NEWSLETTER

March 2016
Year IV. Edition LII

INSPECTION & ENGINEERING - SOLUTIONS & TRENDS

SPECIAL EDITION ON

## Effective and Timely Thickness Monitoring

EDITORIAL

## Challenges and Unforeseen Events.

In this Edition when we have already left behind the first quarter of 2016, I want to invite our community of readers to share reflections on the progress of projects and goals that we have set for this year. Quarter (25%) of 2016 has passed and we have three-quarters (75%) achievements to materialize in such detail what we plan and we started to run in the first quarter.
This is a good time to recognize the challenges of implementation and identify the contingencies that we could have ahead. On these challenges it is where we want to build strong relationships with our customers, employees, suppliers and friends.

We are dedicating this edition to discuss ways to implement thickness monitoring programs able to effectively detect metal loss and provide early information on corrosion rates changes, in a way to correlate them with process and operational changes.

Francesco Solari
Inspfalca President

**ACHIEVED**

**46.400**

MAN HOURS WITH NO

**ACCIDENTS**

INDUSTRY COLUMN

# Tank Floor Linings

**Pedro Alongi**
Inspection Equipment Cordinator

Recently I read an interesting article in a NACE publication related with tank linings basic and I thought, it is always good to back basis mostly when dealing with critical systems, like in fact a tank lining is, since we rely on them to mitigate internal corrosion in a component which condition is difficult to assess while the tank is in operation.

Some of the most critical uses of protective coatings involve service conditions that require the use of coatings as linings. They may be the same coatings that are used in atmospheric or underground service, but they are usually specially formulated for three specific purposes: 1) To protect the substrate (steel, aluminum, concrete, or other materials) from attack by the liquid being stored inside the tank or temporarily stored inside a containment structure, 2) To protect the liquid being stored from contamination by the substrate and 3) To restore structural integrity to an old tank, while meeting the requirements for protection of the substrate from corrosion and the liquid in storage from contamination

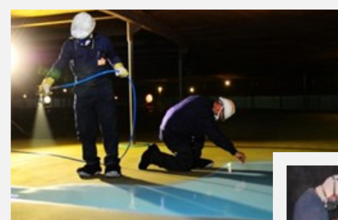
All coatings are permeable to some degree. The choice of coatings as tank linings requires a much greater knowledge of the properties of the liquid being stored and the ability of the coating to withstand permeation by that liquid than would typically be required for any coating being applied in atmospheric service. There are three recommended alternatives that will provide choices with better chances of success in a given application:

1) Comparative side-by-side testing of candidate systems in a laboratory program that simulates, to the best extent possible, the service conditions expected in that particular tank. This takes time but can provide very good indications of a lining's resistance to permeation by a particular liquid for a given period of time at a stated storage temperature.

2) If time does not allow for comparative laboratory testing, the candidate coating manufacturers can be requested to provide their chemical suitability tables for the products that are being considered for a particular tank. Although this normally is limited to specific testing for specific time frames such as 30 and 60 days, it often provides reliable guidelines about the performance characteristics of each product. In addition, these suitability tables normally include some very valuable precautions regarding immersion based on the pH, temperature, etc., of the chemicals.

3) Review selected case histories of tank linings used in similar services. This can be very valuable as it provides longer-term results. However, when doing so, the project tank and containment linings manager must be careful to confirm that the service conditions are truly similar to the expected service conditions. He or she must also be careful to confirm that the product shown in the case history is still formulated the same as it was when that case history was conducted.

Effective product side corrosion mitigation for tank bottoms can be achieved by the right tank lining, and on that regard the API-653 provides the opportunity to use a tank bottoms linings as a credit to extend the inspection intervals when corrosion rates of a new floor are unknown and also is an important risk mitigation attribute in Risk Based Inspection analysis for tanks.



LEARNED LESSONS

# The dangers of hiding explosive mixtures in hot work activities

This is the sad story of a hot work activity that ended in a tragic lost of life, 10 injuried people and devastating damages to a tank.

It happened during the execution of a tank repair job back in November 14, 2014, when a tank was taken out of service to make repairs in the shell. The tank was properly isolated, vented and cleaned, major repairs conducted and internal coating completed.

The entire scope of work took the tank out of service for 318 days, and all the phases were conducted safely according company procedures, but a last minute addition of small conections to the 24" internal manifold required a hot work touching the internal outlet piping inside the tank.

Again gas testing was performed in serveral locations inside the tank includind inserting the gas tester hose 30 cm inside the 24" manifold, getting all the readings within acceptable limits for a safe hot work. While performing the torch cutting the welder heard a noise coming from the manifold and urged the crew to exit the tank, but two violent explosions ocurred inside generating a fire, raising the tank from its foundation and moving it 7 m away which could be even worst, but the connecting piping restricted the tank movement.

It was found that the "U" shape of the two 24" arms of the manifold had not low point drain and collected oil inside during the entire tank turnaround which formed a explosive mixture that was hiding there for almost one year and nobody thought that after so long any hazzards could be present for hot work.

This sad incident brings lessons learned around improvements in Job Safety Analysis (JSA), more scrutiny in desing configurations and ultimately always fight against complacency, understanding that no matter for how long we have been working safe, we can never give up on a good JSA.

A link to a very interesting animation video follows.

Tank Explosion Video

# On-Line Thickness Monitoring Vs. Conventional TML programs

Often for generalized metal loss, UT based TML readings are sufficient to provide good information, but in many cases it may not be if process conditions change or are erratic. In recent years, new technology has become available to supplement manual inspection with a system that can provide data automatically and on demand. This data can then be combined with other relevant data to create detailed logs, which helps make the owner-user aware of the health of the plant and enables them make informed decisions as to what action, if any, is necessary to maintain the integrity of their assets. Online measurement of pipe and pressure vessel wall thickness is made possible by installing wireless, semi-permanent thickness monitoring sensors.

In this article, the need and requirements for online corrosion monitoring and the methodology for choosing the monitoring locations are explained. The quality and frequency of the measurements delivered from the monitoring system is compared with manual ultrasonic thickness (UT) measurements.

In order to know whether refinery equipment has withstood the demands that have been placed upon it, and that it can withstand the demands being placed upon it now and into the future, a current picture of asset health is needed. Manual inspection can provide a snapshot of plant integrity, but is normally only feasible on a limited frequency due to the cost and practicality of accessing piping and pressure vessels. Much of a refinery's process equipment, is simply too hot to obtain a reliable reading while the plant is operating. Additionally, access to certain locations can be expensive if staging is required, and can put personnel at risk. As a result, manual inspection is often carried out during a period with the plant is shut down. An automated corrosion monitoring tool can be used to supplement periodic manual inspection and bridge the information gap.

In addition, and aligned with the API-584 Integrity Operating Windows concepts that we discussed in our January edition; if online measurements are of sufficient quality and frequency, then small changes in the integrity of the plant can be identified in near real time. Knowledge of where, when, and how corrosion is developing, as well as an accurate measure of its severity, without the need for plant shutdown, better enables owner-users to make a multitude of proactive decisions.

Additional benefits can be realized using fixed, online sensors. For example, the same spot is measured every time, eliminating measurement error inherent to manual measurements. Other potential sources for error, such as the use of different technicians or alternative equipment, are also eliminated. The resulting data is more consistent and therefore more useful when comparing consecutive measurements for corrosion rate calculations. The wireless online UT system discussed here can provide direct wall thickness measurements to allow for real-time integrity assessment and the detection of small changes in corrosion activity.

The quality of the measurements, the frequency of those measurements, and the delay in delivery of those measurements to the decision makers are all important factors. In order for the data to be useful for real-time decision making, direct wall thickness measurements should be acquired and delivered without delays or additional costs for data collection or interpretation.

The ability to place sensors within high-risk corrosion areas of a plant is key. For example, in order to measure higher temperature corrosion mechanisms, such as sulfidation or naphthenic acid attack, the sensors must be able to reliably function in extremely high operating temperatures. Areas in which sulfidation corrosion is a concern for refinery equipment will vary depending on the metallurgy, but they are always greater than 450°F (230°C). Naphthenic acid attack, commonly experienced when processing higher acid "opportunity crudes," also occurs at similar elevated temperatures. Available wireless sensor technologies use exactly the same measurement physics as manual ultrasonic inspection, and can be safely installed on or near hot metal surfaces (operating up to 600 ˚C (1100 ˚F)).

The total cost of ownership of a wireless corrosion monitoring system should always be considered. This includes equipment costs, installation costs, and ongoing data acquisition and maintenance costs. It is also important to consider if the corrosion monitoring system can be installed while the plant is in operation. In this respect, a non-intrusive system is desirable to reduce the cost of installation and impact on refining operations. Consumable parts, such as intrusive corrosion probes or coupons, can add to the costs and risks associated with a corrosion monitoring system.

Automated wireless data delivery reduces the cost of installation since no wiring is required in the field and there are no additional data collection costs, delays, or safety risks. For areas that require extensive staging to access, this data collection and retrieval method can also minimize costs associated with maintaining or providing direct access.

Careful consideration should be taken during selection of the corrosion monitoring locations. Each corrosion circuit of interest should be evaluated individually for the selection of monitoring locations. Such a circuit is a subset of the plant that is exposed to similar corrosive conditions. Historical inspection data can be useful to identify areas that have previously showed elevated activity. Consideration should be given to the type of component (e.g. straight run pipe, elbow, tee, or reducer) and its orientation. In particular, corrosion mechanisms that are accelerated by increased shear-velocity effects will have an increased impact on the outside of bends or reducers. Consideration should be given to ensure a variety of components are selected for monitoring, as well as certain susceptible areas, such as turbulent regions, phase separation areas, or deadlegs.

The refining industry has relied primarily on manual thickness data collection for assessing equipment integrity, predicting end of life, and determining time to the next scheduled inspection. Although there have been some advancements, the techniques of ultrasonic testing and radiography have not seen significant changes in decades. For the most part, manual inspection has served as an adequate means of identifying equipment damage.

Typically, thickness readings are taken at a regular interval or at a calculated half-life. Due to the large number of locations that need to be inspected, it is not realistic to gather more than one reading every year. Typical intervals between thickness readings are every three to five years. However, with such long intervals between inspections, it is impossible to correlate the fluctuations in metal loss rates versus changes in operating conditions. With just two data points, it is impossible to know if the corrosion happened at a steady rate between these two snapshots, if it was a result of a single process upset, or if it was related to a specific combination of operating conditions that led to moderate increases in corrosion activity. When the lack of data is combined with general uncertainty as to the measurement accuracy caused by variations in technician capability, and an inability to consistently take measurements in the exact same location, , it is often not possible to identify an issue early before it has a chance to cause significant corrosion or even a leak.

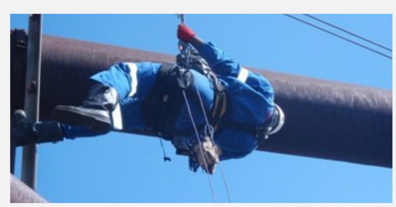
All of these factors are eliminated when a sensor is placed in a fixed location and is able to collect data automatically, multiple times a day. The variation in the data is much lower and the sampling rate can be increased to desired levels and timing over a comparable time period. The combination of repeatability and more frequent measurements can provide engineers and inspectors with necessary data to really

The ability of fixed ultrasonic thickness monitoring sensors to be installed at almost any location in the plant, combined with the frequency of data output, provides the owner-user with an improved understanding of how process changes affect specific parts of the plant. It allows the fixed equipment integrity specialists to determine the severity and rate of corrosion to specific parts of the plant. Finally, a more complete understanding of the corrosion rate and specific areas of degradation allows the maintenance team to more effectively plan necessary work.

Fixed ultrasonic thickness measurement sensors have the ability to show how corrosion can change in near real time, and they can help improve our understanding of refinery operations.

Non-intrusive online integrity monitoring is quickly becoming industry best practice due to the availability of data-to-desk monitoring systems that provide previously unachievable accuracy and frequency of online wall thickness measurements. The availability of wall thickness measurements for engineers and inspectors to easily review provides convenient and consistent access to measurements that can convey the current condition of an asset. In addition, the quality and frequency of the measurements enables variations in corrosion rates to be detected, measured, and acted upon while the plant is operating.

In Inspfalca we are ready to support our customers in the evaluation of specific cases where the potential severity of degradation mechanism that could vary significantly based on process and operational changes could justify the implementation of on-line thickness monitoring systems.



## upcomingevents:

NACE GALVANIZIN WORKSHOP- April 7 2016 Hilton Houston Westchase Houston, TX, U.S.
2016 API /2016 Spring Committee on Petroleum Measurement Standards Meeting March 14 - 18, 2016 Hyatt Regency Dallas at Reunion Dallas, Texas
2016 API/ 2016 API International Trade and Customs Conference March 28 -30, 2016 Hyatt Regency Hotel New Orleans, Louisiana
API Pipeline Conference and Cybernetics Symposium April 5-7 2016, Carlsbad, California.
Rotating Equipment, Reliability and Maintenance Conference 2016 April 18-20, Al Khobar, Saudi Arabia.
Internacional Pipeline Coating Conference April 20-21, Dubai, UAE.
Internacional Aboveground Storage Tank Conference & Trade Show April 20-22, Orlando Florida.
Plant Maintenance, Inspection and Engineering Expo and Conference April 21, Pasadena Texas.
36 Th Annual International Operating Conference & Trade Show May 23-25, 2016 – Houston, Texas.George R. Brown Convention Center.