

TECHNICAL NOTE NUMBER 254

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CHEMICAL BROWN STAIN IN PINE

Stains that develop in logs and lumber are usually produced either by fungi or by chemical changes that occur in the water-soluble extractives. Although the stains produced by fungi are more common and cause greater financial losses, the chemical stains may become troublesome during the seasoning of certain species.¹ Among the commercial species that are subject to objectionable chemical stains are ponderosa pine, the true white pines, Western hemlock, noble fir, and several hardwoods, including maple, birch, hickory, persimmon, basswood, and magnolia.

Occurrence of Stain

Chemical brown stain in the pines darkens the wood to colors ranging from buff to dark brown. It is usually most conspicuous at or near the surface, but may penetrate throughout the wood. The stain is most pronounced in areas where most drying occurs, as at end surfaces and on tangential surfaces.

The occurrence of brown stain is closely associated with the drying of wood. It appears in the zone where the water vaporizes, thus depositing the solutes or extractives. The stain appears beneath the surface if the porosity of the wood and the severity of the drying conditions promote rapid drying of the surface fibers. Under such conditions a steep moisture gradient is established with a moisture content of the surface fibers well below the fiber-saturation point. When the water moves so freely through the wood that the surface fibers remain moist for some time after exposure to a drying atmosphere, the stain tends to develop at or near the surface of the lumber.

In pine, chemical brown stain generally develops in the sapwood, which has a high moisture content, but often develops in the heartwood as well. Blue and brown stains due to fungi are generally confined to the sapwood only. Both types of stain are more prevalent in lumber sawed from old logs than in lumber sawed from newly out logs.

Cause of Stain

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F^r

No. 254 The exact nature of the chemical change responsible for chemical brown stain is not fully understood. Certain facts indicating its cause, however, are well established:

¹Chemical brown stain does not necessarily indicate that the strength values of the wood have been altered.

1. The chemical reaction occurs in the water-soluble extractives to produce the brown color when they are concentrated and deposited during drying.

2. The stain occurs as the wood dries, appearing during both air seasoning and kiln drying.

3. Heat alone, without drying, will not produce the stain, but drying at high temperatures will produce a greater degree of staining than similar conditions of relative humidity at low temperatures.

4. Staining in some species of pine appears to be caused by a caramelization of the soluble extractives.

Control of Brown Stain

Unfortunately, no completely successful way of preventing chemical brown stain is known. Certain means can, however, be recommended for limiting its occurrence.

The substance or substances responsible for the brown stain are insoluble or only moderately soluble in cold water, but are readily soluble in hot water. Therefore, the use of mild temperatures during seasoning will decrease the quantity of soluble material carried by the water toward the surface of the lumber, where it is deposited by evaporation.

The temperature of the free water in wood at the start of a kiln run approximates the wet-bulb temperature. This is especially true of woods in which the movement of the water is rapid and the wood dries almost as fast as the moisture can be evaporated from the surface. Consequently, the wet-bulb temperature is the chief factor to be considered in the control of brown stain, and it should be kept low, especially during the early stages of drying.

Since the zone of extractive concentration should be kept well below the surface, as low a relative humidity as is possible without developing serious surface checking should be maintained by proper ventilation. The use of low relative humidities during the drying will also decrease the drying time.

As previously indicated, an important factor in the development of chemical brown stain is the length of storage of the logs. An effective method of stain prevention is to cut the logs into lumber soon after felling the trees.

Brown stain develops less during air seasoning than during kiln drying, and thorough air seasoning prior to kiln drying, therefore, will reduce staining. This is particularly true of lumber that has been air seasoning during the cold winter months, when the least amount of stain-producing extractive is in solution.