



Forest Products Laboratory

FinishLine



Effects of Acid Deposition on Wood

Acid deposition—the general term for acid rain, snow, and fog—has long been suspected of accelerating the deterioration of many materials.

Researchers at the Forest Products Laboratory (FPL) have studied the effect of acid deposition on wood. Unpainted and painted wood were subjected to weathering under acidic conditions and compared to matched specimens that had been weathered without acid treatment. The results of these studies have important implications for the outdoor use of wood. Acid deposition affects both unpainted and painted wood, with special ramifications for wood that has been allowed to weather before painting.

The rate of deterioration of unfinished wood is affected by the length of exposure to acid and by the strength and type of acid. Even brief exposure increases the rate of deterioration. Tests have shown that wood exposed to severe acidic conditions degrades twice as fast as wood exposed to distilled water.

Since acid deposition increases the rate of deterioration of unpainted wood, it can also affect the performance of paint applied to this weathered wood. In tests conducted near Madison, Wisconsin, smooth-planed wood was allowed to weather before painting. Exposure for as little as 2 weeks shortened the service life of the subsequently applied paint. The paint bond was weak and the paint eventually peeled. Acid concentration in rain near Madison tends to be much lower than that found in many other areas of the United States. High acid concentration would tend to produce more surface degradation and thus

form a weaker paint bond. In any case, wood should be painted as soon as possible after it is installed outdoors.

Researchers at FPL found that sulfur dioxide (one of the precursors to acid deposition) diffuses through paint coatings very rapidly and can be detected in the wood directly under the paint. Consequently, they studied whether acidic conditions could deteriorate the wood under paint, as these conditions affect unpainted wood.

In one test, painted wood was subjected to acidic conditions and exposed outdoors for 3 years. The specimens were dipped in sulfuric, sulfuric, and nitric acids as well as a combination of sulfuric and nitric acids (50/50). During the summer, the specimens were dipped in acid for several hours before sunrise, then exposed at 45° facing south. This dip cycle was repeated daily. During the winter, the specimens were subjected to the same exposure conditions (45° facing south) but were not dipped in acid. Control specimens were dipped in deionized water.

Over the 3 years of exposure, no difference in paint bond strength could be found between the specimens dipped in deionized water and those dipped in acid. However, the acidic conditions did affect the surface of paint that contained a large amount of calcium carbonate. The acid eroded the paint, similar to the erosion of marble building facades and statues in areas with acid rain.

In summary, acid deposition increases the rate of deterioration of unpainted wood. Consequently, wood should be painted as soon as possible after it is installed outdoors. Acid deposition does not affect wood that has been painted before exposure. Paint that contains calcium carbonate filler erodes faster than paint without this filler.

Reference

R. S. Williams. 1990. Effects of acidic deposition on materials. Report 19. Acidic Deposition: State of Science and Technology, Vol. III, National Acid Precipitation Assessment Program. Washington, DC: Superintendent of Documents, Government Printing Office.

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