FPJ Technical Note

Bacterial Attack in Water-Stored Bolts

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Abstract

After storing in water containing 0.5 percent of sodium pentachlorophenate for 6 months, southern pine and yellow-poplar veneer bolts with sour odors were found by microscopic examination to have pronounced bacterial attack. The sour bolts were more permeable than the normal bolts; this resulted in a greater loss of water and lower pressure under the pressure bar when cutting veneer. Increased permeability was accounted for by disruption of the ray parenchyma cells in pine and by degradation of pit membranes in both pine and poplar. Results indicate that freedom from bacterial attack is not assured in bolts stored in water with 0.5 percent sodium pentachlorophenate; the bolts must also be free of bacterial infection when placed in the solution.

THREE SOUTHERN PINE LOGS from Louisiana and three yellow-poplar logs from North Carolina, for use in veneer-cutting experiments, were received in Madison in March 1968. The 9-foot logs were crosscut to 50-inch lengths and turned to 12-inch diameters on a lathe. Because of other commitments this veneer-cutting experiment was delayed. The bolts were therefore stored for 6 months in water containing 0.5 percent sodium pentachlorophenate. The temperature of the holding tank was 60" to 70°F. It was hoped that this storage would prevent any deterioration of the logs. However, when the bolts were cut into veneer, it was noted that all of the bolts from one log of the pine and all the bolts from one log of the yellow-poplar had an offensive sour odor. The bolts from the other four logs stored under the same conditions did not have this odor.

The sour bolts lost more water in cutting than did the normal bolts; this suggested that the sour bolts had higher permeability. Further, the loads developed on the pressure bar in cutting the sour bolts were markedly less than those developed in the normal bolts. Thus there was reason, on the strength of previous experiments (1), to suggest that bacteria had changed the wood of the sour bolts during water storage. To investigate the possibility of this change, the sour pine and the sour yellow-poplar were examined microscopically for evidence of bacterial attack as well as for possible changes in wood structure that might cause increased permeability and the different cutting characteristics of the wood.

Microscopical Observations

Radial and tangential sections for microscopical examination were taken from the outer 2 centimeters of the sapwood of the sour pine and the sour yellow-poplar veneer bolts.

Parenchyma cells in the rays and resin ducts of the sour pine were mostly gone; this alone would make the wood more permeable. The parenchyma cells that remained were empty, indicative of the probable utilization of the cell contents, or storage products, by bacteria. Ray tracheids were intact, although they often contained bacteria, especially in the pit chambers. Contrary to the situation in the pine, the ray parenchyma cells of the sour yellow-poplar were intact with no observable evidence of removal of storage products. There was, however, evidence that pectin had been removed from the pit membranes.

Bacteria were abundant in the pit cavities of the sour bolts of both the pine and the yellow-poplar. Their presence in the sour wood of both species and the reduction in roller bar pressure in the sour wood of both species prompted a search for additional changes in the wood microstructure. Recent studies of bacteria-infected wood indicate that bacteria break down pectin materials in pit membranes, and this in turn aids the passage of liquids from cell to cell (3).

To determine the possible utilization of pectin materials by bacteria, the ruthenium red reaction was used. Ruthenium red is probably the best color reagent available for pectinous substances, although it is not entirely specific.

In normal pine, ruthenium red stained the ray parenchyma cells, resin ducts, and pits an intense red color, whereas the staining was very weak or absent in the sour wood. In the yellow-poplar, there was a red staining of half-bordered pits between vessels and ray parenchyma cells in the normal wood, which was lacking in the sour wood. Similarly, intervessel pits of normal wood often appeared to be somewhat more intensely stained than those of sour wood. There was no apparent differential staining of fiber pits.

pH of the Wood

It has been reported that nitrogen compounds in wood are decomposed during water storage (2). Because a number of bacteria can utilize nitrogen compounds with the liberation of ammonia, the pH of bacteria-attacked wood conceivably might be increased. This was found to occur in the sour yellow-poplar in which the pH was 7.5, whereas in the normal wood it was 4.5. No pH differences were detected between the sour and normal pine.

Table 1. - WATER ABSORBED BY SOUTHERN PINE AND YELLOW-POPLAR BLOCKS FROM SOUR-ODOR AND NORMAL VENEER BOLTS.

Condition	Water uptake[1] (dry weight)	
	1/2-hour soaking	48-hour soaking
	Percent[2]	Percent[2]
	SOUTHERN PINE	
Sour odor	118	152
Normal	41	77
	YELLOW-POPLAR	
Sour odor	69	162
Normal	38	101

[1]Each value based on three 1-cm.-square blocks.

[2]Based on ovendry weight of test blocks (initial moisture content of test blocks war 13 percent).

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Absorption

Data on the absorptive capacity of the sour and normal pine and yellow-poplar wood are given in Table 1. The water-uptake percentages reveal that water-absorptive capacity of the sour wood was considerably higher than that of the normal wood in both species.

Difference in Bacterial Attack During Storage

Because only one log of pine and one log of yellow-poplar had bacterial attack suggests bacteria were present prior to storage in the penta solution. Apparently the 0.5 percent of sodium pentachlorophenate prevented contamination of the unattacked bolts but did not prevent the bacteria from continuing to grow in the already infected logs. This seems reasonable because the large molecules of sodium pentachlorophenate would not penetrate very far into the wood.

Summary and Conclusions

In cutting, the sour bolts of pine and yellow-poplar that had been stored under water for 6 months lost more water and developed lower loads on the pressure bar than did the normal bolts. Absorption measurements indicated the sour bolts were considerably more permeable than the normal bolts, and in yellow-poplar the pH of the sour wood was also increased. Increased permeability could be accounted for by bacterial attack, which in the pine caused disruption of the ray parenchyma cells. In the yellow-poplar, the increased permeability seemed to result mainly from a change in pit membranes of the ray parenchyma, reflected by a loss of pectin constituents. A similar and more extensive change in the sour pine suggests that bacterial damage to the pit membranes was also a significant factor in the increased permeability in this wood species. The greater permeability undoubtedly explains the greater loss of water and the lower pressure developed under the pressure bar when cutting the sour wood.

A pertinent observation in this investigation was that some bolts remained free from bacterial attack, whereas in other bolts bacteria were able to develop, although all the bolts were stored in water containing 0.5 percent of sodium pentachlorophenate. Apparently, bacteria initially present in bolts stored in this concentration of solution may continue to develop but will not develop in other bolts stored in the same solution. Results of this work indicate that freedom from bacterial attack is not assured when bolts are stored in water with 0.5 percent of sodium pentachlorophenate; the bolts must also be free of bacterial infection when placed in the solution. These observations may be of help in accounting for differences in the performance of wood during cutting, drying, and finishing.

Literature Cited

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