say the pipe has to reach the end of its warranty period to experience problems, although time may be a unifying factor. So, should we be surprised at the events?

Signs of Concern

What are inspectors seeing during the course of their site visits?

- Exterior and interior color change in the pipe
- Mold growth on the outside of the pipe
- Softening or jelling of the pipe
- "Blowout," a term used to describe the rupture of the outer jacket of the primary pipe
- Cold growth or lengthening of the pipe, including backing off fittings, and movement of equipment out of position (see Figures 2 and 4)
- Brittle interior core and cracking of the carrier portion, cracking of the secondary wall, and loss of internal integrity of the pipe (see Figure 3)
- Loss of communication within the interstice of a coaxial pipe
- "Alligatoring" or rippling of the outer layer
- Fitting failure

FIGURE 2. *Growing pipe meets fitting*

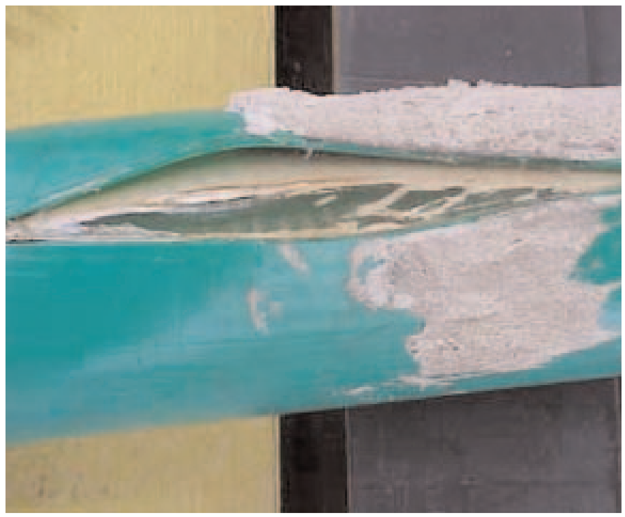

FIGURE 3. *Split of secondary pipe; apparent failure of primary layer underneath*

Causes?

Initially, manufacturers' response to the piping problems was to direct the blame to the installation contractors. However, contractors are all required to be manufacturer trained in piping installation, so this logic is somewhat circular. As states began sharing information about a widening pool of incidents at various types of facilities, this rationale became implausible. I would be remiss if I did not attribute some level of responsibility for the problems to "contractor error," as problems do occur because of deviation from standard practices.

Next in line for blame were the facility owners. Manufacturers insisted that the exteriors of their products were not designed to be in contact with petroleum for an extended time period (e.g., beyond 72 hours). They implied that the initial designs assumed pristine, well-maintained piping runs that were not subject to long-term exposure to petroleum products. Failure to maintain these conditions was obviously a failure in piping maintenance on the part of owners, though the requirement that these products be maintained in such a pristine environment is not stated on any manufacturers' sales literature that I have seen.

Exposure of the exterior of the pipe to petroleum can occur within an interstitial space of a coaxial pipe, within a secondary or tertiary "chase" pipe, or from environmental exposure due to soil and/or groundwater contamination at a facility. Given that in the real world exposure of the piping exterior to petroleum will occur, how is an owner to return the piping to "pristine" condition?

There are two areas of concern associated with post-exposure cleaning. First, the separate-component primary and secondary pipes do not all have the smooth bore typical of thermoset fiberglass pipe. Thermoplastics typically have what I call a corrugated chase that has the potential to retain liquids within the separate cells of the corrugation. Second, with the coaxial style of pipe, there is a question of how to flush the interstice of product once exposure has occurred. Furthermore, how can the cleanliness of the interstice for either type of pipe ever be verified?

Standards?

"Hey, there are compatibility standards in the regulations," you say. Sure, Florida has a number of them, including UL 971 from Underwriters Laboratories (UL).

One of my duties is to represent the Florida Department of Environmental Protection (DEP) on the UL's 971 Standard Technical Panel. The panel is composed of representatives from manufacturing, industry, interested parties, and regulatory authorities that meet and by consensus develop new and revised standards capable of evaluating a specified product. The regulatory authority input has been a recent change to the panel's makeup.

One point of discovery that became evident during the technical panel's evaluation process for the UL 971 standard was that the existing standard focused on the testing of the primary carrier portions of the pipe—the exterior of the pipe was ignored. The new standard under development at present will evaluate the entire pipe—both inner and outer walls.

Now the Containment Sumps

So what about containment sumps? States have different requirements...

■ continued on page 22

■ **Pipes and Sumps** *from page 21*

let alone the federal rule. Florida has specific language requiring dispenser sumps or at least a method of sub-dispenser containment; but the typical piping sump is not a requirement. The facility just has to have a method of providing access to the piping interstice for monitoring. Granted, most new facilities have some form of sump, but many existing facilities have earthen or gravel "pits" beneath a traffic lid—pits that serve as excellent conduits to groundwater.

What do inspectors see when they look into a containment sump? There are facilities with discrete sumps and facilities with factory-mated units. By factory-mated, I mean those sumps that are heat-welded to the tank shell and those where a mating collar is an integral part of the tank shell. The factory-mated units can be made of thermoset or thermoplastic materials. Again, the thermoset types are most likely to suffer from impact damage or contractor error. They do not appear to deteriorate from contact with petroleum or to deform from external ground or water-table pressures.

Signs of Concern

Thermoplastic sumps have exhibited the following types of problems:

- Rippling, collapse, or inward movement of walls from external pressure. (See Figure 4.)
- Distortion of the floor from apparent "long-term" exposure to petroleum.
- Groundwater upwelling pressures or lack of backfill support causing some of the floor distortion on the discrete models. The floor distortion for the factory-mated type is more of a concern since it is typically the tank's secondary containment that is undergoing this deformation.
- Sump penetration boot failures. (See Figure 4.)

Discrete sumps have their share of contractor errors, especially by electrical contractors, who are not typically concerned with maintaining the liquid-tightness of sumps. These errors are all readily visible to the experienced and patient inspector during the installation oversight process. Thermoset sumps require foreknowledge by the inspector of the correct angle of penetration of piping through the sump walls and the use of appropriate penetration fittings.

FIGURE 4. *Ripple in sump wall; torn boots; shift in pipe position within secondary pipe*

Thermoplastic sumps, especially older thin-walled models, can deform in response to soil movement and/or shallow groundwater levels. As mentioned, bulging of the walls is a readily noticeable event, along with cracking of structural features. In addition, there is the reaction of the "plastic" to long-term exposure to petroleum, whether it is free product, petroleum contact water, or vapor.

Manufacturers have failed to provide sufficient guidance on "how" these structures can be cleaned after exposure. Complicating the issue is the designation of most of these sub-grade structures as confined-space entry points. An additional concern from the facility owner perspective is the waste disposal cost of flushing a secondary-containment unit with water or an emulsifying agent. When thermoplastic sumps are damaged, there does not appear to be a manufacturer's recommendation on how to repair them.

Solutions?

In Florida, DEP and Local Program (county-level) inspectors are out in the field routinely performing annual, follow-up, installation, closure, discharge, and quality-control inspections. A heck of a lot of inspections! For example, my local program has performed 814 inspections since July 1, 2003. On a statewide level, more than 25,000 inspections are performed annually!

What is the incentive for a facility to maintain its system in "full compliance"? Protecting a significant investment? Avoiding the potential to receive a regulatory penalty? Even in light of problems with long-term exposure of sumps and piping to petroleum, the regulatory focus has not increased in this area. Granted, inspectors in Florida are tasked to specifically note the type and condition of piping at a given facility, but this item typically remains a "minor" infraction. The bulk of the responsibility rests with the facility owner/ operator, some of whom contract out the monthly release detection monitoring to third parties.

In summary, there are problems with certain components of UST systems. Inspectors, owners, their consultants, and contractors can and must frequently evaluate the condition of their systems, maintain the equipment properly, and act in a timely and responsible manner upon the discovery of problems. Many facility owners mistakenly believe that secondary containment is the cure for all their petroleum storage ills. What they do not recognize is that, in some cases, secondary containment is part of the problem, not the solution. ■

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