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Abstract

To assess the viability of epoxy-based intumescent coatings as a passive fire protection on bridge cable, two sets of experiments were carried out with two types of epoxy-based intumescent coatings (anonymized as Coating A and Coating B).

In the first set of experiments, small steel plates were exposed to various constant heat fluxes in a mass loss cone heater. The initial heating rates were similar to those experienced in a UL1709 hydrocarbon fire. In addition to experiments on samples with just the two types of coating, different configurations with an elastomer membrane, typically used in dehumidifying systems on bridge cables, were also part of the experimental matrix.

A second set of experiments were carried out in an electric oven, where three types of steel profiles were subject to four different heating rates in order to assess the thermal resistance for different scenarios.

The samples were evaluated both visually and quantitively at the end of each experiment. Visual observations included char structure formation, porosity and expansion ratio. Secondly, the performance of the coatings subject to heating in the electric oven was evaluated by the thermal resistance measure from the Eurocode. An efficiency metric was used to compare the heating of the protected steel substrate with that of an unprotected substrate.

Results from the experiments in the mass loss cone heater showed a dependency between the heat flux and the efficiency of Coating A and a critical heat flux needed to achieve a char formation. For Coating B, a full expansion was never reached.

For the experiments in the electric oven, the thermal resistance was determined, and it was found that the thermal resistance increased with higher heating rates and that the duration the transient phase was reduced. The latter is defined as the phase in which the intumescing process and the carbon binder combustion occurs.

Based on these findings, it cannot be concluded whether or not epoxy-based intumescent coatings are a viable solution for fire protection of bridge cables. Still, they provide a good foundation for more focused, in-depth future studies.