



Blue Stain

Blue stain is caused by microscopic fungi that commonly infect only the sapwood of trees, using parts of the sapwood (including simple sugars and starches) for food. They cannot grow in heartwood or most wetwood that does not contain the necessary food substances. Blue stain fungi are prone to cause bluish or grayish discoloration of the wood but they do not cause decay. Blue stain has no effect on the strength of the wood.

In a cross section of wood containing blue stain, the discoloration often appears as pie-shaped wedges, oriented radially, corresponding to the direction of the wood rays. The discoloration may completely cover the sapwood or may appear as specks, spots, streaks, or patches of various color intensities. Blue stains come in various colors, with the most common ranging from blue to bluish black and gray to brown, although various shades of yellow, orange, purple, and red sometimes appear. The exact color of the stain depends on the infecting organism and the species and moisture content of the wood. Sometimes other types of stains are confused with blue stain, such as chemical brown stain.

Some standard lumber grading rules limit the amount of blue stain permitted on structural lumber. Usually this occurs only when the lumber will be exposed (for example, in railings, for which only 25% of the surface may contain blue stain). Structural lumber that will be concealed should not be downgraded for the presence of blue stain. Some

people like the decorative look produced in wood by blue stain. In the decorative wood market, spalted wood (caused by certain white-rot fungi, which can actually diminish the strength of wood if allowed to grow too long) is in high demand. White-rot decay fungi create “zone lines” in the wood where territories of competing fungi meet. These lines create a decorative appearance. White-rot fungi occur primarily in hardwoods such as maple, birch, and beech (see **Decay Fungi**).

Preventing blue stain requires that unfavorable conditions for the fungi be maintained (keep the wood dry, maintain temperatures above or below ideal growing temperatures, and protect the wood from insect infestation). Blue-stain fungi are spread by spores, which are produced in abundance. Although the spores of other fungi are normally disseminated by wind, blue-stain spores are “sticky” and are carried into the wood by insects. Once on the surface of a nutrient-rich environment, the spores grow rapidly. Blue-stain fungi can survive but cannot grow in wood with moisture content of 20% or less or in high or low temperatures. Temperatures higher than 150°F are lethal to blue-stain fungi. Dry kiln operators should be able to use drying schedules to control blue stain. In the summer months and in the tropics, dry kiln operators should chemically treat the wood with fungicides in addition to using proper kiln schedules. Chemical fungicides, or biocides, make the sapwood unsuitable as food for blue-stain fungi.



The bluish-black discoloration is blue stain. Note that the stain penetrated through the sapwood of this crosscut specimen.



The decorative appearance in this wooden bowl is the result of spaltling.

Because sapwood-stain fungi will not grow at temperatures below 35°F, kiln operators often curtail chemical treatment during winter months in northern locations. However, blue stain can develop in the kiln during the short time (days) that the kiln is at ideal growing temperature. Therefore, the kiln must be set above 130°F as early as possible. Unfortunately, chemical brown stain occurs in some species of wood that are stored for a time and dried at high temperature. To alleviate this problem, the best procedure is to get the log from the forest (to the mill) to the kiln as quickly as possible. Sodium pentachlorophenol (PCP) had been one of the most effective and widely used fungicides for controlling sapwood stains in lumber. However, the U.S. Environmental Protection Agency curtailed the use of PCP because of adverse effects on workers and the environment. New chemical formulations with lower toxicity levels appear promising for the control of sapwood stain.

Another approach to preventing blue stain relates to the fact that fungi tend to be territorial. By inoculating wood with a commercially available colorless mutant fungus, stains that develop from other fungi can be prevented. This colorless fungus, a mutant of the sapstain fungus *Ophiostoma piliferum*, was developed for the pulp industry and is commercially known as C97. (Currently C97 is available from only one supplier—AgraSol of Raleigh, North Carolina, 919-831-2240.) A problem with this approach arises if the wood is to be stained with a commercial finish. Sapstain fungi change the porosity of the wood, which might result in a splotchy appearance after staining. Sealing the wood before staining could solve this problem.

Because spores germinate rapidly on untreated sapwood, lumber must be treated—with fungicide or mutant fungus—immediately after the logs are sawed. The mutant fungus has demonstrated beneficial effects in treating both logs and sawn boards at sawmills, but it is still in a trial stage. If used in the sawmill, treatment should be applied as soon as possible after the logs arrive, or after the boards are cut, or certainly no longer than 36 hours after arrival in the yard. Chemically treated lumber should be stacked on stickers immediately after fungicide treatment. Under commercial operating methods, chemical fungicides will usually not soak into the board more than 1/32 in. Therefore, it is important to kiln dry the treated boards as soon as possible at initial dry-bulb temperatures >130°F to prevent the internal growth of fungi that have penetrated deep enough to escape the fungicide.

Glossary

Decay Fungi. Two major kinds of decay fungi are recognized: brown rot and white rot. Brown-rot fungi extensively remove only cellulose from the wood, which takes on a browner color and can crack across the grain, shrink, collapse, and be crushed into powder. White-rot fungi remove both lignin and cellulose from the wood, which may lose color and appear “whiter” than normal. The wood does not crack across the grain, and until severely degraded, it retains its outward dimensions, does not shrink or collapse, and often feels light and spongy. Brown-rot fungi commonly colonize softwoods (conifers), and white-rot fungi commonly occur in hardwoods (broad-leaved trees), but

both brown- and white-rot fungi occasionally colonize both types of wood.

Blue Stain. A bluish or grayish discoloration of sapwood caused by the growth of certain dark-colored fungi on the surface and in the interior of the wood; growth is made possible by the same conditions that favor the growth of other fungi.

Chemical Brown Stain. A chemical discoloration of wood, which sometimes occurs during air or kiln drying of several species, apparently caused by the concentration and modification of extractives.

Iron Tannate. A bluish black surface stain on oak and other tannin-bearing woods following contact of the wet wood with iron or with water in which iron is dissolved.

Mineral Stain. An olive to greenish black or brown discoloration in hardwoods, particularly maple, caused by bird peck or other injury and found either in mass discoloration or mineral streaks. The mineral associated with such streaks is frequently calcium oxalate, which has a tendency to dull machining knives.

Stain. A discoloration in wood that may be caused by microorganisms, metals, or chemicals. The term also applies to materials used to impart color to wood.

Sticker Stain. A gray to blue or brown chemical stain occurring on and beneath the surface of boards where they are in contact with stickers (also fungal sapstain when found only in the sticker area).

Water Stain. A yellowish to blackish surface discoloration caused by water that dripped onto the wood during drying.

Weathering. A very thin grayish brown surface discoloration on lumber that has been exposed to the weather for a long time.

Wetwood. Green wood with abnormally high moisture content that generally results from infections in living trees by anaerobic bacteria but may also result from water logging during log ponding. Wetwood can occur in both softwoods and hardwoods; the green lumber is usually difficult to dry without defects. Although difficult to recognize, wetwood is often characterized by a translucent, water-soaked appearance and a sour or rancid odor.

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