Insurance Institute for Business & Home Safety®

Performance of Fire-Retardant Coatings Used in Exterior Applications: Executive Summary

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Introduction

The U.S. loses approximately 3,000 homes due to wildfires every year (Maranghides et al., 2015). As building development continues in wildland-prone areas, communities will continue to be at risk from wildfires. In addition, since 2000, the wildfire season has lengthened with bigger, more damaging events (Short, 2015; Gorte, 2013).

Buildings threatened by wildfire can be mitigated through the development of a strategy that addresses both the built environment and vegetation (and other combustible materials) on the property. Use of noncombustible materials and ember-resistant design features are examples of strategies that reduce the vulnerability to the built environment.

In buildings where combustible siding has been installed, fire-retardant coatings could be used to reduce their vulnerability to wildfire exposures, particularly radiant heat and flame contact exposures. These exposures are more common in situations where close building-to-building spacing exists and a neighboring building ignites and burns, and where other combustibles (e.g., a wood pile or small out-building such as a tool shed) are located near the building. Commercially available coatings include fire-retardant gel products that can be applied by a resident or first responder. Since the length of time that a gel product is effective after application is on the order of hours, these would be applied only when a wildfire threatens. Other fire-retardant coatings, both film-forming paints and penetrating types, have been reported to have an effective service life on the order of years and would represent a more permanent, passive mitigation strategy. If effective, these longer-term coatings (both film-forming and penetrating types) would arguably be less expensive than, for example, removing combustible siding and replacing with a noncombustible type.

When used in exterior applications, the fire-retardant coating is subjected to changes in temperature, humidity, solar radiation and other weathering factors. This weathering can negatively impact the fire-retardant performance due to surface erosion or other forms of coating degradation, potentially resulting in a reduction of the fire-retardant properties before the end of the anticipated effective service life. For this reason, an experiment was designed to evaluate changes in the fire performance of coatings applied to an otherwise untreated wood substrate as a function of outdoor weathering.

Description of the Product

An internet search found that the number of fire-retardant—largely intumescent—coatings marketed for use in light-frame wood construction was approximately 15. Of these, about half contained marketing information indicating use in interior and exterior applications. Five coating products were selected for use in this experiment. Product literature for each product had reported an effective service life of up to five years when used in an exterior location. These products represented a majority of the exterior-use coating products that we found.

Application of the coating and weathering was performed at the Insurance Institute for Business & Home Safety (IBHS) Research Center in Richburg, South Carolina. Tests to evaluate fire performance of the coatings were conducted using a cone calorimeter at the University of North Carolina at Charlotte (UNC Charlotte). Comparisons were made for product performance over different durations of outdoor weathering time up to 12 months. The fire performance of weathered samples was compared to tests performed on uncoated, non-weathered samples. Time to ignition (TTI), time to intumescence, and peak heat release rate were used to evaluate performance. Manufacturer-supplied performance information for all coating products used in these experiments were limited to a flame spread index obtained from tests conducted on a coated substrate following procedures outlined in ASTM E84. They all reported Class A performance. Flame spread was not evaluated in the experiments reported here. Additional details about the experiments will be available in the full report.

Summary

The two products that were non-film-forming coatings did not enhance fire-retardant performance over uncoated wood, even in baseline testing before weathering. The other three products that were film-forming coatings did not enhance fire performance over the uncoated samples after just three months of outdoor weathering.

As an example of the data available in the full report, the following graph shows the reduction in TTI for one of the tested coatings, Coating A, at a single heat exposure level over the weathering period, with the horizontal line representing the average value of an uncoated sample plus or minus one standard deviation.

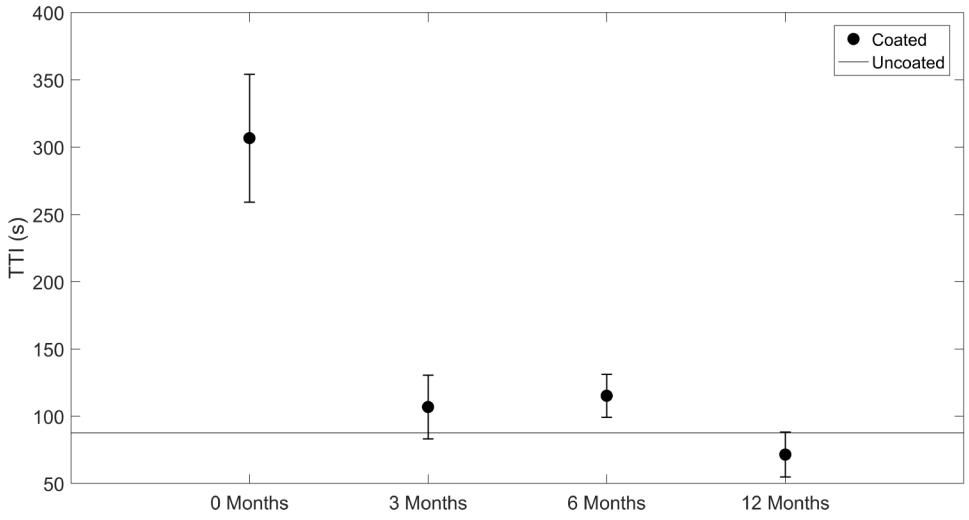

Figure 1. *TTI for Coating A ±1 standard deviation.*

Conclusions

Results concluded that, at least with current formulations, none of the coated products included in this experiment can be relied on to provide enhanced protection from radiant heat exposures relative to uncoated product. While the literature, provided by each of the coating manufacturers, claimed that each product would have an effective service life of up to five years when used in an exterior environment, results from these experiments indicated that none of the products retained their fire-retardant properties for extended periods when used in an exterior environment.