MANUFACTURE OF OAK FURNITURE, CABINETS, AND PANELS

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ABSTRACT. Oak is uniquely favored for use in furniture, cabinets, and similar products. The supply is plentiful. Though drying presents some problems, once oak is properly dried it is a stable wood that machines very well, glues well, and accepts a variety of finishes well.

FROM THE VIEWPOINT of a woodworker, I shall discuss chiefly those technical considerations that are of concern in the conversion of rough oak lumber into consumer products such as furniture, kitchen cabinets, and similar household and institutional fixtures. I shall make no distinction between the red oaks and the white oaks. There are differences, of course; but from the woodworker's viewpoint, these differences are minor.

You already have general knowledge about the characteristics of wood as a raw material for all types of manufactured products. You are aware of its anisotropic structure, which causes it to exhibit differing properties in its mutually perpendicular axes of symmetry—radial, tangential, and longitudinal. You know that wood is hygroscopic and undergoes dimensional change in changing atmospheres, particularly with protracted changes in humidity. Wood is variable in its anatomical structure, which gives rise to varying characteristics of strength, machinability, workability, appearance, and adaptability to finishing.

In its typical combination of all these variables, oak stands prominently unique among the furniture woods. In some respects it is most highly favored. In other ways, it presents challenging problems.

One respect in which oak holds an unchallenged position among furniture woods is its availability. This is not only because of its broad distribution and abundant proportion in eastern forests, but also because it can be harvested feasibly. A high level of demand for pallets and for oak flooring in homes, highway trailers, and railroad cars has provided a market for the lower grades of lumber. Consequently, substantial quantities of No. One Common and Better grades of lumber become available at reasonable cost for conversion to manufactured products requiring the higher grades. Most other species are not so favorably available from the wood processor's point of view.

Another advantage of oak is the typically larger size of logs that come to the sawmill. Not only is mill cost minimized, but also the average width of board is thereby increased. Net yield in the rough mill or the

cut-up plant is improved in turn by a reduction in the proportion of edging waste.

THE DRYING PROBLEM

It is in the drying of the rough green lumber that the principal problems arise in the utilization of oak for furniture; and as a generality it can be said that the key to really successful use of oak for furniture and cabinets lies in the seasoning of the lumber. Oak is not difficult to season properly if procedures are followed that the nature of the wood calls for.

Oak has a tendency to develop surface checks on flat-sawed faces during drying. This tendency is the result of two principal features. First, oak shrinks a considerable amount during drying. Shrinkage of width in a flat-sawed board in drying from green to 6 percent moisture content can be as much as 9 percent. This is in the direction parallel to the annual growth rings. Across the rings, or radially, shrinkage is about one-half this amount. The presence of the many large rays alined perpendicular to the rings restrains shrinkage in edge-grain boards. In flat-grain lumber, on the other hand, the rays form points of weakness, which tend to rupture and create surface checks as the surfaces of the boards begin to dry and try to shrink around the still wet and swollen core of the board.

These tendencies exist in all species of lumber. They become of particular importance in oak because of oak's characteristically large overall shrinkage and because the rays are large and numerous.

Although it is difficult to completely prevent surface-checking in drying oak, precautionary procedures can avoid damaging the lumber for furniture use. The principal requirement is to restrain the rate of drying so that excessive differences in moisture content do not develop between the faces of the boards and the interior portion or core of the board. This can be most effectively done by entering lumber directly into dry kilns, green from the saw. Here the temperature and humidity can be closely controlled and the drying rate can be regulated.

Drying green from the saw, however, is time-consuming and perhaps wasteful of kiln capacity. Frequently kilns are not immediately available. The common practice is to allow lumber to air-dry and lose most of its free water before kiln-drying. The precaution necessary is to avoid as far as possible exposure to rapid air movement across the piles during times of high temperature and low humidity.

A procedure has been advocated, and experimentally substantiated by the USDA Forest Products Laboratory, which calls for surfacing of green lumber before drying to retard surface-checking. Presumably the procedure minimizes local stress concentration and enables the board to withstand the extreme stresses that develop in early drying stages.

Once partially air-dried lumber is entered in the kilns, it is still necessary to restrain the drying rate by use of low temperatures and high humidity. The wood of oak "softens" or becomes more "plastic" than the wood of many other species when heated. Case-hardening can develop rapidly, and there is danger of honeycombing if high temperatures are used before the center of the board is dried below the fiber-saturation point. At a moisture content of 20 percent or less, maximum temperatures can be used without damage. Careful attention to a final conditioning treatment must be given to relieve case-hardening.

With these precautions in air-drying and kiln-drying, most surface checks in oak will be completely cut away in subsequent planing and machining operations.

A STABLE WOOD

Once dried, oak is a stable wood. It stays in place well and reacts less to seasonal humidity changes than some other cabinet woods such as beech or maple. This is in spite of the fact that oak shrinks a great deal in the original drying.

With oak, as with all woods, the principal requirement for good cabinet work is that it be uniformly dried to a moisture content not in excess of 6 percent. It is the differences in moisture content of the several

component parts of an assembly that cause trouble after manufacture.

I would emphasize again that the key to successful use of oak in cabinetry is in the seasoning of the wood. Once this is properly accomplished, you are almost home free because oak is an excellent wood from the woodworker's standpoint.

Let us look briefly at the matter of yield in conversion. The oaks are graded under the standard rules of the National Hardwood Lumber Association. No special allowances or restrictions enter into the grading. Grade for grade, therefore, the net yield for any given cutting bill will be generally similar to that obtainable for any other species graded under the standard rules. Typically, however, the oak lumber that normally enters the furniture market is relatively free of surface irregularities—swirls, burls, twig knots, small mineral streaks, etc., which must be removed in clear face cuttings. This fact tends to improve the yield.

Oak does exhibit a color range, although the heartwood-sapwood contrast usually is not as strong as in such furniture species as birch and walnut. The prominence and variability of grain pattern in the oaks also introduces some complication in conversion. It is here that the skill of the woodworker enters. These features of contrast are reconciled by thoughtful planning of the cutting bill to allow the sawyer a choice in taking his cuttings from the board as it comes to him on the table. One objective must be to provide cuttings at the saws, such as interior or less-exposed parts, which will admit off-color material or flashy grain. If attention is then given to color and grain pattern in matching strips for panels or in laying up for the molders, it is not difficult to fabricate parts to quality specifications with a high level of yield.

WORKING PROPERTIES

In working properties, few species outrank oak as an all-around material. In some respects, oak is exceeded by no other species.

Oak glues readily. Of all the dense hardwoods, it is perhaps the easiest to glue and is adaptable to all the conventional adhesives. Because it tends to lie flat, with a mininum of twist or warp in strips, it works well in edge-gluing machines such as high-frequency and steam-heated flat-bed presses. However, caution must be used, in hot-platen presses because there is a danger of surface-checking if moisture content exceeds 6 percent.

In machining, no serious problems are encountered. Because it is a dense wood and generally straight-grained, oak is subject to relatively little tear-out, chipped grain, fuzziness, or raised grain. It lends itself readily to sanding. In fact, because of the porous grain structure of oak, coarser grit abrasives can be used for final sanding than with close-grained diffuse-porous woods. Paper does not load up, and burning is no problem. Life of sandpaper is greatly extended.

A few years ago, the USDA Forest Products Laboratory published the results of a great deal of research on the machining properties of native hardwoods. They evaluated some 34 commonly used species for comparative behavior in planing or molding, shaping, turning, boring, mortising, sanding, nail-splitting, and screw-splitting. The top ranking wood of all these species in properties of planing (or molding), sanding, boring, and freedom from nail- and screw-splitting was red oak. In the other machining operations red oak ranked no lower than tenth. Differences between the white and red oaks were small. Endorsed by such authority, oak ranks as a superior wood for working properties. Our experience in our shop confirms this.

Aside from oak's position as an adaptable raw material for the woodworker, it is, of course, the viewpoint of the marketplace that determines the extent to which it will be accepted as a furniture wood. Here the principal considerations are design and finish. There is ample evidence that designers and finish technologists have been able to develop a happy marriage with an intrinsically fine wood.