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INTUMESCENT COATINGS, ULTRA-LONG TERM DURABILITY, AND SUSTAINABLE FIRE PROTECTION SOLUTIONS

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SUMMARY

Modern, sustainable construction requires building materials and products used to be fit for long term durability and in-service resilience. Intumescent coatings for fire protection of steel have been in use for over 30 years, providing excellent protection against the effects of fire. However, the weather resistance of some types of intumescent coating can be limited. This paper considers long term durability of a novel technology in this field and will show that correct specification of products can provide fire protection to buildings and structures for the entire design life, and possibly beyond.

Keywords: Sustainability, Durability, Intumescent coatings, Fire protection

1. INTRODUCTION

In the past century, steel has been utilised globally as a structural framing material for many types of assets and facilities. A combination of desirable physical properties, material cost, and ease of use has led to it being called the building material of the last century [1].

Additional to the desirable properties of the steel as a building product, it is also recognised steel is readily recyclable and reusable, and in the 21st century this is an increasingly essential aspect of sustainable design. It works very well in the demands of a circular economy, where value needs to be maintained in a material when it reaches the end of its design life [2]. However, along with the list of desirable features, steel is susceptible to the effects of fire. To provide protection against fire, several different methods of passive fire protection for steel are in existence, ranging from mineral sprays, to fire resistant boards, to intumescent coatings.

Intumescent coatings are spray applied materials that can provide fire protection to structural steel. They can provide several benefits over alternative passive fire protection methods:

1. Speed of installation
2. Aesthetics, allowing steel to be an architectural design feature
3. Allow steel to be fire protected off-site, leading to fast-track construction methods



4. Enable modern steel construction through use of long span beams that incorporate web openings (often referred to as cell beams).

There are several families of intumescent coating, which have different degrees of weather resistance and durability. Not all these coating types are created equal, though. There is a typical hierarchy of durability for intumescent coatings, ranging from single component water-based coatings to multi-component, weather, and damage resistant products.

Traditional water-based coatings are suitable for use in mild environmental conditions such as within the envelope of an office building, but likely not suitable for harsh internal or external exposures. Two-pack materials on the other hand (including novel pMMA chemistries), are designed to provide significant weather and damage resistance.

The highly differentiated coating in question is based on pMMA (methyl methacrylate) chemistry, well known for rapid curing and return to service. By using this chemistry in this coating, several highly desirable features and benefits have been incorporated into the product line:

- a) Rapid drying and overcoating time, in as little as one hour
- b) Handle and transportation time in as little as two hours
- c) Significant enhancements to weather and damage resistance compared with traditional single component coatings.

The combination of the above features enhance the suitability of off-site (in-shop) application of the passive fire protection system, thus enabling the benefits of off-site paint: cost effectiveness, higher quality of application and removing the painting from the critical path of the on-site works.

2. DESCRIPTION

When we consider the terms of the design working indicative life span of a building, Eurocode EN 1990 states [3]: “The design working life is the assumed period for which a structure is to be used for its intended purpose with anticipated maintenance but without major repair being necessary”. From this same document, an indicative design working life of 50 years is quoted.

Intumescent coatings for fire protection of steel can be tested under the requirements of the European standard EN 16623 [4]. This document identifies that properly maintained intumescent coating systems are intended for 10-25 years specifications.

So how does a coating supplier, and the end owner of the asset, reconcile the disparity between design working life of a building (50 years), and the assumed working life of the intumescent coating (10-25 years)? And how can it be demonstrated that coated steel can potentially be reused and repurposed, rather than recycled?

This paper will evaluate testing of intumescent coating materials in line with recognised protective coating pre-qualification standards such as ISO 12944-6 [5], in combination with established fire testing protocols. From this testing, extrapolating ISO 12944 pre-qualification methods for longer design lives, it is intended to demonstrate how state of the art coating systems can meet the demanding requirements for protection materials for life of building designs and specifications.



3. RESULTS

The purpose of this work is to evaluate the performance of the novel pMMA intumescent coating to multiple, cumulative exposures to the weathering requirements for C3 Very High, both in terms of corrosion protection to the underlying steel, as well as providing the specified degree of fire protection that is required by the steel.

Testing of various intumescent systems composed with the novel pMMA intumescent coating has shown that following concurrent ISO 12944-1 C3 VH exposures the following was observed:

1. Corrosion protection provided to the steel by the fire protection system comfortably meets the corrosion creep requirements of this standard.
2. Fire protection to the steel has not been negatively impacted, with the coating system meeting the required degree of fire protection in standardised testing to EN16623.

4. CONCLUSION

Based on third-party laboratory test results centred around exposure to cumulative ISO 12944-6 weathering test protocol for C3 VH scenario, this paper expects to demonstrate the capacity of a novel intumescent coating capacity to meet Eurocode EN 1990 design working life target.

REFERENCES

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