The Hazards of Fire Retardant Treated (FRT) Wood

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A Brief History

The use of inorganic salts as a treatment to render wood fire-retardant is not a modern development. Indeed, approximately eighty years ago, the wood treating industry developed and later refined a pressure impregnation process where these mineral salts are forced deep into wood cells. This process resulted in a new building component known as Fire Retardant Treated (FRT) Lumber or FR-S (per Underwriters Laboratories, Inc.). FRT is applied to wood building materials such as plywood and structural lumber (including dimensional lumber used to fabricate roof trusses) to reduce the capacity of the wood to contribute to a fire. The FRT chemicals reduce the temperature at which thermal degradation can occur, thereby increasing the amount of char and reducing the amount of flammable volatiles. In this regard, FRT has performed effectively.

In the late 1950's and early 1960's several companies began aggressively marketing formulations of these fire retardants under various trade names. While the formulations of these products were (and still are) proprietary, and no doubt varied to a small degree, these "first generation" products contained inorganic salts, such as Monoammonium Phosphate, and Ammonium Sulfate. In some cases Zinc Chloride and Diammonium Phosphate were used as well.

The Problem

The problem with the use of these salts as fire retardants is that they are highly hygroscopic. That is, they will absorb moisture from the air when relative humidity becomes high. It has been reported that some products were so hygroscopic that they would actually drip solution at relative humidities of approximately 90%. Initial problems included corrosion of metal fasteners and fittings (such as metal truss plates). However, in the last few years, it has become increasingly apparent that there are far more serious problems associated with the "early" FRT's.

Fire retardant treatments are also acidic. Under the right conditions, (high relative humidity and high temperature) the water absorbed by the treated wood will react chemically with the fire retardant to produce a condition known as "acid hydrolysis" (also known as "acid catalyzed dehydration"). This process attacks the fiber of the wood causing it to become brittle and lose strength. Significant losses in the Modulus of Elasticity (MOE), the Modulus of Rupture (MOR) and impact resistance can occur. (MOE is a measure of stiffness, while MOR is a measure of bending strength). The modes of failure include heavy checking parallel and perpendicular to the grain, splitting, and full cross grain breaks. Eventually, the degradation continues to the point that the wood becomes so weak and brittle that it actually snaps under normal loading conditions. This process is insidious in that it is progressive, and latent.

The Property and Life-Safety Issue

The loss of strength properties mentioned above can result in truss damages, truss failures and roof collapse. These failures can be catastrophic and therefore represent a real threat to life safety. Obviously when one structural member breaks, adjacent members take up the load, resulting in a "domino-effect". Depending on conditions, it can take twenty to thirty years for the degradation to reach the point of full breakage. Oftentimes, breakage is not noticed due to inaccessibility to the areas involved. Additionally, failures can (and do) result in significant repair costs. Replacement of the trusses requires destruction of the entire roof structure, and oftentimes involves removal and/or destruction of building infrastructure such as electric, HVAC, plumbing, etc...

Going Forward

The writer has been personally involved in a number of cases where life safety was a genuine concern. While litigation in one of these matters was pending, the client (a large insurer) initiated an inspection program of buildings contained in its' insurance portfolio. As a result of that survey, extensive FRT damages were uncovered in other locations including school buildings, libraries, and other public structures. Many other organizations and associations have advised their members to undertake inspections to determine if similar damages are present in their buildings as a result of FRT lumber being used in the construction.

Identifying FRT Wood

While chemical analysis can be used to positively determine the presence of FRT, the following list can be used as a general guide in inspections:

- If they are still in existence, review the plans and specifications of the subject structure to determine whether FRT lumber was specified as a building component.
- Determine if fire rated construction was required at the time the structure was built.
- Try to determine the date of construction. As noted above, FRT problems are commonly associated with buildings constructed in the 1960's and 1970's. Note, however that FRT lumber can exist in any structure regardless of construction date.
- Look for identification stamps which are typically located on visible portions of the plywood deck or dimensional lumber. The stamps can be ink stamps or paper stickers. The stamps may also identify the proprietary name of the FRT, the manufacturer or the applicator. Additionally, if an Underwriters Laboratories (U.L.) stamp is found, more than likely the lumber contains FRT. (see photo)
- Look at the color of the wood components. FRT is typically darker in color. A reddish-brown color is typical.
- Look at the surface of plywood. FRT plywood can degrade and can cause the surface to be "fuzzy" in appearance. This occurs often where the wood has been subjected to direct water intrusion near eaves and roof penetrations.
- Look at the surface of the dimensional lumber. Light checking (cracks) along the length of the wood is normal. Heavy checking perpendicular to the grain of the wood can be associated with the use of FRT.
- Look at metal fasteners and metal plates on pre-fabricated trusses. Corrosion of the metal truss plates and/or the presence of white residue may be associated with the salts from FRT.
- Look for cracks, splits, or breaks in the dimensional lumber. These types of damages can be most extensive in the bottom chord of a truss (the horizontal member at the bottom of the truss which often supports the finished ceiling) and web members closest to the middle of the roof (vertical or diagonal framing members located below the roof ridge). (see photos)
- Look for the presence of fire-rated walls. The absence of these walls, that are typically covered by fire-rated drywall, may be associated with the use of FRT roof framing.

The Bottom Line

The hazards associated with the FRT problem are real and should not be overlooked by property managers, owners and others who have responsibility for building maintenance. If an inspection reveals the presence of FRT lumber or plywood sheathing, a complete structural analysis by a competent structural engineer should be undertaken to determine the extent of any damage and loss of integrity of the wood. If necessary, immediate steps should be taken to secure the structure from a safety standpoint. In extreme cases, the building may have to be vacated.

Thereafter, an assessment can be undertaken to determine the manufacturer(s) of the particular FRT and a complete damages evaluation can be conducted. Oftentimes, litigation against the manufacturers and/or others involved in the construction of the project results.

For more information on Fire Retardant Treated (FRT) Wood, log onto our web site at www.nexsenpruet.com or email your questions to bwaring@nexsenpruet.com

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