

STAINS AND DISCOLORATIONS DURING HANDLING AND DRYING LUMBER

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WHAT ARE STAINS AND DISCOLORATIONS?

Stains and discolorations are usually defined as objectionable color or appearance of the lumber. These may occur on the lumber surface or within the wood itself. The discolorations or stains may be in streaks, in patches, or in irregular areas. In some cases, they may occur throughout the wood.

Usually stains or discolorations do not significantly impact the major physical, mechanical, or processing properties of the wood. There are, however, exceptions. For example, heavy blue stain may reduce toughness and increase permeability. Some mineral streaks are more prone to hairline checking during drying than the normal wood of that species. Mineral streaks in hard maple and red gum are examples of this situation.

Stains and discolorations in lumber are not new. They have always been around to some extent. What is different today is the market demands. The emphasis in today's market is for "bright white" woods, with "clear" or "natural" finishes. May times this makes even the smallest amount of stain objectionable.

Complicating these market demands is the changing nature of the timber resource. We are presently using younger, smaller diameter material than in the past. More lumber is being cut from near the pith and within the juvenile wood area. We are cutting timber from poorer sites and have a greater variation in the species mix. All these factors may influence the extent and frequency of stain potential.

Finally, climatic factors play a role in the risk of stain and discoloration in lumber. Periods of prolonged wet, humid, and warm weather increase the risk substantially. Mild, warm winters also increase the risk.

CATEGORIES OF STAINS AND DISCOLORATIONS

There are three major categories or sources of stains and discolorations:

1. Fungal-Based Stains
2. Chemical-Based Stains
3. Resource-Based Stains and Discoloration

FUNGAL-BASED STAINS

Blue Stain or Sap Stain. The major fungal-based stain in lumber is blue stain or sap stain. It is a blue, black, or gray color of the sapwood of the lumber. The color is caused by the dark coloration of the hyphae (the thread-like bodies of the fungi) that are in the wood. As they grow and concentrate in the wood, they give the wood the blue, black, or grayish color. It is important to note that blue stain affects only the sapwood.

Molds and Mildews. In warm, moist conditions, molds and mildews can grow on the surface of wood. Generally, they are only a surface contamination and can be easily brushed or planed off the lumber. They normally cause little problems with stains or discolorations in lumber. However, it is speculated that they may play a role in enzymatic chemical reactions.

Requirements for Fungi Activity

Oxygen. Fungi need oxygen to colonize wood. In normal green wood, there is usually sufficient air in the cell lumens. However, logs stored in water or logs and lumber stored under water spray will usually have insufficient oxygen to sustain fungi activity.

Food. Blue stain fungi obtain nutrition from the stored carbohydrates in the sapwood. Chemical dips to prevent blue stain essentially create a chemical envelope on the lumber to prevent the fungi from using this food source.

Temperature. The optimum temperature range for blue stain fungi activity is about 70 to 90° F. Below 50° F, the risk is slight. Temperatures over 130° F are generally lethal to blue stain fungi.

Moisture or water. Blue stain fungi require free water in the cell lumens; thus, the wood must be above fiber saturation point. In practice, the risk of blue stain occurs in wood when the average moisture content is above about 45 percent.

Blue Stain Control Procedures

Control procedures are to prevent NEW blue stain; there is no way to correct what has already occurred. Control must start with the log and carry on through proper lumber drying procedures. When temperatures are in the favorable range, proper log handling practices are important to minimize the risk of blue stain. The longer logs are stored in warm, humid, or damp conditions, the greater the risk of stain. A similar situation exists for green lumber piled at the sawmill, and during shipment. Therefore, how the logs and green lumber are handled has a significant impact on the risk of blue stain in the lumber during those times when the conditions are favorable for fungi activity.

In most cases, the primary method to control blue stain is to dip the lumber in an anti-stain chemical. When the temperature is over 70° F, lumber must be dipped within 24 hours to reduce the risk of blue stain. Generally most anti-stain dips are effective for only a short time during warm, humid weather. Lumber should not be dead stacked for long periods of time during such weather. Finally, the chemicals used today are less forgiving to errors than the older anti-stain chemicals. It is important that they are properly mixed and maintained at the proper strength according to the manufacturer's recommendations. Taking shortcuts with the chemicals increases the risk of premature failure of the protection.

CHEMICAL-BASED STAINS

Sticker Stain

Sticker stain is a discolored or stained area across the width of the lumber at the locations of the stickers. It may be visible in the rough lumber, or not until the lumber is planed, or not until the wood is finished. The stain may be only near the surface of the lumber or completely through its thickness. Sticker stain is a chemical stain, an enzymatic oxidation reaction of chemicals in the wood. In some

severe cases, sticker stain may also be accompanied by blue stain in the sapwood area and mold and mildew on the surface.

Other Chemical Stains

Other chemical stains include the gray stain in southern oak and yellow poplar, brown stain or coffee stain in white pine, and pinking or browning in maple. As with sticker stain, these are all enzymatic oxidation reactions of water soluble chemicals in the wood.

Iron tannate stain in oak is a special type of chemical stain. It is the dark black color that occurs when the tannins in oak react with iron and water.

The conditions necessary to cause chemical stains are similar to the conditions necessary for blue stain: warm temperatures, high moisture content in the wood, air in the cells, and the presence of chemicals in the heartwood. The reaction can start from the time the tree is cut. Slow drying concentrates the chemicals and heat tends to darken them.

The important factors in chemical stain control are as follows:

1. In warm weather, begin drying immediately.
2. Use low relative humidities during drying.
3. Use high air flows.
4. Avoid slow drying at high humidities.
5. Beware of fog, rain, and high humidity on the air dry yard.

PROCEDURES TO MINIMIZE STAIN

1. Use fresh logs; old logs stored for more than several weeks increases the risk.
2. In warm weather, sticker lumber within 24 hours.
3. Dip lumber for blue stain control within 24 hours after sawing during warm weather.
4. Use stickers with a moisture content less than 10 percent.
5. Use stickers that are at least 3/4 inch thick and no more than 1-1/4 inches wide.
6. A grooved sticker may provide some additional protection.
7. Protect green, stacked lumber from rain during warm weather.
8. Use higher air velocities and shorter air flows (remember the effects of temperature drop across the load).
9. Do not use high humidity snow melting or ice thawing schedules.
10. Reverse the fans every 2 hours.
11. Use low humidities at the beginning of drying, such as a 10-degree depression for many white hardwoods and a 15-degree depression for white pine.
12. It is important to reach the humidity setting immediately, the longer it takes, the greater the risk of stain -- the first 6 to 8 hours are critical.
13. Be sure to use a "white wood" or anti-stain schedule for the species being dried.

RESOURCE-BASED DISCOLORATIONS

The major resource-based discolorations are the mineral streaks that occur in many species. In other situations, there are extensive discolorations that occur in the wood resulting from insect attack or micro-organisms that infect the tree. Many of these infections occur because of some type of wounding or injury to the tree.