THERMAL INSULATIVE COATINGS OFFER MULTIPLE SAFETY ADVANTAGES FOR MANUFACTURING FACILITIES

Coatings Offer a Degree of Process Heat Retention while Protecting Against Burns, Condensation, Slips and Corrosion

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Dangers lurk around many corners in a wide array of manufacturing facilities, but they're especially present anywhere high-temperature equipment is in close proximity to personnel. Workers can easily burn their skin on hot assets like pipes, ductwork and tanks if facility owners don't take care to isolate or insulate that equipment.

Safety caging and fencing are common isolation solutions that keep people away from hot surfaces. However, they can be expensive to install, take up significant space and hinder maintenance access. Alternatively, traditional insulation systems can be used to eliminate bulky caging in favor of slightly less bulky materials like mineral wool that are wrapped around an asset and then clad in aluminum or stainless steel. The sealed cladding is meant to keep moisture from saturating the insulation material. Such insulation systems are effective at preventing burns yet expensive to inspect and maintain while carrying an increased risk of developing corrosion under insulation (CUI) when water penetrates the cladding.

Perhaps surprisingly, a relatively thin layer of insulative coating material can offer an alternative to both caging and insulation systems, while providing a host of benefits. Such spray-applied thermal insulative coatings (TICs) have sufficient thermal conductivity properties to keep exterior surfaces safe to the touch, protecting personnel without the need for exterior isolation structures or insulation. They offer the added safety benefit of protecting workers from slips and falls by reducing the likelihood of condensation forming on coated assets and dripping onto walking surfaces such as floors, steps and catwalks. In addition, the coatings effectively eliminate the concerning issue of CUI, which may lead to downtime and dangerous leaks. Importantly, TICs can also provide some degree of heat conservation to potentially maintain process heat within coated assets, making them a practical choice for many operations.

BURN PROTECTION: PREVENTING INJURIES

In high-temperature manufacturing environments, burns are a high-priority concern. A few seconds of incidental contact with a hot surface is all it takes for skin to blister and burn. The U.S. Occupational Safety and Health Administration (OSHA) sets a maximum skin temperature limit of 140°F (60°C) after contact with a hot surface for five seconds. No reportable injury will occur beneath those thresholds. That means any asset that's within about 8 feet of where a worker may be situated will need to be protected via a physical barrier, an insulation system or a TIC. That distance is important to heed, considering a six-foot-tall person can reach about 8 feet with extended hands.

By specifying a TIC instead of a physical barrier or a traditional insulation system, facilities can eliminate the fabrication, installation and care associated with those alternatives — while still meeting OSHA burn protection requirements. For example, the Heat-Flex® lineup of TICs from Sherwin-Williams Protective & Marine includes water-based, acrylic, spray-applied coatings containing a high volume of ceramic or engineered silica-based microspheres and low thermal conductivity aerogel particles. These

elements create low thermal conductivity within the final cured coating. This low thermal conductivity effectively limits the transfer of heat energy through the coating, preventing people from getting burned on assets housing internal fluids and gases at high temperatures. Facility managers should target any asset in a plant that has an operating temperature over 150°F (66°C). Even dangerously hot systems like steam piping and boiler ductwork that can reach up to 350°F (177°C) may be coated with a Heat-Flex TIC coating to prevent burns from incidental contact.

Following the application and drying of a TIC, inspectors can use a thermesthesiometer on the coated asset to confirm that its surface temperature is within OSHA requirements for burn protection. This special instrument is required per ASTM C1057-17 "Standard Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer" guidelines, as a traditional surface temperature probe will not provide an accurate reading of skin temperature.

CONDENSATION PROTECTION: REDUCING SLIPS AND FALLS

Because thermal coatings reduce the transfer of heat to the exterior surfaces of operating assets, a smaller temperature differential exists between those surfaces and the surrounding air. That means there's less chance that a hot or cold pipe will encounter surface condensation. Such condensation carries a minor risk of affecting the TIC system and underlying asset, as water in contact with coatings may eventually lead to corrosion. More troublesome, condensation that collects on assets may threaten worker safety if it drips down onto walking surfaces where employees may slip and fall. Such incidents are a top cause of plant accidents.

Various processing operations involve both hot and cold temperature extremes, each of which increases the likelihood of condensation occurring on equipment. However, Heat-Flex TICs can effectively insulate assets operating at service temperatures ranging from -80°F (-51°C) to 350°F (177°C). This capability helps significantly reduce the temperature imbalances between a surface and the surrounding air that causes condensation. The surface temperature should rarely drop below the dew point, minimizing the chance for significant condensation to form, drop onto the floor and cause a fall.

CORROSION PROTECTION: ELIMINATING CUI

Assets covered with traditional insulation systems face the potential of a common problem in various industries — CUI. Moisture will inevitably enter an insulation system and become trapped there, whether from water breaching the exterior cladding or from condensation forming on the covered asset's surface. This moisture will never dry out, keeping water in constant contact with the substrate. If that substrate is uncoated, the steel is sure to face rapid deterioration, but even a coated substrate can eventually corrode unless a Heat-Flex CUI mitigation solution has been applied when in constant water contact — especially when that environment is contained and heated. Such corrosion can eventually lead to a steam pipe, for example, corroding through and developing a leak that causes system downtime at best and worker injury at worst.

Perhaps the biggest concern with CUI is that it's hidden — lurking beneath insulation or cladding with limited warning signs of its existence. Therefore, insulated assets must be inspected periodically to confirm CUI is not an issue. This ultimately involves removing portions of cladding and insulation to visibly inspect the surface of the metal. Inspectors may also need to assess the thickness of the metal using ultrasonic testing techniques.

The easiest way to remove the threat of CUI is to remove the insulation altogether, thereby removing the corrosion zone between the insulation and the substrate. This effectively eliminates the "under" in CUI. Insulative coatings like Heat-Flex TICs enable facilities to do just that, as the coated surfaces do not require a physical exterior covering. There's no opportunity to trap moisture against metal surfaces, which effectively eliminates the risk of hidden CUI as well as the need for CUI inspection protocols.

Heat-Flex TICs themselves create a barrier that prevents moisture and condensation from contact with the metal substrate. They simply require periodic visual inspection to ensure the coatings are intact and are still providing corrosion protection. Coated surfaces can be touched up when necessary.

PROCESS PROTECTION: MAINTAINING OPERATING TEMPERATURES

When first installed, traditional insulation systems are highly effective at maintaining heat inside covered assets. However, the resulting high insulation R-values can diminish quickly if moisture infiltrates a clad insulation system, which is common. The moisture displaces the air content within the insulation that initially provided the stated R-value. For example, typical mineral wool insulation material will lose up to 85 percent of its R-value when 10 percent water by volume is present in the material (Table 1). That moisture content not only reduces the system's insulation value but may also lead to inconsistent thermal performance, as the insulation's moisture content – and therefore its temperature control – may vary across an insulated asset.

Heat-Flex™ Hi-Temp 3500, for example, can eliminate this issue by providing consistent thermal performance for coated assets. While the coatings can't replace insulation systems when asset operating temperatures must remain significantly high, they are especially effective for insulated assets operating at temperatures of 150°-275°F (66°-135°C). Facilities can achieve such performance by layering multiple coats – each at about 20 mils dry film thickness (DFT) – on assets based on the desired insulative value. Facilities can work with their coatings supplier to estimate the insulation efficiency achievable with Heat-Flex TICs under ambient and process conditions. Using thermal modeling software, the supplier can help the owner determine if the desired insulation value is achievable with the coatings, as well as how many coats are required.

Compared to traditional insulation systems, Heat-Flex TICs have been found to be effective in providing initially lower, yet consistent and predictable, insulation to piping, tanks and vessels.

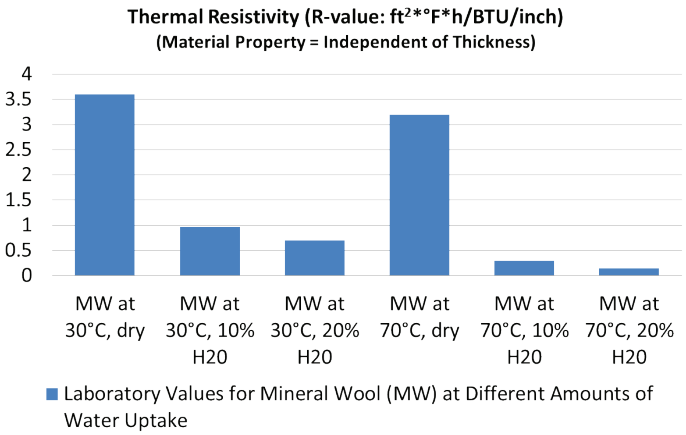

Table 1. Lab Testing of Wet Insulation vs. Dry Insulation
When first installed, traditional mineral wool insulation systems are dry and therefore maintain optimal insulative values. However, those R-values drop drastically as moisture infiltrates a clad insulation system. For example, the mineral wool will lose up to 85 percent of its R-value when 10 percent water by volume is present in the material.

BOTTOM LINE PROTECTION

The right coating can play a significant role in enhancing workplace safety and protecting people from avoidable accidental injuries. Heat-Flex TICs are able to replace bulky safety caging and physical insulation systems in a wide variety of plant applications. The coatings can enhance plant safety by offering OSHA-required burn protection, reducing slip and fall potential by limiting condensation, and eliminating the dangers of CUI. Further, facilities can realize these benefits while maintaining process heat inside coated assets. Spray-on Heat-Flex TICs also offer the added benefits of keeping ambient temperatures more comfortable around coated assets operating at high temperatures, as well as reducing noise levels. Because the coatings can be used almost anywhere that traditional isolation or insulation systems are used, all of these benefits combine to enable safer, more economical operations for plants.

ABOUT THE AUTHORS

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FIGURES AND CAPTIONS

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