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Published in:
Fire Safety Journal

Link to article, DOI:
10.1016/j.firesaf.2017.10.004

Publication date:
2018

Document Version
Peer reviewed version

Citation (APA):
Experimental study of the performance of intumescent coatings exposed to standard and non-standard fire conditions

Andrea Lucherini\textsuperscript{a,b,\ast}, Luisa Giuliani\textsuperscript{a} and Grunde Jomaas\textsuperscript{a,c}

\textsuperscript{a} Department of Civil Engineering - DTU Byg, Technical University of Denmark (DTU), Denmark
\textsuperscript{b} School of Civil Engineering, The University of Queensland, Australia
\textsuperscript{c} School of Engineering, The University of Edinburgh, UK

Keywords
Intumescent coatings, thermal resistance, heating rates, standard and non-standard fire curves, steel protection

Abstract
Three different experimental setups corresponding to three different fire scenarios were used to investigate how different heating conditions and heating rates affect the behaviour of two different thin intumescent coatings (a solvent-based and a water-based paint). Coated steel samples were exposed to different standard and non-standard fire conditions in an electric oven, in a gas furnace and in a cone heater. A general trend was observed in the thermal resistance development for the tested intumescent coatings, divided into three general phases: inert phase, transient phase and steady phase. The different stages were identified according to four critical points: activation, end of reaction, binder exhaustion and steel austenitization point. The tested water-based paint had better performance for low heating rates, while the tested solvent-based paint had better performance for high heating rates. However, for really low heating rates the solvent-based paint did not activate or provide proper insulation. In summary, the results confirm that the current procedure for the design of intumescent coatings has shortcomings, as different paints have different performances according to the heating conditions and, in particular, according to the fire heating rate.

[...]

Acknowledgements
This study was performed at the Department of Civil Engineering of the Technical University of Denmark (DTU) with the partial financial support by COWI Fonden [Grant A-121.35]. The authors would also like to thank Razvan-Ioan Costa and Jesper Andersen, whose work on this topic in the framework of their M.Sc. thesis provided useful insights to this paper.

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