# WOOD PROTECTION:

## A guide to protecting your home

There are approximately 70,000 new homes built each year in the Southeastern U.S. These new homes are important for the economy and new homeowners. However, the warm and wet climate in the South results in a high deterioration hazard to the many wood products used in residential construction. To minimize costly wood degradation, homes should be properly designed and constructed by knowledgeable professionals.

Homeowners can arm themselves with information as a first line of defense against the forces that can destroy decks, homes and other wooden structures. This research advance is designed to give homeowners information on: (1) the organisms which commonly attack wood in the South and solving minor fungal deterioration problems; (2) the proper materials to build a deck or other exposed structure; and (3) the safety of treated wood in pre-existing structures. Homeowners with major deterioration concerns, or who are thinking of purchasing a home and wish to determine if any termite or decay problems exist, should seek the help of trained professionals.

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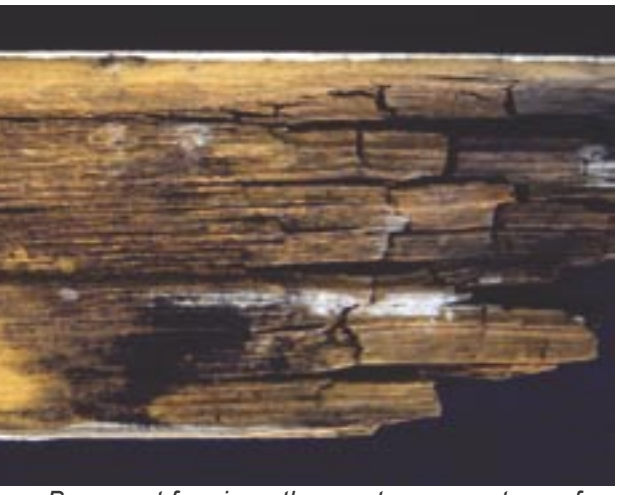
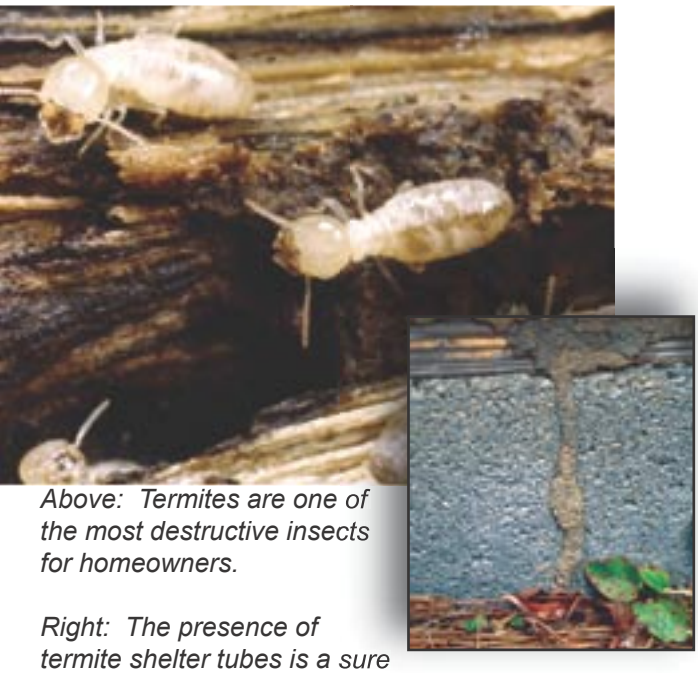
RESEARCH ADVANCES

Forest and Wildlife Research Center

*This fascia board was exposed to rain water which soaked in the board ends. Note the cracked appearance of painted wood and the brown, soft wood in the inset.*



*Brown-rot fungi are the most common type of decay fungi which attack wood in homes. This brown-rot was found in vertical molding which rested on a concrete pad and was frequently soaked by puddles of rain water. Note the brown, cracked appearance of the wood.*



*Above: Termites are one of the most destructive insects for homeowners.*

*Right: The presence of termite shelter tubes is a sure sign of invasion.*

## Identifying Wood Destroying Organisms

The warm and humid environment in the southeastern U.S. results in high potential for wood deterioration. Decay fungi and termites are the most destructive wood pests of homes in this region.

Decay fungi are a major concern for every homeowner. It is estimated that replacement materials to repair decay damage amount to about 10% of the U.S.'s annual lumber production. Most decay fungi which attack the wood in homes are called brown-rot fungi. These fungi colonize and degrade wood which is frequently wet, or wood which is in ground contact. The key to preventing damage by decay fungi is to keep wood dry. An exception, fortunately rare, is the fungi which can transport water from soil to nearby wood, the so-called dry-rot fungi. Dry-rot fungi frequently enter structures through the sill in flower planters, raised patios, or earth-filled porches. Wood degraded by brown-rot fungi becomes brown and develops cracks perpendicular to the grain. Wood which is extensively degraded partially collapses and, when rubbed, forms a brown powder. The wood also is soft and easily punctured by a knife. Painting decayed wood does not solve the underlying problem, which is frequently water-soaked wood, and the painted surface quickly becomes uneven and develops cracks (see top left picture). Wet wood also can be colonized by mold and stain fungi, which discolor but do not degrade the wood. However, the presence of molds and stain fungi are an indication of moisture problems and possible future wood decay.

Most termites in the U.S. are subterranean and only attack wood in ground contact or where they have constructed shelter tubes to reach above-ground wood (see bottom left picture). A second type of termites, drywood termites, can attack houses directly from the air. As their name implies, these termites can attack relatively dry, unfinished wood (e.g., in attics or crawlspaces). Fortunately, in the Southeastern U.S., drywood termites are only found near the Gulf or along the southern Atlantic coast. Another type of subterranean termite, the Formosan termite, was unintentionally introduced into the continental U.S. and is slowly spreading northward. It is anticipated that the Formosan termite will not extend its range past approximately 35° north latitude. Although subterranean, Formosan termites can build nests above ground without soil contact where water is present. Potential moisture sources are in a wall near a water leak, condensation from a roof-top air conditioner, and leaks in roofs or windows. Termites avoid light and consume the inner portion of lumber, such as hidden studs in walls and, thus, may be difficult to detect. Termites mature and swarm, or fly, from their nesting sites in the spring. In infected homes, as termites swarm, homeowners may notice small piles of wings, all of the same size and shape, near windows or caught in spider webs. Termites are poor flyers and lose their wings after flying short distances. If wings or small ant-like insects are observed in a house, homeowners should collect a few and ask a trained professional to examine them and inspect the home. Termites cause more damage to homes in the U.S. than fires, storms, and floods combined!

## Curbing the Appetite of Wood Destroying Organisms

Proper house design and construction techniques by trained professionals are critical. A poorly designed and/or improperly built structure is almost certain to eventually have decay and/or termite problems. If a particular decay problem occurs regularly, homeowners need to determine the source of water supporting the growth of the decay fungi or contact a trained professional to correct the problem. Simply replacing the deteriorated wood without correcting the underlying cause will result in the newly replaced wood becoming decayed at some later date.

Homes should be designed and constructed to keep wood dry, especially at joints. In the hot and humid south, good designs feature wide roof overhangs and/or porches, ventilated attics and crawl spaces, and gutters and associated drainage to remove rain water well away from the structure on all sides. Wood primarily absorbs water through the end grain, such as at joints where two pieces of siding adjoin, around windows and doors, or where a piece of vertical molding or support post touches a concrete pad where puddles form during storms, etc. At these places wood can easily become wet and is especially susceptible to decay. The first picture on the previous page illustrates the cracked appearance at the ends of the adjoining fascia boards that is typical of decayed wood. This decay was caused by water draining off of the roof. Homeowners need to ensure that lumber remains dry, or use treated wood.

Exterior wood that is exposed to frequent wetting, e.g., window sills, doorjambs, fascia boards, etc., should be periodically inspected for signs of fungal decay. Probe any suspect areas, such as where painted wood is cracking and uneven, with a knife. Decayed wood is very soft and the knife blade will penetrate easily. If decay is detected in the early stages, it can be controlled by boring a hole near the affected portion and wicking in a wood preservative or inserting a fused borate rod. Borate rods can be obtained at some hardware stores or through the internet at sites including www.woodcaresystems.com or www.prginc.com. After inserting the rod the hole should be sealed. Small decayed areas can easily be repaired by removing the soft decayed wood and patching with epoxy systems obtained at local hardware stores or web sites such as www.woodcaresystems.com.

When constructing a new home, the soil underneath the structure should be treated by a professional to prevent subterranean termite attack. Barriers should be installed between masonary and wood framing and a minimum of eight vertical inches should be left between the bottom of siding and the ground. All scrap lumber should be be removed from the construction site.

Routine inspections for termite activity should be made around foundations and in crawl spaces. Shelter tubes extending from the soil are an indication of termite activity. Due to the potential destructive nature of termites on hidden structural wall studs and roof beams, homeowners may want to have regular termite inspections by trained professionals. When new raised flower beds, patios, and/or porches are constructed adjacent to homes, the soil adjacent to the foundation wall should be treated by a professional.

# The Right Material is Primary for Outdoor Structures

Proper home construction practices will minimize wood degradation problems. However, some wood, such as lumber in outdoor exposed applications like decks or in ground contact, must be treated with commercial biocides to prevent fungal and/or termite degradation.

Homeowners in the Southeast wishing to treat wood themselves for above-ground use can purchase wood preservative products at a local hardware store for brush-, dip- or spray-on application. This only provides short-term protection and requires frequent re-applications.

Treated wood used for residential construction is processed at a commercial treating facility with biocides approved by the Environmental Protection Agency (EPA) and standardized by the American Wood Preservers' Association (AWPA) or other appropriate organizations. This lumber is treated by a vacuum/pressure cycle process, subjected to rigid quality-control testing, and has sufficient biocide levels and penetration necessary to ensure long-term performance. Essentially all biocides used to pressure treat lumber for residential applications are dissolved in water so treated wood has a non-oily surface and can be painted or stained when dry. Treated wood is also odorless and can be used indoors. Once impregnated into the lumber, most biocides become fixed to the wood after a short time and are relatively permanent. Thus, most treated lumber can be used in ground-contact, fresh water, or in above-ground exposed applications such as decks. The exception is borate-treated wood, which can only be used for non-exposed above-ground applications such as structural framing. Homeowners need to inspect the preservative label to ensure that the treated lumber is for the intended application.

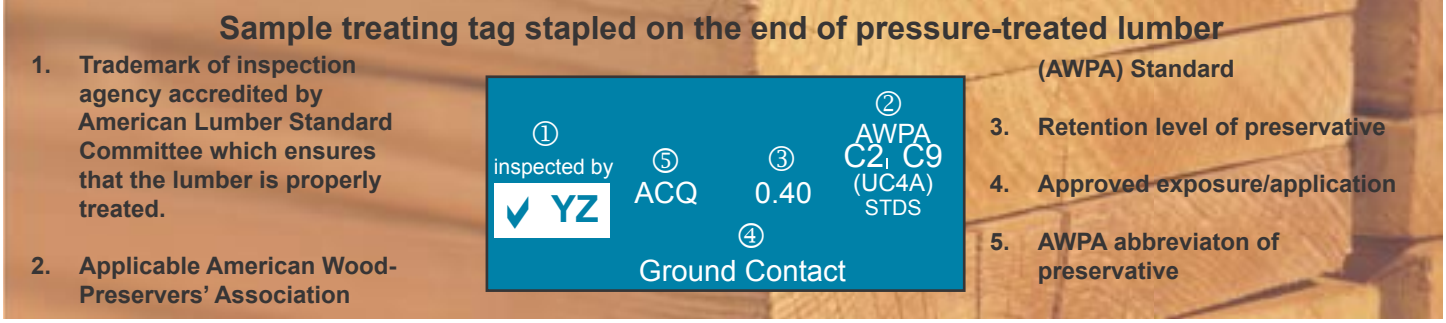
The southern yellow pines (SYP) grown in the southeastern U.S. produce lumber that is easily pressure treated. One exception is that it is difficult to get a biocide solution into the heartwood, the darker center portion of logs cut from mature trees. Consequently, when buying large-sized timbers for ground-contact structural applications users should select lumber with only a small amount of heartwood. Lumber from western species, such as spruce, hemlock and Douglas fir, is more difficult to treat. Homeowners should coat any sawed ends of lumber with one of the brush-on biocides described below. Larger size lumber, such as 4x4 and 6x6 timbers which are used for structural support, may not be completely treated in the center. Thus, if timbers are cut prior to being placed into soil or concrete, or rested on masonry, the cut end should be brush-treated with a preservative and the cut end oriented up so it is not in the soil or in contact with masonry. If wooden structural supports rest on concrete, a metal support should be used to raise the timber slightly above the concrete.

Several studies by the EPA and other organizations have shown that treated wood is safe to use both indoors and outdoors, provided some safety precautions are taken. Workers should minimize exposure to sawdust and wear a dust mask and eye protection when sawing any wood, either treated or untreated. When using treated wood that is still wet, workers should use rubber gloves. These precautions are not necessary when using dry treated wood. Construction debris of treated wood should be cleaned up and disposed of by trash collection. Left over pieces of treated wood should **never** be burned since this may form a toxic smoke and hazardous residual ash. Wood treated with most preservatives should not be used where it could come into direct contact with food or drinking water, such as kitchen countertops, silage storage, etc. Although several studies have shown that exposure to treated wood is not a significant health risk, homeowners concerned about exposure can use sealers such as polyurethanes on a yearly basis to cover dry treated wood. More consumer information is available from stores which sell treated wood.

## Homeowners guide to treating wood

Homeowners desiring to treat unprotected wood in above-ground applications need to first clean the wood surface, read and follow the safety instructions on the product label, avoid skin contact and wash clothes afterwards, and use only products approved for wood. In addition, wood which is already partially degraded should first be replaced and the problems which caused the degradation corrected. Exposure of untreated wood to water and soil are the major causes of degradation and need to be corrected before the wood is replaced or, alternatively, use treated wood.

EPA-approved biocides which can be purchased by homeowners for brush- or spray-on application include: (1) Borates, which control both insects and decay fungi in non-exposed applications. Borates are harmless to animals and humans, but are leached from wood in soil contact or frequently wet. (2) Copper naphthenate, effective against insects, decay fungi and molds. (3) Copper-8-quinolinolate, also called oxine copper or Cu-8, which protects wood against fungi, molds and insects. Wood treated with Cu-8 has been standardized by the




AWPA for applications where the treated wood will come into direct contact with foodstuffs. (4) Iodo-2-propylbutyl carbamate, or IPBC, which controls fungi and molds but not insects. (5) Permethrin, and other synthetic pyrethroids such as deltamethrin, which can control insects but not decay fungi. Synthetic pyrethroids can be identified by a name which ends with "thrin".

The biocide used in the wood preservative product, available at local building supply stores, is listed on the container label as the active ingredient. These biocides have undergone rigorous health and efficacy testing and are registered by the EPA. Indeed, some of the biocides listed above are also used in common household products. Some products also contain a water repellent, to minimize warping and bowing of lumber. Homeowners should carefully read all instructions and follow proper safety precautions. Some products sold as wood protectors only contain a water repellent and/or sunlight blocker (ultra-violet light protector) with no biocide and, thus, will not inhibit insects and have only a slight benefit on preventing decay from fungi, but will minimize splitting and warping of lumber if applied yearly.

**Homeowners guide to purchasing treated wood**

The major wood preservative used to pressure treat lumber in the U.S. has been chromated copper arsenate, abbreviated CCA. Due to recent concerns, wood preserver manufacturers voluntarily agreed to limit CCA to mostly industrial applications starting in 2004. Despite the negative publicity, several studies by the EPA and other organizations have shown that CCA-treated lumber is safe, provided a few safety precautions are taken. The EPA also concluded that existing structures made with CCA-treated wood do not need to be replaced. Most health concerns have arisen from burning pieces cut from treated wood, or handling freshly-treated wet lumber in which CCA is not yet fully fixed, without taking precautions. CCA controls almost all wood destroying organisms except a few insects which inhabit but do not consume wood as a food source (e.g., carpenter ants and carpenter bees) and molds and stain fungi which discolor but do not degrade wood.

Two new biocides have been standardized by the AWPA as CCA alternatives for treating wood for use in exterior exposures. They both contain relatively high levels of copper to control most decay fungi and insects, and a smaller amount of an organic, non-metal biocide to manage copper-tolerant fungi. One system is called alkaline copper quat (ACQ), and the other is copper azole (CA). Both are safe to use if safety precautions are followed. Indeed, quats are in many household disinfectants and the azole in CA is applied to food crops and available to homeowners as a plant spray. These new systems protect wood well but are corrosive to iron or aluminum fasteners, so homeowners need to ensure that stainless-steel, hot-dipped galvanized metal, or ceramic/polymer-coated fasteners and joist hangers and other hardware are used. Both of these preservatives leave lumber with a clean and non-oily surface, thus lumber can be painted or stained. Other copper:organic wood preservatives are being tested and may be available shortly.

Some lumber is treated with inorganic boron (SBX). Borates provide a broad range of protection against decay fungi and insects, are inexpensive, non-corrosive and have a low toxicity to humans. However, borates can leach from lumber exposed to water or in ground contact, unlike lumber treated with ACQ or CA. Thus, SBX-treated lumber should only be used in non-exposed above ground applications, such as indoor structural framing, to prevent damage by subterranean or drywood termites. SBX lumber might be suitable in partially protected exterior applications, such as fascia boards under a roof overhang, if the lumber is painted or sealed to minimize borate leaching. Borates are also used to treat logs in log homes to protect against decay fungi, termites, and beetles.

Treated lumber has a plastic tag at the end of each piece. The tag or stamp lists the AWPA abbreviation for the biocide, the biocide retention and approved application (decking, above ground, ground contact, etc.), the company which treated the wood and the inspection agency which verified that the lumber is properly treated to AWPA Standards. Some pressure-treated lumber also has a water-repellent added to the preservative system to reduce checking and warping. Treated lumber which has been stacked wet can have mold on the surface, but the mold is typically harmless and once the lumber is unstacked, the mold dries and can be easily brushed off.

## Naturally Durable Lumber

Some lumber is cut from trees which are naturally resistant to attack by fungi and termites, such as cypress

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and western red cedar. However, **only** lumber cut from the darker-colored **heartwood** in the center of logs from mature trees is naturally durable. The sapwood of all wood species is susceptible to decay fungi and insects. Lumber cut from the heartwood is only moderately durable and may have a short service life in the high or severe deterioration conditions present in the Southeastern U.S. Thus, lumber from the heartwood of naturally durable woods should be used in semi-protected applications such as siding, or where failure will have minimal economic cost such as outdoor furniture. Brushing on a wood preservative product will increase the service life of naturally durable lumber.

Naturally durable lumber should be handled with the same care as treated wood, since the heartwood is durable due to the presence of toxic extractives. Sawdust from naturally durable wood can cause skin rashes, respiratory difficulty and other health problems, especially if the dust accumulates in unvented workshops or other confined areas.

## Non Solid-Wood Lumber Alternatives

Products made from smaller pieces of wood which are glued together are called composites or engineered wood. Since they are made from wood, composites can also be degraded by fungi and termites. Composite lumber products used in home construction include laminated veneer lumber (LVL), oriented strand lumber (OSL), I-beams, and glued laminated (glulam) beams. Other wood-based panel composites include plywood, orientated strand board (OSB), hardboard, and particleboard. Some of these products can be pressure treated with the biocides described above. Composites may also have a solid biocide, usually zinc borate (ZB), added during production. A newly developed composite is plastic lumber made from a mixture of plastic and wood particles, which is used for deck flooring, railing, etc. Originally plastic lumber was made without a biocide, but some manufacturers now add ZB. Some deck lumber is made only with plastic, and requires no biocide. Plastic lumber is dimensionally stable and will not warp or split but is weaker than solid wood lumber so shorter spans between structural supports are necessary.

## FOREST PRODUCTS RESEARCH AT MSU

The Southeastern U.S. grows a majority of the trees in the U.S. used to make construction lumber. Lumber cut from SYP trees is easily treated with biocides, unlike lumber from the Western U.S. Thus, about half of all SYP lumber is treated. The Forest Products Department at Mississippi State University (MSU) devotes considerable effort to wood protection and is known world-wide for research in this area. Researchers in the department hold patents on their innovative preservation research.

The Department of Forest Products has recently partnered with MSU's College of Architecture, College of Engineering, and Center for Sustainable Design, to conduct collaborative research on housing for the southern region of the U.S. MSU also joined other universities to interact with the Advanced Housing Research Center of the U.S. Department of Agriculture Forest Products Laboratory as a founding member of the Coalition for Advanced Housing and Forest Products Research.

Other studies in the department have resulted in the development of improved treatments and processes for wood products. Evaluation of new preservatives for lumber and wood composites is a major component of this program. Many other long-term scientific studies are underway to help develop future wood preservatives which are economical, effective and safe. Forest Products faculty also conduct technology transfer to help companies develop new products or improve an existing product, assist users of treated wood, and help organize many international scientific meetings to publicize the latest scientific research.