

## FIRE PROTECTION DURABILITY OF INTUMESCENT COATINGS AFTER ACCELERATED AGING

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**Abstract:** The most common method of achieve the required fire resistance of structures and structural elements is using passive fire protection systems, being the intumescent coatings the fire protection material frequently used. This work presents a research study about the effects of aging on the fire protection performance of intumescent coatings. A commercial water based coating is submitted to an accelerated aging cycle, using a QUV accelerated weathering tester. These tests aim to simulate 10 years of the coating natural aging according to the European technical approval guideline (ETAG N° 018). The coating durability is tested comparing the fire protection efficiency of small steel samples submitted to a constant radiant heat flux exposure from a cone calorimeter as prescribed by the standard ISO 5660. In total, 28 tests were performed on intumescent coating protected steel specimens, in which 14 specimens were tested before the hydrothermal aging test and other 14 after accelerated aging. The experimental test results of the steel temperature evolution shows that increasing the intumescent dry film thickness, an increase of the fire resistance time is attained. After the accelerated aging cycles, the coating lose their ability to expand, resulting in an increase of the steel temperature of approximately 200 °C, compared to the samples without aging.

*Keywords:* Fire protection, intumescent coating, accelerated aging, fire resistance durability.

### 1. Introduction

Passive fire protection materials insulate steel structures from the effects of the elevated temperatures that may be generated during fire. They can be divided into two types, non-reactive, of which the most common types are boards and sprays, and reactive, being intumescent coatings an example, [1]. These has been widely used as fire protection because it has such advantages as lightweight, attractive appearance and convenient construction.

Exposure to long term environmental conditions can cause intumescent coating to lose the reactive and swelling properties, thus reducing the effectiveness of the intumescent coating over time, [2].

### 2. Cone calorimeter experimental tests

To assess the performance of a commercial water- based intumescent paints a set of experimental tests was performed in a cone calorimeter. This equipment allows the specification of a constant radiant heat flux calibrated for heat flow meter, depending on the temperature specification of the electrical resistance.

The steel plates are 100 [mm] squared and with 5, 8 and 14 [mm] thick, coated on one side with different dry film thicknesses and tested in a cone calorimeter as prescribed by the standard ISO5660, [3], with two different heat flux 35 and 75 [kw/m<sup>2</sup>].

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Temperatures are measured by means of two thermocouples type k, welded to the plate on the heating side and on the opposite side and related with a data acquisition to measure them during the test.

The results of the tests made in the cone calorimeter are shown in "Figure 1".

The temperature variation of different samples before and after aging test for a radiant heat flux of 75 [KW/m<sup>2</sup>] and thickness of steel plates ds=14 [mm] are shown in Figure 2 and Figure 3, respectively.



Figure 1: Coated steel plates before and after accelerated aging, with fixed thermocouples. Tested samples at 35 and at 75 KW.m<sup>-2</sup>.

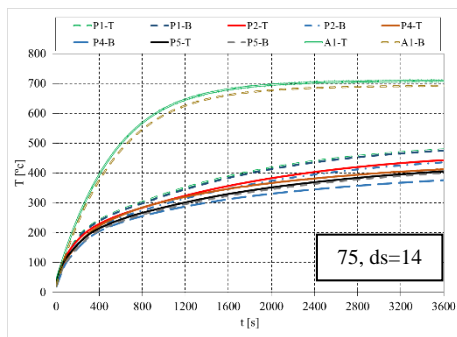


Figure 2: Measured temperature in the steel plates before aging.

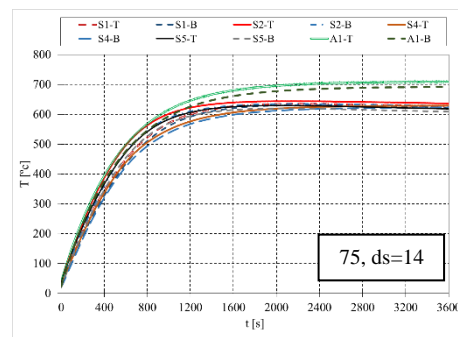


Figure 3: Measured temperature in the steel plates after aging.

### 3. Conclusion

This work presented the results of a series of fire tests on steel plates protected with an intumescent coating, performed in a cone calorimeter to assess its performance when used in fire protection before and after 21 cycles of hydrothermal aging. This accelerated aging corresponds to 10 years in service according to exposure condition type Z1 from ETAG 018-part 2, [4]. The results have been presented in terms of the steel temperature and intumescence development.

### References

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