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Abstract

The protection of structural steel on exposure to a fire has become paramount to prevent the loss of lives and assets with increasing use of structural steel as a material to create the shape of construction projects. Structural steel loses bearing ability when its temperature exceeds 500 °C (critical temperature), and an efficient way to prolong the time before the critical temperature is reached is to use intumescent coatings. At elevated temperature, intumescent coatings swell, via a complex chemical mechanism, to a porous multicellular char layer that acts as a thermal shield protecting the underlying substrate.

The focus of the present work is the so-called hydrocarbon intumescent coatings, as it is the most challenging type used for fire scenarios in high-risk environments such as petrochemical complexes and offshore platforms. Zinc borate, an effective but suspiciously toxic compound in hydrocarbon intumescent formulations, was investigated with respect to its effects on the performance parameters (e.g. fire-resistance performance, thermal degradation, dynamic viscosity of incipient char, and char expansion and structure) of the coatings. With the understanding of the mechanism behind the positive effects of zinc borate, one can get a scientific basis for the replacement of zinc borate.