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CHANGING THE LANDSCAPE OF THERMAL INSULATING COATINGS

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SUMMARY

This paper details the development, application and performance verification testing of a next generation thermal insulating coating system based upon an Ultra High Build material with better application and insulative properties than current Thermal Insulating Coatings (TIC). The novel technology, based upon a carefully selected combination of insulation particles and unique waterborne acrylic resin system, widens the range of situations where TICs can advantageously replace conventional thermal insulation for personal protection (PPE) and solar radiant heat control purposes, reducing the risk of Corrosion Under Insulation (CUI) and installation time and cost.

Keywords: Thermal insulating coatings, Corrosion under insulation, PPE, Solar radiant heat control

1. INTRODUCTION

Thermal insulation of piping, valves, tanks, or vessels is typically achieved by an INTEGRAL SYSTEM comprising of corrosion mitigation coating, thermal insulation media, and external cladding. The downside of these conventional insulation systems is that they leave an air gap to the primed surface and, when damage to the jacketing occurs, substandard primer coatings that cannot resist cyclic boiling electrolyte conditions will not avoid corrosion under insulation (CUI) to occur. CUI can become a real issue for the plant as it can often go unseen for years. This has been seen to result in some cases of catastrophic failure resulting in millions of euros of damage and in some cases and, more importantly, loss of life.

Thermal insulating coatings (TIC's) have also been used, with a narrower scope, for personal protection against burns, solar radiant heat gain protection and limited energy or process preservation as an alternative to conventional insulation such as mineral wool or calcium silicate. First generation TICs, however, are limited in several ways. A novel technology, discussed in this paper, remove these limitations to a measurable extent.

2. DESCRIPTION

In 2021, when the insulation system on a tank roof in the USA was being removed, the asset owner allowed samples to be taken from various parts of the roof. The insulative media samples were tested for weight loss after heating at 200°C. The results demonstrated a surprising degree of weight loss between 33% to 72%, corresponding to the degree of moisture content in the media. At this level of moisture intake, the thermal efficiency of the insulation system on the tank roof would have been very poor, and CUI would had occurred if not for a suitable primer being in place. These results gave further justification for the urgency of research focused on TICs improvement, to remove some obstacles to the use of this option and make it a true alternative to conventional insulation.

TIC's are based upon a closed cell structure and hence will not retain water. This assures that the original insulative properties are kept during design lives and reduces the risk of CUI. This insulative barrier can be inspected visually without removal of the insulation system and without the use of very expensive electronic techniques. The current technology also has system application limitations. A thickness of 500 microns dry thickness per coat requires multiple coats to be applied to achieve the required film thickness to give thermal efficiency. The next generation material can easily obtain the performance requirements in a single coat, reducing the time to install the insulation system.

The objective of the development described in this paper was to develop a novel TIC material allowing a drastic improvement on both limitations: achieve higher dry film thickness per coat, and a lower thermal conductivity. In conjunction, these features bring TIC further in the scope of use normally reserved to conventional cladded conventional insulation.

Achieving a low thermal conductivity requires a holistic approach to coating formulation. Details are given about the relative merits of aerogel particles, hollow particles, and utilization of entrained air or foaming agents. The next generation formula is based on a modified water based acrylic latex matrix holding a combination of low thermal conductive materials, capturing relative merits, and addressing its downsides. ASTM C177 is the standard test for measuring the thermal conductivity of a material by means of a guarded-hot-plate apparatus and this was used to measure thermal conductivity. Simultaneously, the formulation was optimized to achieve application of up to 3 mm dry film thickness per coat and a touch dry time of 2 hours.

Finally, the last and key element of the development (allocated 50% of the total development time), was the search for the ideal application set up. This is critical for the thermal performance and the application efficiency, that will not be achieved unless the specific application set up is in place: mixing time, equipment type, nozzles, spray pressure and more all play a role, and its prescription is part of the solution.

The project achieved a TIC system able to be applied in fast drying single coats up to 3.75 mm, comprised of a basecoat and a sealer coat, with thermal conductivity less than 0.08 W/m.K.

3. CONCLUSION

The result of the described development was a novel TIC system with a much wider scope of use compared with currently used TICs. Thanks to the combination of a lower thermal conductivity and higher dry film thickness application per coat, the new TIC system can be installed faster and economically for PPE and solar radiance control purposes, not only to replace current TICs, but also in situations currently addressed by conventional insulation only. The novel TIC system can withstand service temperatures from -60°C up to +177°C, with peak temperatures up to +200°C.

REFERENCES

[1] NACE SP0198-2017. Control of Corrosion under Thermal Insulation and Fireproofing – A materials Approach.

[2] S. R. Hostler, A. R. Abramson, M. D.Gawryla, S. A.Bandi, D. A.Schiraldi. Thermal Conductivity of a Clay-Based Aerogel Stephen Holster et al, *International Journal of Heat and Mass Transfer*, 52 (3-4) (2009) 665-669, https://doi.org/10.1016/j.ijheatmasstransfer.2008.07.002 .

[3] Steven Badger, IDEA 2017 Sustaining Our Success 108th Annual Conference & Trade Show (June): 26-29.

[4] VTec Laboratories, Inc, ISO 17020, 17025 and 17065 Accredited, www.vteclabs.com.

[5] Scott Sinclair John Manville Corrosion 2021 - The Myths of Insulation Treatments & CUI: What Works & What Doesn’t.