A LOOK AT AND A RESULT OF REORGANIZING DRYING RESEARCH AT FOREST PRODUCTS LABORATORY

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Drying research at the Forest Products Laboratory began with the late Harry Tiemann, considered the father of drying research in this country. However, past accomplishment does not ensure continued research benefits, and the pressure for research dollars during the past few years has forced our Laboratory to focus research activities on studies likely to be of major benefit to the Nation. We have, therefore, asked ourselves what, if anything, in drying research has a good chance of paying off to the public. This self-examination revealed a possible nearsightedness in our development of drying research efforts over the past few years. Perhaps, we have been guilty of considering the drying process independent of the other parts of the processing system. Have we given enough consideration to the fact that the source of our raw material is a tree--not a green chain?

Papermakers have greatly influenced forestry research and forest management practices over the past few years. Their efforts are aimed at growing more pounds of fiber per acre by genetic and silvicultural improvements. Have we, who are concerned about the drying of lumber, even suggested to a forest geneticist that perhaps he should be breeding trees that will dry without degrade? In fact, could we who concentrate on the drying of lumber even tell a forest geneticist the kind of tree we would want even if he were willing to breed a tree type for drying purposes? Have we been too complacent in accepting the concept of natural variability in the drying properties of wood? Have we given enough attention to the real causes for this variability in drying behavior?

At the Forest Products Laboratory we concluded that we have been overlooking some of these points; thus, this paper--to briefly describe some of our efforts to amend the situation.

First, we examined the relationship of the drying process to the entire tree-processing system. We remember that the cost of drying per se is not a critical factor; the critical factor is the total-processing cost. Obviously, a reduction in drying costs is not acceptable is some other processing cost increases concomitantly that is greater than the reduction in the drying costs. Equally important, perhaps equally obvious, is that it is possible to spend more money on the drying operation if cost savings somewhere else in the processing sequence offset this increase in drying cost. You are all aware of these points, but sometimes when we plan drying research we tend to overlook the entire processing system and focus narrowly on the simple drying operation. Does this also happen in actual production situations? At the Forest Products Laboratory we reorganized our various processing research efforts into a single work unit to better correlate our research in areas such as machining, drying, and gluing. Because these operations are closely related in manufacturing sequence, it seems logical that they should be treated so in the research efforts as well.

Secondly, we began to look at the tree as the source of our raw material rather than to consider simply the sawn cant or plank as the source. In reviewing the information on drying from this viewpoint, it became obvious that factors in addition to the usual grain direction, density, and moisture content criteria were causing the widespread inherent variability in the drying properties of wood. Yet we hadn't done much to further define the cause of this inherent variability until we inadvertently came upon the bacterial problem.

From studies on the quality of living red oak trees, we found evidence that certain bacteria that infect the heartwood can also be largely responsible for the unexpected occurrence of honeycomb and ring failure during drying. It now appears that bacterial infections in red oak lumber may account for much degrade that has heretofore been attributed to the so-called inherent variability in drying.

Our work on the kiln drying of bacterially infected red oak is described in U. S. D. A. Forest Service Research Paper FPL 165. In this paper, green 4/4-inch lumber of northern red oak (Quercus rubra L.) was kiln dried to 7 percent average moisture content in 20 days under a mild schedule and in 16 days under an accelerated schedule. The loss from honeycomb and ring failure in bacterially infected boards grading No. 1 Common and Better was 6.5 percent for the mild schedule and 23.7 percent for the accelerated schedule. No loss was detected in noninfected boards grading No. 1 Common and Better when dried under either the mild or the accelerated conditions. Figures 1 and 2 show examples of honeycomb and ring failure in bacterially infected red oak boards after kiln drying.

One of our present research objectives is to develop a practical means to identify and separate bacterially infected and presumably defect-prone wood from noninfected, easy-to-dry wood. Identifying and presorting logs or lumber on a defect-prone basis offers both reduced drying time and a reduction in drying degrade. By sorting according to susceptibility to drying defects, defect-prone material can be given the slow drying necessary to eliminate or greatly reduce drying defects. Normal material, however, can then be dried at a faster rate and not be subject to the limitations imposed on an entire batch of lumber that contains defect-prone material.

Although bacterially infected, defect-prone heartwood of red oak may be similar in appearance to normal, noninfected heartwood, there are some clues for detection. We found that the bacteria that were consistently isolated from defect-prone lumber are apparently the same as bacteria that were consistently associated with shake in red oak trees. Thus it might be possible to sort out logs with shake for special drying. An example of shake in red oak is illustrated in Figure 3.

We have looked at some other species of trees and also found that when shake occurred in these species, the sound, clear wood adjacent to the shake zones was invariably infected with bacteria, and was susceptible to either honeycomb or ring failure or to both. The species observed were eastern hemlock, eastern white pine, cottonwood, red or slippery elm, American elm, water oak, and black oak. From these observations we have been able to define a general pattern of bacterial infections and shake in the tree as shown in Figure 4.

In summary, we have attempted to look at drying as a part of the entire processing system. Then we have searched out areas of research that will benefit not only drying but the entire system. One such area is the relationship between bacteria in the living tree and drying degrade. Preliminary work indicates that this relationship partially explains the so-called inherent variability in drying.

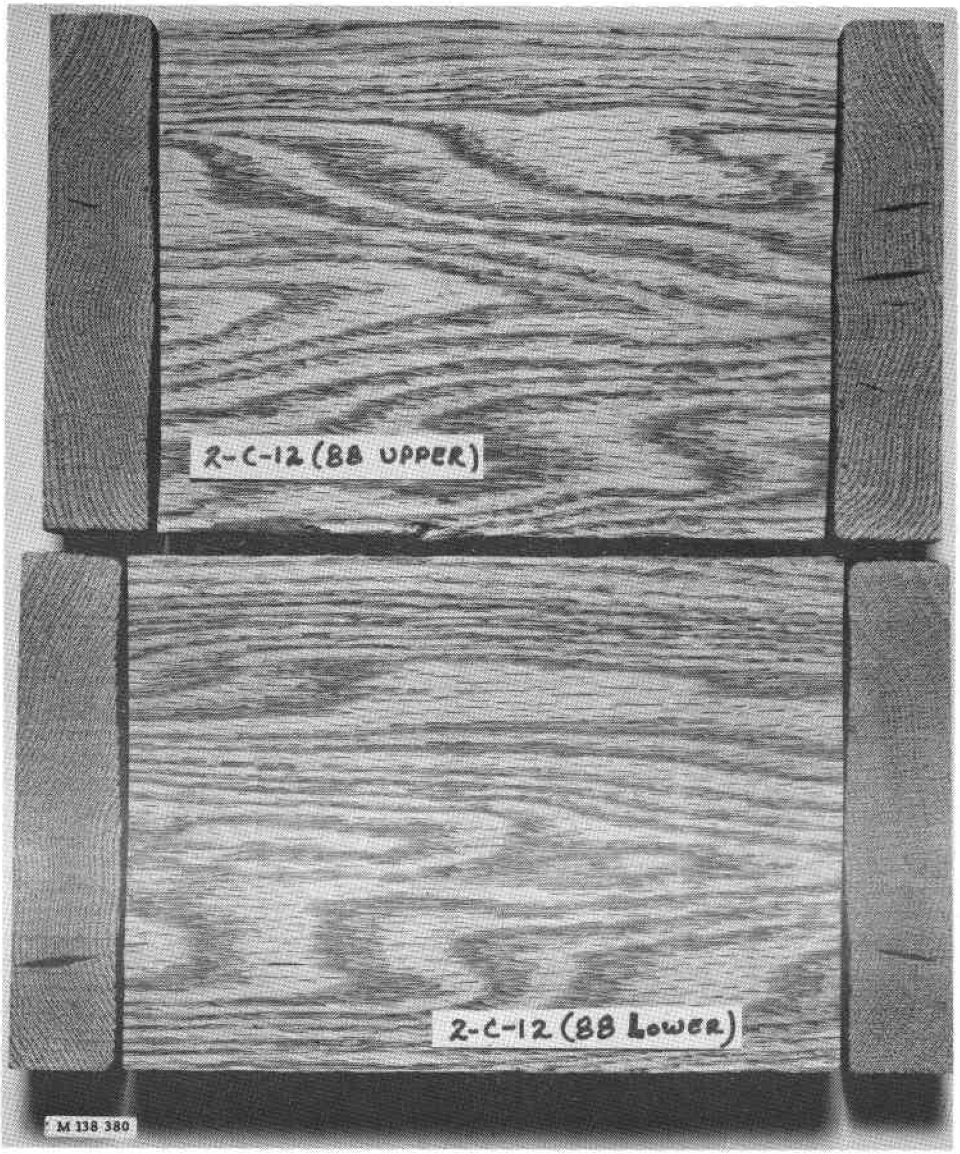

Figure 1. Honeycomb in sections from a man-dried, No. 1 Common, 4/4-inch board of northern red oak that was bacterially infected when green

(M 138 380)

Figure 2. Ring failure in sections from a kiln-dried, FAS, 4/4-inch board of northern red oak that was bacterially infected when green. (M 138 328)

Figure 3. Stem section, 1 foot above ground, from a northern red oak tree showing a combination of both ring shake and spider heart (star shake). The sound, clear portions of the heartwood are infected with bacteria. (M 136 406)

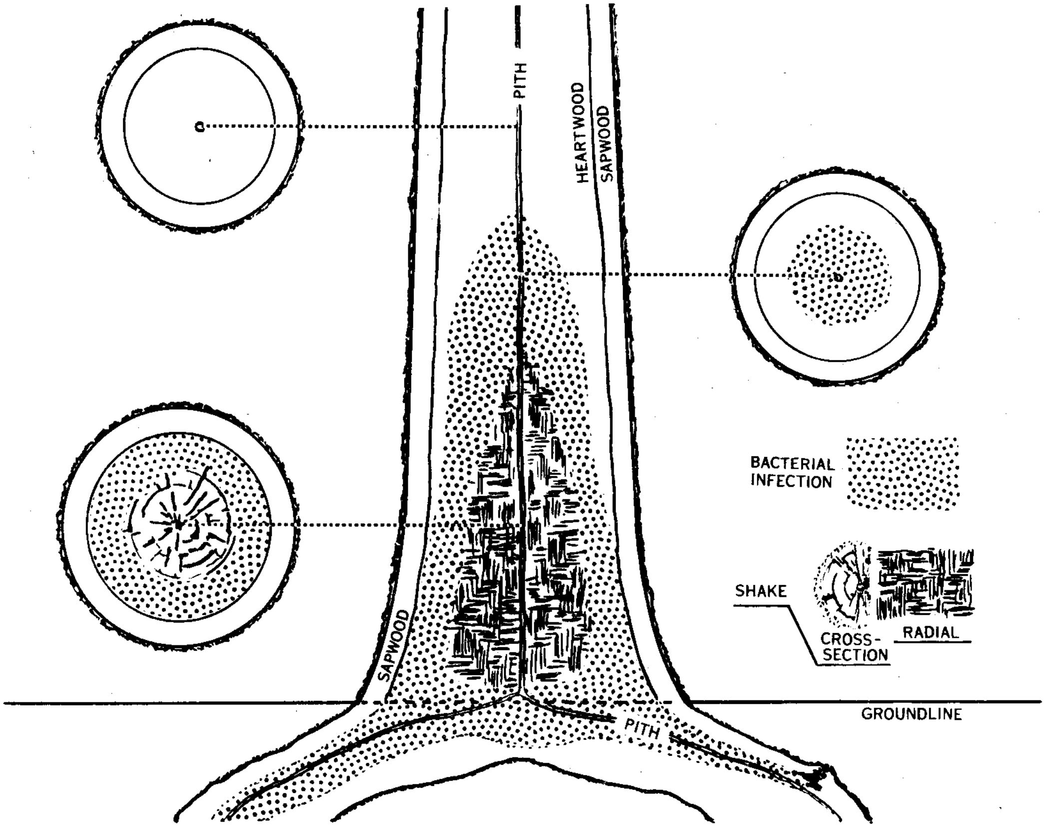

Figure 4. Schematic trunk section illustrating general pattern of bacterial infection and shake within a tree. (M 140 284)