Abstract

The study presented herein shows a comparative experimental methodology to investigate timber fundamentals protected with intumescent coating against fire. The experiments employed a commercially available, transparent intumescent coating for a range of applied DFT and at varied heating conditions. The substrate employed is Sitka Spruce CLT with a 1-component polyurethane adhesive. **The incident heat fluxes varied between 20 and 60 [kW/m2], and the DFT applied to the tested samples was 127, 328, and 784 [µm]. Control samples of bare timber without any protection are also used to demonstrate the influence of the coating empirically. The vast majority of the experiments were performed employing the cone calorimeter**

The study's outcomes show that thin-intumescent coating (DFT > 127 µm) delays the time-to-ignition resulting in sustained flaming, increasing the critical heat flux for ignition resulting in sustained flaming. The coating applied is directly proportional to the critical heat flux obtained. Timber protected with a DFT lower than 127 µm and exposed to external incident heat fluxes higher than 30 kW/m2 presented a lower time-to-ignition than bare unprotected timber.

Many other parameters are influenced by DFT and heating conditions. For example, the HRRUA is inversely proportional to the DFT applied. Timber protected with **127, 328, and 784 [µm]** showed approximately 55%, 30%, and 15% of the HRRUA peak reached by unprotected timber. Regarding the onset of charring, the presence of coating delays the process. For 40 kW/m2, unprotected timber onset of charring occurred at 43 [s], while coated timber onset of charring was at 124, 452, and 1078 [s] for a DFT of 127, 328, and 784 [µm], respectively. On the other hand, timber's in-depth temperature and charring rate are not always reduced for timber protected with an intumescent coating. Timber protected with DFT lower than 127 [µm] and exposed to incident heat fluxes higher than 30 [kW/m2] presented a higher charring rate than unprotected timber. Lastly, DFT and heating conditions impact the swelling evolution differently. The heating conditions significantly influence the swelling rate after reaching the maximum thickness, while the applied initial DFT controls the maximum swelled thickness.