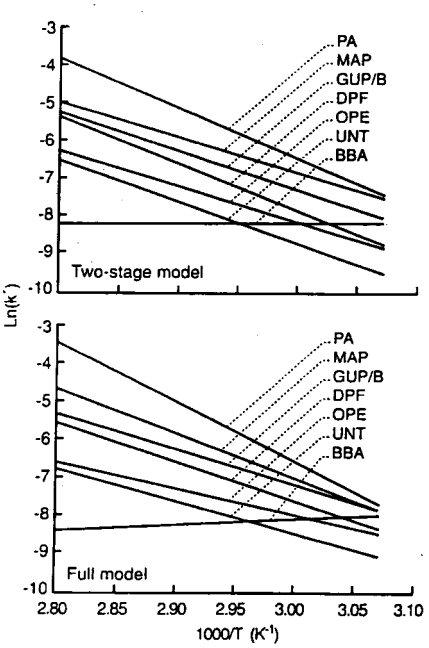
TECHLINE
Properties and Use of Wood, Composites, and Fiber Products

Effects of Fire-Retardant Treatments on Wood Strength at Elevated Temperatures

Fire-retardant-treated plywood can substitute for noncombustible materials in some structures. However, some commercial fire-retardant treatments have weakened plywood used as roof sheathing. The combination of chemicals, moisture, and elevated roof temperatures caused by solar radiation can prematurely activate some fire retardants, causing the plywood to darken, become brittle, check across the grain, and crumble easily. Such deterioration has been found most often in the eastern United States in post-1980 commercial buildings and multifamily dwellings built without parapet walls.



Predicted degradation rates of different fire-retardant formulations using various approaches: (a) two-stage approach with nonlinear first-stage and weighted regression second-stage and (b) single-stage full approach, where

PA = phosphoric acid, an inorganic acid;
MAP = monoammonium phosphate;
GUP/B = guanylurea phosphate, an interior organic salt;
DPF = dicyandiamide phosphoric acid formaldehyde an exterior organic salt;
OPE = organophosphonate ester;
UNT = untreated; and
BBA = borax and boric acid.

Scientists at the Forest Products Laboratory developed models to predict the factors that influence thermal-induced strength degradation. This work included assisting in the development of several new American Society for Testing and Materials (ASTM) and American Wood Preservers' Association (AWPA) standards intended to test treatments prior to commercial marketization.

Different formulations had different effects (see figure). Each fire retardant studied accelerated strength loss, but the inorganic salt phosphates had a significantly greater effect than other exterior or interior organic salts studied. However, even untreated wood suffered permanent thermal degradation when exposed at 180°F (82°C).

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