"FIRE RETARDANCY WITH STRUCTURAL MATERIALS"

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PRESSURE TREATED FIRE RETARDANT WOOD

Impregnating wood with chemicals to reduce or prevent combustion is not an idea developed last year or even in the last decade. Historical documents of the United States Navy show that fire retardant treated wood was specified as early as 1895, and it was written into the New York City building codes by 1898.

The market for fire retardant treated wood remained small and processing was confined to one or two treating plants prior to World War II. During the war, and periods following, some potentially disastrous fires were held to relatively minor dollar losses because of treated wood in the structures. These experiences resulted in the first real recognition of FRTW as a fire-safe material of construction. Ultimately, acceptance into the building codes resulted and by 1963 all of the model codes had approved FRTW for various uses. In 1964 over 32 million board feet of lumber was treated. In 1969 this had increased to 45 million board feet. In addition, nearly 10 million square feet of plywood and 3 million square feet of other miscellaneous wood products were also treated. In 1969 there were 46 plants processing fire retardant lumber.

Commercially there are two basic types of fire retardants available - an interior type and an exterior type. These names refer to the usage of the treated material; i.e., on the interior of a structure, or the exterior. The interior type is considerably older. It was the fire retardant available when the Navy wrote it into their specifications in 1895.

Interior fire retardants for pressure treated wood all are formulated with water soluble inorganic salts. These salts are dissolved in water at concentrates of 10 to 15 percent depending on the formulation. The salts commonly used are compounds of borates, sulfates, phosphates, chlorides, etc. Some manufacturers add as many as five different salts in one formulation; each added to control certain properties (cost, hygroscopicity, smoke, etc.).

All Underwriters' approved fire retardants carry a Class I fire hazard rating. This means that treated wood has a flame spread of 25 or less when tested in the 25-foot tunnel by ASTM Method E-84. The better fire retardants will have an actual flame spread of about 15 which compares to 0 for asbestos cement board and 100 for untreated red oak. Fuel contributed and smoke developed during the tunnel test are also in the range of 25 or less.

Interior fire retardants do an excellent job of protecting wood from combustion. They are accepted by all model and local building codes. They provide permanent, life-long protection, except when exposed to the weather or prolonged conditions of high humidity. The salts, being water soluble, will leach from treated wood when exposed to the action of running water. Unless well protected by paints or other impervious finishes, interior FR should be limited to interior uses. The salts are also hygroscopic, meaning that they have an affinity for moisture in the air, and when exposed to high humidity conditions, can absorb sufficient moisture to leach salts. (See Figure 1).

Exterior fire retardants are of recent discovery. Initial research originated following the massive Bel Air fire in 1961. The investigation of this fire disclosed that burning wood shakes and shingles blew from roof to roof contributing immensely to the loss of more than 500 homes in the Bel Air area. This fire prompted Koppers Company to initiate planned research for an exterior type fire retardant. Underwriters' Laboratories provided immeasurable assistance by establishing parameters for what they would consider to be a permanent treatment for wood shakes and shingles when exposed to any weather conditions. Underwriters' criterion for an exterior type fire retardant is detailed in UL790, Test Methods for Fire Resistance of Roof Covering Materials. This is available from Underwriters, Chicago, Illinois, or Santa Clara, California.

In late 1966 Underwriters' approved an exterior type fire retardant and gave Koppers the authority to apply a Class "C" roof covering label to red cedar shakes and shingles. The structure of this fire retardant is a complete new concept from the interior types. Where the interior fire retardants are simply inorganic salts dissolved

in water, this exterior type is a water soluble monomer that polimerizes under heat to form an insoluble polymer. Phenolic resins, such as the common plywood adhesives, are in this category. The monomer is manufactured by reacting exact proportions of selected proprietary chemicals in water to form a low solids resin solution. Once the resin is properly cured it is no longer water soluble, nor is it hygroscopic.

In addition to the Class "C" approval on shakes and shingles, further research has resulted in a Class "B" roof system. The Class "B" systems incorporate the Class "C" shakes or shingles on a plywood roof deck covered with a durable polyethelene coated steel foil. Lumber and plywood treated with this exterior fire retardant have been approved by Underwriters' for permanent exterior exposure. Lumber and plywood carry a Class I flame spread, as do the interior type fire retardants, but are not limited to indoor use.

Wood can be processed with this exterior fire retardant in the same facilities as used for interior fire retardants. Wood treated with exterior fire retardants are kiln dried at higher temperatures than interior. This is necessary in order to properly cure the monomer and assure its permanence in the wood.

Underwriters' Laboratories and the Building Codes recognize only pressure treated fire retardant wood. By pressure treating, control is maintained over penetration and retention of fire retardant chemicals. This is necessary in order to meet Underwriters' listing requirements. Underwriters' "Follow-up Service" assures the quality of treatment, and if for no other reason, where life safety is involved only Underwriters' listed products should be used.

Exterior fire retardants are generally easier to bond, machine, and finish than the interior types. Exterior fire retardants provide a good degree of decay and termite resistance. (See Figure 2). Exterior fire retardant treated wood products are more expensive because of the greater sophistication required in processing and more costly chemicals.

This paper could expound on the auxiliary properties of fire retardant treated in great length. The purpose, however, is to inform those unfamiliar with fire retardants that fire retardants do exist for both interior and exterior construction. They

are approved by the codes and receive preferential insurance rates. For availability, ease of application, fire safety, economics, and architectural appearance, fire retardant treated wood is unequalled as a material of construction.

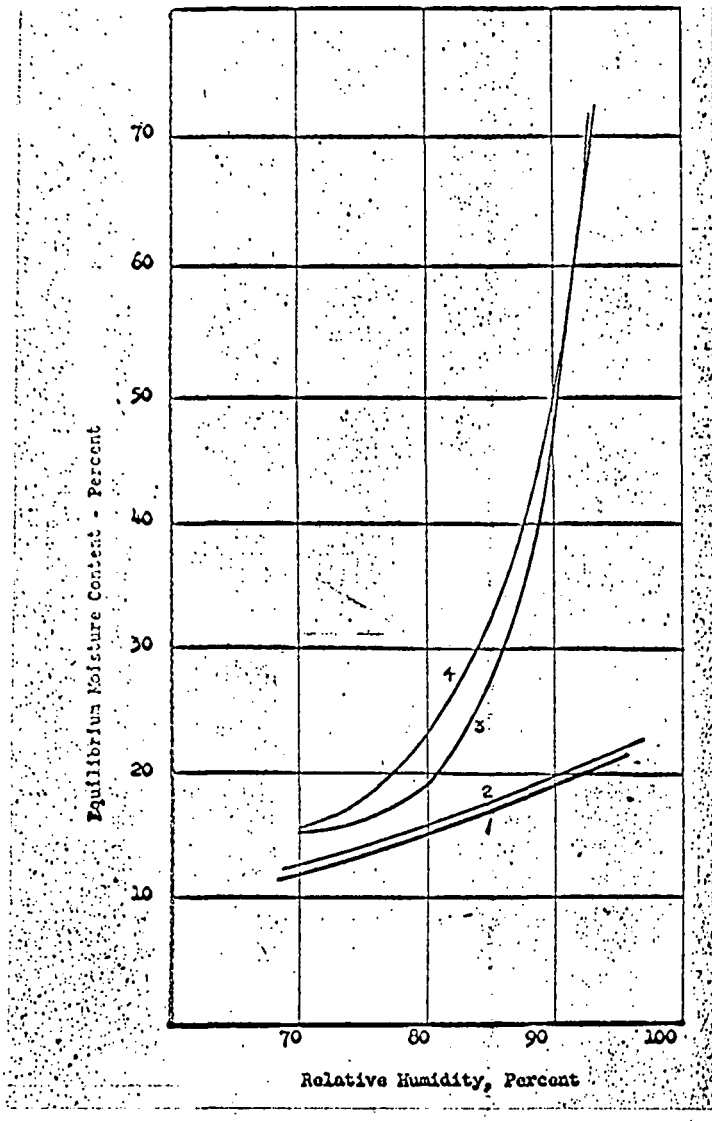

Figure 1. - Comparative hygroscopicity of interior and exterior type fire retardant treated wood.

Curve 1. Exterior fire retardant
Curve 2. Untreated wood
Curve 3. Interior fire retardant
Curve 4. Interior fire retardant (another formulation)

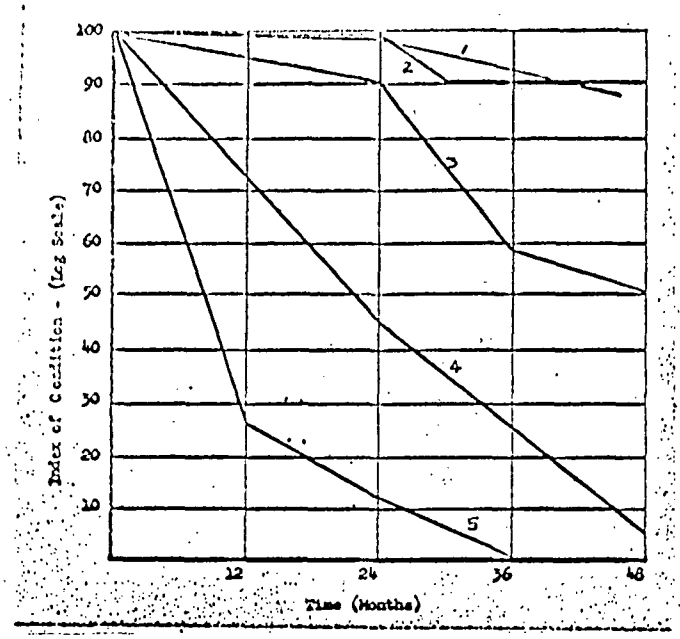

Figure 2. - Comparative resistance of exterior fire retardant treated wood to decay and termite attack. Tested in accordance with ASTM Method D1758.

Curve 1. Non-Com Exterior (R) fire retardant
Curve 2. Wolman Salts (FCAP) 0.4 pcf retention (preservative for above ground use)
Curve 3. Untreated foundation grade redwood
Curve 4. Untreated heart Western red cedar
Curve 5. Untreated sap Southern pine