HOW TO ELIMINATE CORROSION UNDER INSULATION IN HOT AND COLD PLANT APPLICATIONS

Thermal Insulative Coatings Replace Insulation Systems to Eradicate CUI, Boosting Profitability, Sustainability and Safety

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Plant managers may be surprised to learn that a simple layer of paint – or, rather, lack thereof – could be keeping them from achieving better profitability, sustainability and safety.

The notable layer of paint offering these benefits is known as a thermal insulative coating (TIC). Such TICs can be applied to a variety of hot and cold assets throughout a plant that are traditionally covered with bulky mineral wool insulation systems. They're able to provide a comparable level of thermal performance as those insulation systems, but in a more economical and less resource-intensive manner. They can also reduce condensation drips from cold assets and, more importantly, eliminate the potentially dangerous and costly condition of corrosion under insulation (CUI).

Enabling the ability to forgo exterior insulation systems and eliminate CUI, TICs are a welcome and easy specification choice for many applications that fall within the coatings' wide approved range of thermal capabilities. In those cases, plants stand to realize improved profits from fewer maintenance needs, reduced environmental footprints related to using fewer materials, enhanced safety due to preventing workers from incidental contact burns, and minimizing slip/fall hazards related to condensation.

Plant managers have the potential to boost their profitability, sustainability and safety by switching from traditional mineral wool insulation systems to thermal insulative coatings (TICs) for both hot and cold assets.

THE POTENTIAL FOR THERMAL INSULATIVE COATINGS TO MAINTAIN TEMPERATURES, HALT CUI, REDUCE COSTS AND BOOST SAFETY

Traditional insulation systems typically feature thick mineral wool banded around assets with exterior metal cladding installed on top. They help materials inside storage tanks, process piping and pressure vessels maintain elevated temperatures, as well as keep refrigerated assets such as freezers and cold storage areas at low temperatures. While highly effective at these tasks, physical insulation systems are prone to troublesome CUI. This costly phenomenon often leads to increased maintenance costs associated with required inspection protocols and frequent repairs. It can also carry a high environmental cost associated with those repairs, which often include replacing deteriorated steel.

Today's advanced TICs can now deliver comparable levels of heat and cold retention as traditional insulation systems – with just the coating acting as a thermal barrier. Due to this level of insulating capacity, plants are able to remove physical insulation in favor of just applying a few layers of the coating material. In doing so, they can maintain the required process heat or cooling level and eliminate CUI in the process. With no CUI possible, facilities can extend inspection and maintenance intervals. In addition, they can minimize asset repairs and environmental costs.

Both physical insulation systems and TICs also offer personnel protection benefits by preventing workers from getting burned if they accidentally touch a hot asset. In addition, they can minimize condensation on cold assets to reduce the potential for slip/fall hazards related to standing water on flooring surfaces. Many plants opt to replace physical insulation systems that serve these purposes with TICs due to the coatings' lower overall cost of ownership, as well as their ability to eliminate CUI.

NOTABLE COST SAVINGS BY ELIMINATING CUI

The biggest cost savings associated with using TICs over traditional insulation systems relate to the coatings' ability to eradicate CUI by eliminating a specific element of the corrosive equation – the insulation. A TIC can completely replace the need to cover an asset with a typical insulation system featuring thick mineral wool wrapped in exterior metal cladding. Without those materials installed on top of an asset, there's nothing under which corrosion could form. Therefore, CUI is simply eliminated by default, and cost savings follow.

Getting rid of CUI could be a boon to manufacturing and processing plants, as corrosion is a leading cause of plant shutdowns. Hidden under insulation, CUI often has few, if any, obvious signs that it has taken hold. As a result, if no stains or drips are visible on the exterior cladding, any hidden CUI may not be caught until the next scheduled inspection period when technicians remove portions of cladding and insulation to visibly inspect the metal substrate below. Even then, the corrosion could be missed if spot testing accidentally bypasses any areas of notable corrosion. Those areas could then corrode further and perhaps not make it to the next inspection cycle, leading to dangerous leaks and even explosions.

CUI is such a common occurrence because cladded insulation systems are notorious for allowing moisture to penetrate their coverings and work its way into the insulation. Once there, the moisture may never dry out, keeping water in constant contact with the asset's metal substrate. Add heat from the covered asset, and the moist, warm environment against the metal becomes a zone that's highly amenable to the formation of corrosion – and can even become a catalyst for it.

TICs allow asset owners to remove the threat of CUI altogether by removing the insulation system. This effectively eliminates the corrosion zone that would otherwise exist between the insulation and the substrate. Then, there's no opportunity for moisture to become trapped against metal surfaces, and there's no possibility of experiencing CUI. Significant cost savings arise based on using fewer materials, not needing to replace corroded steel and eliminating complex CUI inspection protocols.

Common in many plant environments, long stretches of insulated process piping are notorious for experiencing CUI. Water nearly inevitably breaches their insulation systems, leading to diminished insulating capacity and exacerbated CUI.

MATERIAL REDUCTIONS DELIVER ENVIRONMENTAL SAVINGS

Notable environmental savings enter the picture when you consider the amount of physical materials that are required to prepare and install a mineral wool-based insulation system compared to spraying on a TIC. Typical insulation systems consist of thick mineral wool insulation, wiring, pins, banding and the exterior metal cladding that's mounted over top. All these materials add to the cost and environmental footprint of insulating hot assets.

When switching to a coating as the insulator, those physical materials are no longer needed. Therefore, plants can eliminate the hard and environmental costs of manufacturing, shipping and storing them. Consider the significant amounts of water, raw materials and energy required to manufacture steel, and it becomes evident that every wire, band and piece of cladding saved by using a coating instead of a traditional insulation system represents environmental savings.

The physical materials required for a traditional insulation system can now be replaced by a thick layer of coating material. Naturally, that TIC carries an environmental footprint from its production to its application, but that footprint is far smaller than what's realized with a physical insulation system. Part of that reduction is due to the fact that most physical insulation systems typically include at least a primer coat on the asset's substrate to mitigate corrosion. So, a single coating layer is often already part of the environmental footprint of an exterior insulation system – with the additional materials adding significantly to that environmental impact.

Further environmental savings come from assets lasting far longer before any steel needs to be replaced, if at all, when using a TIC. When CUI is part of the picture with a traditional insulation system, some steel will often need to be replaced over time to overcome serious pitting corrosion or metal loss. Because TICs eliminate CUI, there is little chance that any steel repairs or replacements will be needed when insulating assets with coatings.

RETAINING PROCESS HEAT WITH CONSISTENT PERFORMANCE TO REDUCE ENERGY COSTS

Perhaps the most surprising capability of a TIC is its ability to retain a great deal of process heat within an asset with just a half- to three-quarters-inch thick layer of coating material. This coating layer can help assets maintain operating temperatures up to 350°F (177°C), with excursions to 400°F (204°C), when using a TIC like Heat-Flex® Advanced Energy Barrier (AEB) from Sherwin-Williams Protective & Marine. The coating can retain a minimum target of 70% of that heat energy with just a thick layer applied to an asset's exterior and no other form of insulation system added on top.

The insulating capability of Heat-Flex AEB comes from a high insulation particle content within its dried coating film. These insulation particles couple with entrapped air present in the film and act as an effective insulator to slow the transfer of heat energy through the coating. More heat then stays within the coated asset, and owners don't need to expend as much energy to heat the contents.

An added benefit of using TICs instead of exterior insulation systems is their thermal consistency. TICs will remain at the same level of insulating capacity throughout their service lives, which means owners can maintain assets at their required operating temperatures without needing to increase process heat over time. Such heat increases are often necessary when using insulation systems due to their proclivity for water infiltration.

As moisture finds its way beneath cladding and into mineral wool within a traditional system, the insulation material loses some effectiveness – up to 85% of its R-value when 10% water by volume is present in the mineral wool – and may lead to additional heating needs. TICs don't face these moisture-related issues, as the closed-cell structure of the coating film minimizes the amount of moisture the coating can actually absorb, and that moisture can dissipate from the coating through heating and evaporation within 24 hours.

Interestingly, the notable thermal performance of Heat-Flex AEB can be achieved in a single coat that can be applied at up to 200 mils dry film thickness (DFT) per coat. This high-build capability eliminates the wait time

between coats that are required for other TICs on the market. Those TICs can only be applied up to 30 mils per coat and would require three to four coats to reach a specified thickness of 100 mils DFT, for example. With each coat requiring a wait time of 18 hours, the project may require extended out-of-service periods and/or the rental of containments and scaffolding for prolonged durations. Heat-Flex AEB delivers a higher R-value in a single coat, making it much more efficient from a timing perspective.

Condensation forming on the exterior of refrigerated assets can drip onto surrounding areas and even turn into a ball of ice. TICs like Heat-Flex AEB can greatly reduce or eliminate the development of condensation, minimizing the potential for drips to form and lead to slip/fall hazards and corrosion.

ENHANCING SAFETY IN BOTH HOT AND COLD APPLICATIONS

TICs also offer notable safety benefits on both sides of temperature extremes. In high temperature applications, they keep personnel from getting burned. And in cold temperature applications, they help to reduce slip/fall hazards by minimizing condensation.

On the hot side of things, a TIC like Heat-Flex AEB can be applied to assets operating at elevated temperatures that are within reach of workers who could accidentally encounter those assets. Even a few seconds of incidental contact with a hot surface can lead to skin blistering and burning. Caging and insulation systems have been traditionally used to prevent that direct contact, but a sprayed-on TIC can serve the same purpose, while also eliminating CUI. That exterior insulation system can be skipped as long as the TIC is able to prevent the outer surface temperature of a coated asset from exceeding the maximum skin temperature limit of 140°F (60°C) after being in contact with the hot surface for five seconds, which is the U.S. Occupational Safety and Health Administration (OSHA) threshold. Given that maximum, facility managers should target any asset in a plant that has an operating temperature over 150°F (66°C).

For cold-temperature applications, TICs like Heat-Flex AEB can help to minimize the development of condensation on the exterior of refrigerated assets. The coatings' insulating capabilities minimize the temperature differential between the surface of an asset and the ambient air, helping to keep condensation at bay. Less surface condensation means there will be less water forming on the outside of assets and dripping onto floors where personnel may slip, fall and experience a reportable event. Less water also means a reduced chance of atmospheric corrosion on insulated assets, as well as on any surrounding steel that may otherwise have been exposed to additional moisture.

AN EASY SPECIFICATION CHOICE FOR SAVING TIME, MONEY AND RESOURCES

Swapping a traditional insulation system featuring thick mineral wool wrapped in exterior metal cladding with a TIC is an easy specification choice in many applications that are typically prone to the scourge of CUI. TICs remove the potential for CUI to develop in the first place, delivering notable cost savings and enhanced safety by ensuring assets don't develop hidden corrosion that could lead to repairs, leaks or worse. The reduction in materials that comes from making the switch to TICs offers environmental benefits due to the less resource-intensive processes required to manufacture and apply coatings compared to insulation systems. TICs also offer safety benefits by preventing skin contact burns. Plus, with TICs applied to their surfaces, refrigerated assets should rarely drop below the dew point, minimizing the chance for significant condensation to form, drop onto the floor and cause a fall. Given these benefits, specifiers stand to experience enhanced profitability, sustainability and safety by opting for TICs to handle their insulating needs.

ABOUT THE AUTHORS

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