

## SHORT NOTE

### EFFECT OF FIRE RETARDANT ON PINE WOOD COMBUSTION

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Effects of three fire retardants, ammonium polyphosphate (APP), ammonium dihydrogen phosphate ( $\text{NH}_4\text{H}_2\text{PO}_4$ ) and boric acid ( $\text{H}_3\text{BO}_3$ ) on pine wood combustion were studied. Samples were burnt in a cone calorimeter under heat fluxes of 20, 50 and 75  $\text{kWm}^{-2}$  and solid char residue was analyzed by the Scanning Electron Microscope (SEM). Volatiles from wood pyrolysis were measured by an analytical pyrolyzer coupled with gas chromatography and mass spectroscopy (PY-GC/MS).

The peak heat release rates (PHRR) were 141.22  $\text{kWm}^{-2}$ , 243.35  $\text{kWm}^{-2}$ , and 202.39  $\text{kWm}^{-2}$  respectively for APP,  $\text{NH}_4\text{H}_2\text{PO}_4$  and  $\text{H}_3\text{BO}_3$  treated samples under a heat flux of 50  $\text{kWm}^{-2}$ . Compared with the PHRR of untreated pine of 256.17  $\text{kWm}^{-2}$ , it was observed that all the three fire retardants would reduce the peak heat release rate.

APP gave a lower peak heat release rate. Suppression mechanism came from analysis of pyrolysis volatiles. Pyrolysis of APP treated pine produced more levoglucosan and furfural, and fewer phenolic compounds. Introducing compounds from APP cracking enhanced the dehydration reaction of cellulose and hemicellulose to form water at low temperature. Heat would be extracted by water evaporation to produce apyrous compounds. The time to ignition was extended

with lower chance to burn. An intumescent structure was observed in the solid char of APP treated pine. It would protect the timber substrate against further decomposition. All fire retardants involved gas-phase reaction, not condensed phase. That is because the microstructure of pine wood did not change.

Details were reported in the PhD thesis jointly supervised by The Hong Kong Polytechnic University and Zhejiang University [1].

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#### REFERENCE

1. Xiujuan Guo, "Mechanism research on the selective pyrolysis behaviour of biomass", PhD thesis jointly supervised by The Hong Kong Polytechnic University and Zhejiang University (2011).