U. S. Department of Agriculture, Forest Service

FOREST PRODUCTS LABORATORY

In cooperation with the University of Wisconsin

MADISON, WISCONSIN

OAK BEER BARRELS MUST PREPARE TO MEET KEEN COMPETITION

By R. P. A. JOHNSON
Engineer in Forest Products

Published in
BREWERY AGE
January, 1934

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R. P. A. Johnson, Engineer

Wood used for beer barrels must meet exacting requirements. The wood must be tough and strong to withstand the hard usage it receives in service and manufacture; it must be naturally nonporous or be treated to prevent leakage through the pores; it must have good bending qualities; and it should not impart an objectionable odor or taste to the beer. In addition, it must be decay resistant because at times the conditions of service are favorable to decay.

Beer Barrels a One Wood Use

Only one species, white oak (Querous alba), known to the trade as forked-leaf white oak, has in actual service demonstrated that it can meet all the foregoing requirements. White oak combines with its strength, toughness, and decay resistance a peculiarity of structure which especially adapts it to use in beer barrels. As the sapwood ages membranes form in the large open vessels. These membranes are called tyloses and they plug the openings of heartwood so completely that liquids cannot be forced through the wood even under the pressure used with beer.

Species other than white oak have been and are used for barrels for oil and other liquids, and considerable interest exists in the possibility of using them for beer barrels. Gum, ash, elm, red oak, cypress, Douglas fir, maple, birch, and the other white oaks have all been considered. None of these species, with the exception of the other white oaks, have so favorable a combination of the properties required as forked-leaf white oak. This does not mean that they cannot be used. It may be possible to obtain the required strength with the weaker woods, such as Douglas fir, gum, and southern cypress, by increasing the thickness of staves and heads, the decay hazard may be such that the less durable woods, such as maple and birch, will wear out before they rot, and it appears possible to artificially plug with pitch or other substances the porous woods, like red oak and yellow birch, so that they will not leak. However, it is improbable that any wood will be generally accepted by the trade as long as white oak is available at reasonable prices.

The reason for the decided preference for "forked-leaf" white oak (Querous alba) over the other commercial white oaks is not apparent. All the white oaks are very similar in strength, toughness, hardness, and shrinkage. Several are tougher and slightly higher in other strength properties than forked-leaf white oak. They also have tyloses which plug the open vessels and prevent leakage of gas or liquids. There is no known difference in their decay resistance, nor is there any known way in which the wood of one white oak can be distinguished from another. It appears probable that some of the other white oaks are used in beer barrels, although the specifications call for white oak, and only the forked-leaf is knowingly accepted.

There is some question as to whether the taste of beer would be unfavorably affected by the use of other than forked-leaf white oak. There is, however, no distinctive difference in the odor or taste of wood of the various oaks. In addition, the inside of a beer barrel is coated with pitch protecting the beer from actual contact with the wood. Coatings have proved very efficient in preventing other commodities from absorbing odor or taste from wood. It appears unlikely, therefore, that the taste of beer would be adversely affected by the use of staves and heading of species other than forked-leaf white oak. It is probable that only a service test will convince the trade that other woods can be satisfactorily used.

The Supply of Raw Material for Tight Cooperage

The stand of white oak is adequate to meet the immediate demand for tight cooperage. The total drain annually on the forest imposed by tight cooperage of all species, including the waste involved in manufacture, is between 1 and 2 percent of the estimated combined stand of red and white oak saw timber and about 3 percent of the estimated stand of the white oaks. The total annual drain on all oaks from all sources is about 1/15 of the estimated stand of saw timber. Although the total annual drain on all oaks indicates adequate supply to meet immediate demands, it also indicates the desirability of service tests to determine the fitness of other woods for high quality beer barrels. So far as is known no such service tests have been made. If and when they are made they will take time, for not only must the tests demonstrate that other species will hold beer without leakage or contamination of taste but the wood must also be in service long enough to demonstrate that it can successfully withstand wear and tear and resist the decay hazards. Such service tests should be started now by the cooperage industry not only with the idea of broadening out the supply of wood suitable for beer barrels but for the purpose of taking the beer barrel out of the one-wood class and also to have ready substitute species should they be required in order that wood may hold its place in this market. If the tests are delayed until an emergency arises the market will be captured by substitute materials before convincing service tests can be completed on possible substitute woods.

Specifications

The beer stave and heading specifications of the Associated Cooperage Industries of America are very rigid. They limit the number, size, and character of defects so that the staves will develop practically the full strength of the clear wood. They exclude material in which the annual rings make an angle of more than 45° with thickness or narrow edge of stave because quarter-sawed material shrinks only half as much as flat-sawed material. They exclude all but a fourth of an inch of sapwood because sapwood is not decay resistant and is not thoroughly plugged with tyloses. They specifically limit the length, width, and thickness of the staves and heading to facilitate manufacture and assure adequate strength.

The specifications are general rather than specific in their limitations on defects. The interpretation of such clauses as "free from short crook," "they must be straight grain or nearly so," "they must be free from heart checks of such a nature as to make them unfit for the purpose for which they were intended," is largely a matter of the judgment. When good judgment is used the rules eliminate all but a small percentage of unsatisfactory material, but careless inspection and poor judgment result in heavy losses at the bending machine.

A systematic study of the staves which fail in the bending machine is needed. Such a study will provide information on which to base more definite defect limitations. There is a possibility that a more definite limitation on defects will improve the efficiency of the rules by decreasing the waste in staves culled at the mill and at the same time decrease the percentage of staves which fail in the bending machine.

Coopering Culls Poor Material

Selection and inspection combined do not eliminate all unsatisfactory material. The bending machine, however, eliminates both poor quality material that has passed inspection and material that has been injured in seasoning. Staves containing small knots, crooked grain, or heart checks, which inspection missed or misjudged, break in bending. Staves badly end or side checked in seasoning seldom get past the bending machine. Neither do exceptionally light weight weak staves with no defects. High quality material is largely assured by the stave bending machine.

The breakage at the stave bending machine while assuring high quality material may be hard on the pocketbook. The loss at the bending machine sometimes runs as high as 20 percent. When the breakage exceeds 3 percent something is wrong and a study should be made of the bending failures. If a high percentage of the failures is due to defects, a check inspection should be made on all stave shipments. If the breakage is occurring in staves with large end and side checks which have developed in seasoning the need for expert advice on the air of kiln drying is evident. Loss at the bending machine from seasoning defects can be held under 2 percent with either air dried or kiln dried staves. If the breaks are largely tension breaks at the bilge either the steaming is insufficient or the wood in the staves is of poor quality. The steaming can be corrected by lengthening the time in the steam chest, better piling in the steam chest so that the steam has access to all staves, or occasionally a better steam chest may be necessary. If, however, the breakage is resulting from poor quality wood that is exceptionally light in weight and weak the problem is more difficult because strength or lack of strength is not easy to detect visually. The specific gravity is the best indication of strength of staves aside from an actual test. It is impractical, however, to apply a specific gravity test to all staves and heading. Low specific gravity and low strength are associated with a high percentage of large openings in white oak. Weak wood with a very high percentage of large openings does differ quite markedly in appearance from strong wood with a low percentage of openings (fig. 1). It is difficult to incorporate this visual difference into specifications or grading rules. Some coopers can recognize poor staves by the visual difference shown in Figure 1, but it is doubtful if a shipment otherwise satisfactory could be rejected on the basis of such visual inspection. Fortunately the percentage of exceptionally light, weak staves in a shipment is seldom as large as 1 percent. A much larger percentage of this type of material indicates the desirability of a change in the source of supply of staves or more careful selection of bolts for staves.

Number of Annual Rings Poor Indication of Quality

Limiting the number of annual rings per inch is frequently suggested as a means of excluding the weak, lightweight staves. Unfortunately such a limitation will not work. It is true that the slow-growth, narrow-ringed white oak is on an average weaker than wider-ringed, fast-growth. The limitation on rings per inch fails because when applied it does not exclude all the weaker staves or a high percentage of them. In addition it is inefficient in that it excludes almost as many good staves as poor.

Shrinkage Spoils Good Barrels

The selection, inspection, and manufacturing processes assure high quality wood, but not necessarily a satisfactory beer barrel. Poor workmanship and inadequate seasoning result in poor barrels from high quality material. The results of poor workmanship are obvious and need no explanation. The results of inadequate seasoning are not so well known and not so easily detected. Barrels made from inadequately seasoned staves shrink and develop into leakers. In addition as the hoops are tightened from time to time to take up the shrinkage the barrel loses capacity and

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Determining the moisture content of barrel staves by electrical prong contacts and readings of the "blinker" machine.

eventually must be recoopered to bring it up to the required capacity. Just how important a part shrinkage plays in the satisfactory service a barrel renders is shown by the fact that a half barrel made up of staves with an average moisture content of about 30 percent will lose about two quarts when it dries as much as it will in use. This is more than the allowable tolerance and in addition such a barrel is a potential leaker and may cause a loss not only of contents and taxes but also good-will. The maintenance required to keep such a barrel in service is high. Maintenance and losses from leakers can be reduced by specifying the average moisture content new barrels must have and testing them to see that they conform to the specifications.

The Proper Moisture Content for New Beer Barrels

A new barrel should be dried to the average moisture content it will have in use. In service beer barrels have been found to have a moisture content of about 30 percent just under the pitch; from 6 to 14 percent on the outside, and between 21 and 27 percent at the center. The moisture content of a stave before it goes into a barrel is distributed differently. Staves with a moisture content of 21 percent at the center have an average moisture content of from 11 to 15 percent on both inner and outer surface depending upon whether they are kiln dried or air dried. Due to the difference in moisture distribution in air dried and kiln staves both will have a moisture content of 21 percent at the center if the kiln dried staves are dried to an average moisture content of 16 percent and air dried to 18 percent. The inclusion of a maximum moisture content in the grading rules for beer barrel staves would improve the product and help wood to hold its place in the highly competitive market which has developed.

When the present rules were drawn a moisture specification would have been impractical. At that time there existed no means for the instantaneous determination of moisture content. There are now on the market two types of moisture meters, one of which was developed at the Forest Products Laboratory (fig.2). The use of either of the two types of moisture meters makes it practical to include a maximum moisture content limitation in the specifications for beer barrel staves or in the specifications for finished beer barrels. Advantage should be taken of the opportunity these instruments offer for improving a high quality product.

Progress is Essential if Volume is to be Maintained

The wood beer barrel cannot stand still and expect to hold its place in a highly competitive market. Its competitors are constantly studying the weaknesses which develop in their products and their research men are working to reduce or eliminate them. Even in the short time they have had to work on the problem they have attained considerable success in -- --

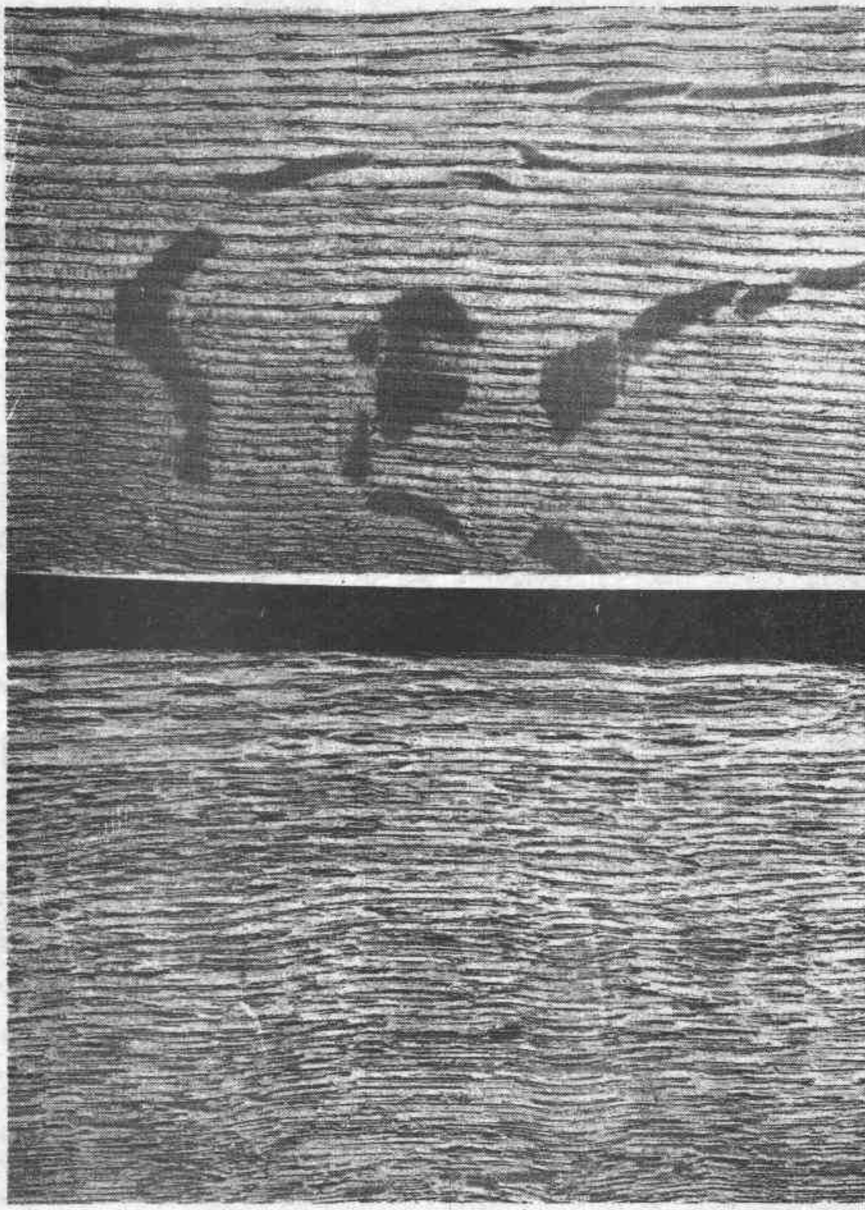

Figure 1.—Strong and weak beer barrel staves. A.—A compact, dense, and strong stave. The proportion of large vessels is small and form comparatively distinct lines on barrels. B.—A porous, light, and weak stave. The proportion of large vessels is so large that they appear to cover the whole surface and do not stand out in bands as in A.

overcoming some of the natural advantages of wood. They will continue to improve their product and the competition between wood and other materials promises to become keener with time. The cooperage industry should embark on a similar study of the weaknesses of the wood barrel. In this field their opportunities are probably equally as good as those of their competitors. The obvious weaknesses, such as the enormous wastage in election and manufacture, the one species limitation on raw material, and the tendency of the finished barrel to lose capacity and to leak, offer opportunities for improvement which if made will materially aid the wood barrel in maintaining its position as a container for beer.