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Corrosion Monitoring from the Comfort of Your Office, Home, or Car.

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ABSTRACT

Wireless technology for monitoring fixed asset corrosion/erosion conditions has enabled corrosion engineers and others the ability to monitor wall thickness data on demand via an internet connection and a web browser. Information is immediately accessible when working at the facility office or remotely.

Utilizing the long-range characteristics of LoRaWAN® in conjunction with IoT technology provides users the ability to place sensors in key strategic areas of a facility with minimal wireless network hardware and IT infrastructure.

Multi-user access of IoT data enables people from different departments to utilize ultrasonic wall thickness data in their specific roles and responsibilities, thus multiplying the value of the information. The thickness data, trending, alerts, and other tools provide critical information needed to make key decisions on fixed asset conditions, effects of past processes, and overall asset life predictions.

Keywords: LoRaWAN, Ultrasound, Thickness, Corrosion, Ultrasound, Permanently Installed Monitoring Systems (PIMS), Wireless Sensors, Ultrasonic Thickness (UT), Monitoring, Asset Integrity, Internet of Things (IoT).

INTRODUCTION

How often have you lied awake at night wondering if everything is alright at work? It happens to many of us quite often. Imagine being able to put your mind at rest by simply picking up your phone or laptop, clicking a few links, and seeing the systems are running and there are no warnings or alarm conditions with the assets you are responsible for maintaining. This future is now realized with the use of wireless sensor technology and cloud data systems.

The task of monitoring and tracking asset fitness for service in a Petrochemical or other processing facility is a job that requires attention to detail of many facility variables. The monitoring of corrosion/erosion of systems historically has been a manual process of inspection and managing the data from the manual inspection.

The incorporation of computers for the management of data has improved the process, unfortunately, the manual data collection process and time to transfer data into the system relies on the data to be transferred. The data itself is only as good as the day/time it was collected.

Using wireless ultrasound sensors and the cloud enables the ability to have data available 24/7 on-line and the ability to have increased frequency or amount of data for an almost real-time monitoring program of the facility assets.

The accessibility of this data in the cloud enables multiple people to access and utilize the information in an as-needed situation regardless of their location. Information is available on-demand without the need to wait for new information to be acquired or manually managed.

Working Remotely

COVID-19 has limited access of personnel to many operation sites. Facilities have closed the doors to outside contractors, many of which are hired specifically to perform ultrasonic thickness measurement testing throughout the facility.

Utilizing wireless transmitters and IoT (Internet of Things) technology, the ability to monitor a TML (Thickness Measurement Location) can be easily achieved. Sensors are mounted onto a pipe, tank, vessel, or other assets. The sensor is programmed to make an ultrasonic thickness measurement and optional temperature measurement and transmit the data via cellular connectivity or RF (radio frequency) transmission via a gateway receiver. The data is transferred via an internet connection to an on-line software host system where it is databased with previous measurement data.

Utilizing the IoT technology, users and administrators have the ability and tools to log onto the system and immediately have the most recent data displayed on a PC screen, tablet, or even a cell phone.

Decreased Risk to Human Life

The utilization of wireless sensors and IoT technology also provides users with a level of safety increase not realized. By using an on-line system, the need of having a human being on-site is decreased. Risks involved with performing manual inspections include trips, falls, exposure. Per OSHA, “5,250 workers died on the job in 2018” and “on average, more than 100 a week or more than 14 deaths every day.”

Top 10 most frequently cited OSHA standards violated in FY 2019

The following were the top 10 most frequently cited standards by Federal OSHA in fiscal year 2019 (October 1, 2018, through September 30, 2019):

1. Fall protection, construction
2. Hazard communication standard, general industry
3. Scaffolding, general requirements, construction
4. Control of hazardous energy (lockout/tagout), general industry
5. Respiratory protection, general industry
6. Ladders, construction
7. Powered industrial trucks, general industry
8. Fall Protection–Training Requirements
9. Machinery and Machine Guarding, general requirements
10. Eye and Face Protection

Most all the above are potential risks to humans performing manual inspections.

SECURITY

These days everyone is concerned about data security. We do not want our personal or company confidential information to land in the wrong hands. The same concern for measurement data is needed and we must also keep in mind the type of information we are keeping secure and what levels are needed.

Personal information such as a social security number, bank account, passwords are all high-level security items. If this information were to be provided to the wrong people, bad this could happen.

Thickness and temperature information about a specific location in a facility is a lower-level concern vs personal or company confidential information. Only a person with specific information about the location and conditions of the information can utilize it. If someone were to hand me a piece of paper with a social security number, most anyone could do harm by using the social security number to file false claims, open accounts, steal your benefits, or commit a crime. On the other hand, if someone were to hand me a piece of paper with a thickness number and temperature number, I would not have any use for this as I do not know where it may have come from, what it relates to, or if it is important or not.

Per the LoRa Alliance, “Securing an Internet of Things (IoT) deployment and keeping it safe and secure is not only a matter of choosing the right protocol, it relies on the implementation process as well as embracing best practices and industry standards.” The alliance also advises that “authentication and encryption are, in fact, mandatory—but networks and devices can be compromised if security keys are not kept safe, not randomized across devices or if cryptographic numbers used once (nonces) are reused”. As an example, the LoRaWAN system is designed specifically to address these security concerns.

Wireless and Cloud-Based Systems

Wireless technology provides an advantage to all other types of systems. The advantage of most wireless systems is primarily in the technology's long-range capability and low-power requirements. A single gateway can handle thousands of nodes over an area of several square miles. Wireless networks can support many different devices using the same wireless protocol, enhancing the system for multiple use functions.

For corrosion/erosion monitoring in facilities, this technology has the primary advantage of being able to deploy thousands of battery-powered sensors, covering thickness monitoring locations (TMLs) over a mile from the gateway and antenna. See figure 1 for a typical sensor installation. Thus, multiple process units, and usually the entire facility can be covered by a single gateway. Furthermore, the STAR network topology allows for predictable, long battery life because the individual sensor nodes are not required to relay sensor data, in contrast to MESH network technologies such as Wi-HART and ISA100. Because the gateway is capable of connecting to and using available third-party cellular networks, it avoids the problems associated with installing hardware on the plant IT infrastructure. Overall, this allows for an easy and low-cost installation of the technology with a wide deployment footprint. Thus, allowing asset owners to realize the economic scalability in deploying not just a handful of sensors, but sensors by the hundreds or thousands and thereby moving from a manual time-based maintenance interval to that of an automated predictive-based model.