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ERADICATING EXTERNAL PIPE CORROSION

Hani Almufti and Yulman Flores, Cogbill Construction, USA, discuss protecting above-ground piping systems from external corrosion under pipe supports.

Numerous attempts have been made over the past few decades to protect piping systems from external corrosion at the pipe support points. Metal wear plates that cradle a pipe from beneath are either fully-welded or tack-welded to a pipe at the contact regions to protect it from friction, and they can be an effective solution.

While these metallic saddles do protect the pipe's paint coating, they do not stop corrosion, but rather promote it: you still have metal-to-metal contact, after all. Also, the installation process requires line shutdown, welding permits, and experienced welders to conduct the work. This would halt production for the duration of the procedure. Such metallic wear pads can also become a safety hazard if moisture is trapped in crevices between pad and pipe, causing the formation of hidden corrosion cells that are hard to detect.

Metal round bars have also been used to raise pipes above their supports to promote airflow. However, such bars would scuff the coating and also point-load the pipe and cause increased stress at the points of contact, not to mention promote corrosion, since there is still metal-to-metal contact. Their plastic counterparts sometimes deteriorate and break off, or simply cause the same point-loading and associated damage.

Rubber, neoprene, and PTFE flat sheets or wraps are sometimes placed under or are wrapped around a pipe at contact regions to isolate it from its supporting structures. However, these sheets and wraps often slide off, fall off, or are torn apart due to high friction forces, thus exposing the pipe to the elements again. Ultimately, they all lead to corrosion.

Most of these solutions, including traditional fibre-reinforced plastic (FRP) wear pads that cradle a pipe and use epoxy to be fastened to pipes, usually require special inspection procedures to verify their effectiveness over time. Inspection devices and processes, including X-ray, radiography, ultrasonic spot readings, etc., are costly. Lifting pipes and recoating them at these weakening points is even more costly.

An innovative solution

The RedLineIPS SmartPad System is Cogbill Construction's all-composite pipe support, with a patent pending, and is designed from the ground up to protect above-ground piping systems in the petrochemical and LNG industries from external corrosion under pipe support (CUPS) points. By utilising a unique composite strapping system, there is no requirement for epoxy or welding to be installed. It installs, can be removed, and then reinstalled in seconds. This allows inspectors to

perform routine visual inspections for corrosion, quickly and at a minimal cost.

The FRP SmartPad cradles a pipe from beneath and raises it above its supporting structure, thus minimising moisture accumulation at these points of contact that would otherwise promote corrosion. It also eliminates metal-to-metal contact between a pipe and its support, thus preventing the formation of corrosion cells. Most importantly, it protects a pipe's protective coating from friction and wear, a major element of protecting the pipe against corrosion. This is achieved by the following:

- The SmartPad's shape cradles a pipe from beneath and protects its paint coating from erosion caused by friction between the pipe and its supporting structure.
- The pad seals and protects the contact surface of the pipe from its supporting structure.
- The pads raise the pipe above its supporting structure, thus improving ventilation.
- The SmartPad's FRP exoskeleton prevents the formation of corrosion cells by eliminating metal-to-metal contact.
- The SmartPad System does not require epoxy or welding for installation. It uses a unique composite strapping system to allow installation, removal, and reinstallation in seconds. This, in turn, allows quick and inexpensive visual inspection for corrosion, instead of relying on more expensive inspection methods such as radiography, lasers, X-ray, etc.

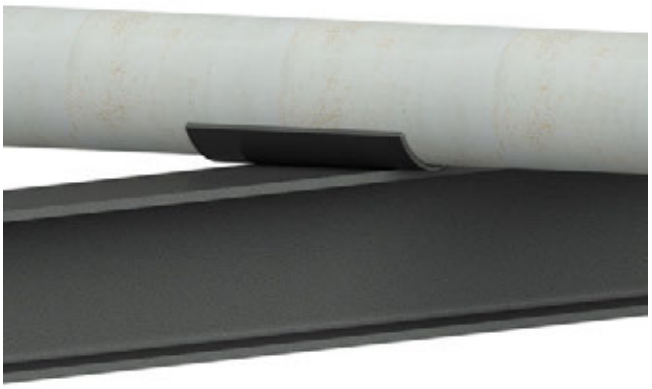

Figure 1. Traditional FRP pads cradle a pipe from beneath and require epoxy to be installed.

Figure 2. Installed RedLineIPS SmartPad protects piping from external corrosion.

Traditional FRP wear pads

The design of the RedLineIPS SmartPads resembles that of epoxy-bonded FRP wear pads. They are both made from the same material and have the same shape that cradles pipes from beneath. Epoxied-on, or glued-on, FRP wear pads are a proven and effective solution to combat CUPS. The pads effectively separate and support the contact region of a pipe without point-loading and damaging the pipe over time. They also have no metallic components, and as such, they do not promote corrosion or require welding permits or line shutdowns.

However, FRP wear pads do have a few drawbacks, especially when compared to the RedLineIPS SmartPads System, as follows:

- The pads are not a suitable solution if the pipe has already corroded, even if repaired, as it may have pits and valleys that cannot be fully filled out by the epoxy to allow proper bonding between pad and pipe.
- The installation process is laborious and can take 30 - 60 minutes, or more, depending on the experience of the installer and various environmental factors.
- The installation process requires an additional 24 hours of cure time for the epoxy to bond the pad to the pipe.
- Installation requires the epoxy to fully cover the inner surface of the pad, as well as a sealing perimeter bead around the entire pad. Therefore, this requires experienced and diligent installers, otherwise installation failures can occur.
- The use of epoxy is particularly cumbersome and messy in the summer and can be almost impossible to use in extremely cold weather conditions.
- Faulty installations are possible; installer experience is critical.
- The process may require a paint touch-up afterward – an added cost.

A new FRP wear pad

Cogbill's SmartPad System is an innovative and patent-pending solution made from components and materials that have been on the market for many years. However, these components have either been physically redesigned, or are used as is but are combined in a new way to better solve the CUPS problem, at a fraction of the overall cost of competing solutions.

In short, the SmartPad System protects piping systems from external CUPS in the following manner:

- The SmartPads themselves are all-composite FRP wear pads with special design modifications, including

two recessed grooves to allow our SmartBands to sit recessed into the pad's body. The recesses anchor the bands firmly in place while protecting them from being damaged by the pipe's supporting structure.

- A closed-cell Hydroseal gasket is pre-installed on the inner surface of each SmartPad. These gaskets are capable of offering NEMA 4-level watertight seal when compressed.

- The SmartPad, with its Hydroseal gasket, is placed underneath the pipe at the pipe support point, to isolate it from its supporting structure.

- The gasket, which resembles a memory foam mattress, protects new pipes as well as those that have pits and valleys due to remedied corrosion.

- Composite SmartBands are looped around each SmartPad into the recessed grooves, and composite buckles are attached to the SmartBands.

- Our SmartTool is then used to easily apply a high rate of tension to tighten the SmartBands, thus compressing the Hydroseal gasket. This, along with the pipe's compressive load, cause the gasket to create a NEMA 4 watertight seal at the contact surface, effectively eliminating the possibility of moisture ingress between the pad and the pipe.

- Finally, the built-in clipping mechanism of the SmartTool is used to cut off excess banding.

- The installation process takes only seconds.

- The SmartPads can be removed in seconds to visually inspect the pipe for external corrosion by cutting off the SmartBands. They can then be reinstalled, again in seconds, using the original SmartPad and gasket, but new SmartBands, an inexpensive component.

Benefits

The SmartPad System is the latest of many competing solutions designed to solve the expensive problem of CUPS. While each solution has its pros and cons, the SmartPad System offers numerous advantages and benefits that no other solution offers or combines. Among such benefits are:

- Heavy-duty, all-composite material.
- Eliminates metal-to-metal contact.
- Prevents external corrosion in piping systems at the pipe support points.
- Epoxy-less and weld-less.
- Installs in seconds.
- Quick removal and reinstallation.
- 100% install success rate.
- Usable on pipes already pitted due to previously-remedied corrosion.
- NEMA 4 watertight seal between pipe and pad/gasket.
- Removable in seconds, allows visual inspections for corrosion at reduced costs.
- Reusable, making it a cost-effective and greener solution.
- A versatile solution that offers a wide range of gasket materials to meet specific applications, including corrosive chemicals resistant options.
- Dampens vibration and noise.
- Installs on live lines.
- No welding permits or line shutdown required.
- -60°F to 400°F (-51°C to 204°C) operating temperature.

Figure 3. RedLineIPS SmartPad System components.

Figure 4. Installed SmartPad with Teflon (white) strips to protect it from highly-corrosive chemicals.

Figure 5. Standard SmartPads installed in a chemical plant in the Gulf of Mexico.

In operation in corrosive environments

The RedLineIPS SmartPad System has been in service since 2018 in facilities at or near the Gulf of Mexico. Currently, a few major customers are deploying the system in pilot programmes, for both assessment purposes and for full adoption. Among those customers are Chevron, Formosa, and Nutrien, all located near the Gulf of Mexico or at offshore platforms.

Notably, a chemical plant at the Texas Gulf Coast, in immediate proximity to the Lavaca Bay, was faced with ageing and damaged pipelines due to exposure to humidity, caustic chemicals, and salty air. Numerous sections of the pipelines in the older units were installed directly on the supporting steel structures without any buffer material in-between to protect them from corrosion.

In this setting, the pipes' protective paint coating, at the points of contact with the support steel structures, had eroded over time due to friction. Friction was caused by the pipes' movement due to seasonal and daily temperature changes, as well as their connections to rotating equipment such as pumps and compressors. As such, and as the pipes moved back and forth, and up and down, over the supporting steel, the paint coating was rubbed off until bare steel was exposed. The bare steel was left unprotected and exposed to the elements.

Over time, and in the areas of the pipes that are in contact with the supports, corrosion cells had grown to a point of great concern. Third-party inspections were performed to assess risk, and the plant was forced to perform serious maintenance to ensure the pipe walls were safe, especially those under high pressure. Steps to protect the pipes from further damage were also required. Failure to find a permanent solution would have significantly raised their insurance cost, increased the chance of premature and sudden failure of systems, and worst of all, exposed personnel to an elevated risk of injury, and possibly death.

Solution

This plant had been using epoxied-on FRP wear pads on new construction projects to help prevent CUPS. These FRP pads were bonded, using epoxy, to the pipes' coated surface to protect them from corrosion. These pads had been effective and are commonly used for new piping systems, but major problems can arise if a pad is installed on a pitted surface, meaning a previously corroded pipe that had been remedied and repaired. For the adhesive to effectively seal such pads and prevent moisture traps, it requires an even, smooth surface. This was going to be a major challenge since the corrosion at the existing pipes had created an uneven surface that would have prohibited the epoxy from properly sealing the pad to the pipe. Grinding the surface down smoothly would require line shutdowns (due to sparks) and could further diminish the pipe's wall, which was already thinning.

At that point, this chemical plant began to consider emerging technologies, and as such conducted a comprehensive evaluation of Cogbill's RedLineIPS SmartPad System as a faster, easier, and safer method to mitigate their corrosion problem.

Cogbill's SmartPad System incorporates a compressible gasket into its design that could conform to the uneven surface of a corroded pipe, which effectively seals any moisture or contaminants out of the damaged area. This would stop corrosion and prevent future damage, without the use of epoxy or welding or the need to shut the lines down to grind the pipes to a smooth surface condition.

Performance

The first set of SmartPads was installed in December 2019. The plant had planned on deploying the pads over three to four weeks since they did their planning using the typical time it takes to install glue-on FRP wear pads. Since the SmartPads are installed using a composite banding system, installation time was greatly reduced. There was also no need to wait for the epoxy to cure, so their installation crews were able to move from section to section rapidly.

Their first project using the SmartPad System was completed in one week, a quarter of the time they had anticipated. The response to the SmartPad system has been very positive, and SmartPads are now in use in two of the largest units in that plant. The SmartPads were used to protect an ageing line that was vital to multiple systems in various units. Thousands of SmartPads are now in use in that facility and are performing within their design parameters in corrosive gulf coast environments.

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