USING KINETICS-BASED MODELS TO ADDRESS SERVICEABILITY CONCERNS FOR FIRE RETARDANT TREATED WOOD AT ELEVATED IN-SERVICE TEMPERATURES

Jerrold E. Winandy, Research Wood Scientist
USDA Forest Service, Forest Products Laboratory
Madison, Wisconsin, USA

During the last decade, much North American research has evaluated the cause of in-service thermal degrade of fire retardant (FR) treated plywood and lumber. Both the American Society for Testing and Materials and the American Wood Preservers' Association have now developed new testing or treating standards to evaluate and qualify new FR treated products. Research continues on assessing current condition (i.e., residual strength) of FR treated plywood roof sheathing and lumber. The final phase of that research looks at predicting residual future serviceability. This paper is an update on work in that final phase.

In the 1980s in North America, thousands of buildings built with plywood roof-sheathing and roof-truss lumber treated with commercial FR chemicals prematurely failed in-service. Elevated roof temperatures caused by solar radiation in combination with some FR chemicals and moisture prematurely activated those poorly performing FRs, causing the wood to become brittle and eventually fail in-service. This led to litigation and resulted in much research to address the cause. prevent reoccurrences. and develop a serviceability evaluation (1,2).

Methods for predicting residual serviceability are based on recently developed and verified kinetic models (3.4). These kinetic-based models predict the effects of FR treatments on the bending strength of wood subjected to on-going thermal degradation during exposure to elevated temperatures in-service. These models were developed for FR treated wood exposed in the laboratory to various durations of a steady state exposure at 54°C/73% relative humidity (RH) and 82°C/50% RH for up to 5 months or at 66°C/75%RH for up to 4 years.

The predicted strength losses and field serviceability from these kinetic models seem to parallel actual field performance (Fig. 1). The results showed that the worst generic FR. 56 kg/m^3 of phosphoric acid (PA), lost an additional 20% of original in-service capacity when our models (3,4) were used to simulate a 10-year exposure in Madison. WI, USA (5). Untreated wood only lost a predicted 4% after the 10-year simulation. Other generic FR chemicals, such as 56 kg/m^3 monoammonium phosphate (MAP) or a 70/30 mixture of guanylurea phosphate/boric acid (GUP/B). lost intermediate levels of strength. Based on time-temperature superposition, the strength loss in warmer, sunnier climates would be greater. This information is currently being introduced into U.S. design codes and standards.

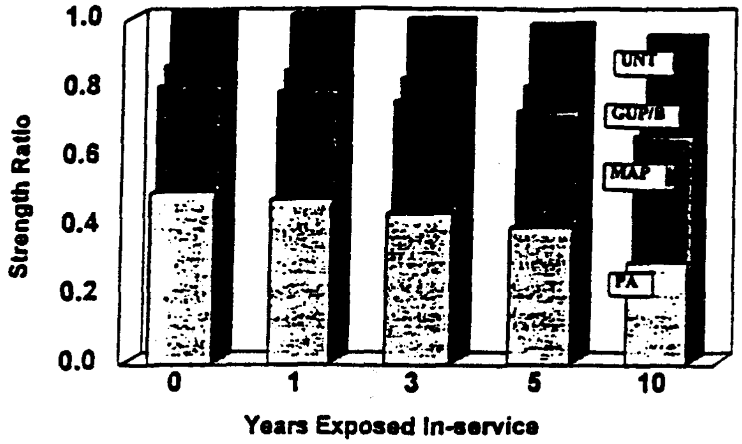

Figure 1. Predicted change in strength of untreated (UNT), phosphoric acid (PA), monoammonium phosphate (MAP), of guanyturea phosphate/boric acid (GUP/B) treated wood during a simulated 10-year exposure in North Central United States based on new models (3,4).

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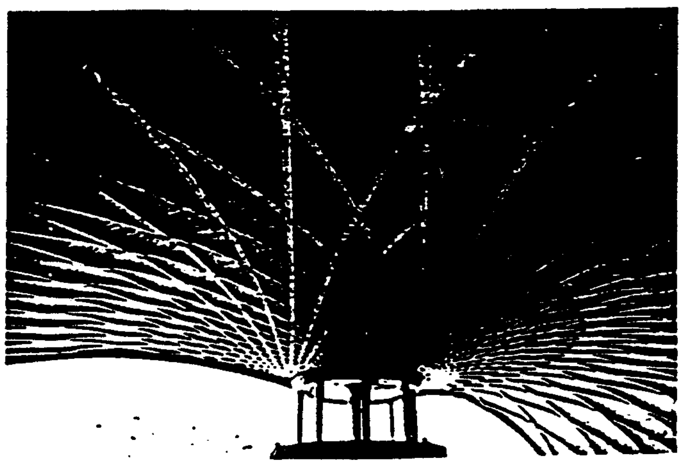

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