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ACCELERATING OAK AIR DRYING BY PRESURFACING

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Introduction

Previous research has shown the benefits of presurfacing oak lumber before kiln drying. Leney (1964) showed that the tendency of red oak to surface check during kiln drying was reduced by surfacing the lumber before drying. McMillen (1969) took advantage of this reduced checking tendency to accelerate kiln drying. Wengert and Baltes (1971) showed both the separate and combined effects of presurfacing, accelerated schedules, kiln automation, and smooth vs. step changes in kiln conditions. Their finding on the effect of presurfacing alone was that it reduced kiln drying time from green to 8 percent moisture content by 7-10 percent. They attributed this time reduction to the reduction in board thickness by presurfacing.

The above-mentioned drying research was all conducted on material kiln dried from the green condition. While kiln drying green from the saw has definite advantages, most oak drying operations air dry before kiln drying. The question then arises does presurfacing offer similar advantages in air drying as it does in kiln drying?

The purpose of this investigation is to compare the air drying time of presurfaced oak lumber with that of rough oak lumber.

Procedure

The study included approximately 2,700 board feet each of 4/4 northern red oak and 4/4 white oak, both from southern Wisconsin. It was obtained green, directly from the saw, and brought to the Forest Products Laboratory. Each species was then stacked into two piles, with alternate boards going to the pile to be presurfaced and the pile to be dried rough. At every fifth course, two boards were marked for use as sources of sample boards and moisture sections.

The boards that were to be surfaced were planed on both sides to just slightly over 1 inch. Thickness measurements on the sample boards showed that the rough lumber was approximately 1/8 inch thicker than the presurfaced lumber.

One sample board, 32 inches long, was cut from the center section of each of the boards marked for that purpose. One-inch moisture sections were cut from each end and the average of these two sections was taken as the initial moisture content. The sample boards were end-coated immediately after cutting.

The air-drying arrangement is shown in figure 1. The piles were arranged in a north-south line so that air travel through the load was east-west. There were no obstructions near the four piles. Each of the four separate piles consisted of two 22-course subpiles with each course separated by 3/4-inch stickers. Each combination of species and surface condition was represented by 12 sample boards, six on the west side and six on the east side.

The lumber was placed on the air-drying yard in late August. During the first 20 days of air drying the weather was predominantly warm and sunny, with only one or two brief showers. In late September, there were several consecutive days of cool, rainy weather. After another 10- to 14-day period of good drying weather, there was an extended period of cool, rainy weather in late October.

Results and Discussion

The initial moisture contents of the four groups were:

Rough white oak	63.8 percent
Surfaced white oak	62.8
Rough red oak	85.7
Surfaced red oak	77.3

There is no apparent reason for the large difference in initial moisture content between the two red oak groups. While the sample boards were not chosen by a statistically valid random process, their selection was evenly distributed over the entire lot with no criterion other than that the wood be sound. This large difference complicates the comparison of drying rates.

The actual drying curves are shown in figures 2 and 3. Each point is the average of 12 sample boards. Since the initial moisture contents of the rough and presurfaced lumber are not the same, it is impossible to make a drying rate comparison from these two curves. Two other methods of comparison were tried in order to compensate for the difference in initial moisture content.

One method deals with the fraction of the total change that has occurred at any time. The fractional change, E , is the change in moisture content at any time divided by the total change in moisture content. Thus, at the start of drying, $E = 0$; and when drying is complete, $E = 1.0$ (figures 4 and 5). For this type of analysis to be valid, the denominator of the E calculation will be in error unless the experiment is run until a new moisture equilibrium is reached. In this study, the lumber was close to but not at equilibrium, and so both rough and presurfaced drying curves were forced to $E = 1.0$ at the same time. The error is probably at a minimum at $E = 0.5$ (that is, when one-half of the total moisture is lost in air drying), so approximate comparisons can be made there. The rough and presurfaced white oak took 8.2 and 7.8 days, respectively, to reach half of their total change--a time reduction of 4.9 percent. The rough and presurfaced red oak took 9.2 and 8.6 days, respectively--a time savings of 6.5 percent.

The other method of comparison is shown in figures 6 and 7. The method involves delaying drying-curve comparison until the higher of the two initial moisture contents is reduced to equal the lower initial moisture content. In both comparisons, the rough material had a higher initial moisture content than the

presurfaced material, and the comparison therefore ignores the early changes of the rough material. These early changes are probably the fastest of all changes and therefore to ignore them for the rough material gives the surfaced material a slight "head start" in the comparison. The head start is only 1 percent moisture content in the white oak and probably unimportant, but it is larger in the red oak and may influence the comparison. The rough and presurfaced white oak took 27.6 and 23.5 days, respectively, to reach 30 percent moisture content in this method of comparison--a time reduction of 14.8 percent. The rough and presurfaced red oak took 37.7 and 34.0 days, respectively, to reach 30 percent moisture content--a time savings of 9.8 percent.

The reductions in drying time observed in this investigation are similar to the 7 to 10 percent figure found by Wengert and Baltes (1971) in their kiln-drying studies. If, for example, we take an average time reduction of 9 percent for a 1/8-inch presurfacing, a 60-day air-drying cycle will be reduced to 55 days and a 90-day cycle will be reduced to 82 days if air drying is carried out to a specific moisture content. Alternatively, if air drying is continued for a certain number of days regardless of moisture content, subsequent kiln-drying time can be shortened because the material is at a lower moisture content going into the kiln. This will only hold true, of course, if the material is not left on the air-drying yard longer than is necessary to reach a moisture content equilibrium,

While this reduction in air-drying time alone may not be enough to justify presurfacing, it should be considered along with such subsequent benefits as reduced kiln residence time and increased (about 10 pct.) kiln capacity.

Summary and Conclusions

A comparison was made between the air-drying rates of rough and presurfaced northern red oak and white oak. In both species, the presurfaced material was about 1/8 inch thinner than the rough material and dried faster than the rough material. The reduction in drying time depends on the method of analyzing the drying curves, but is slightly less than 10 percent.

Leney, L.

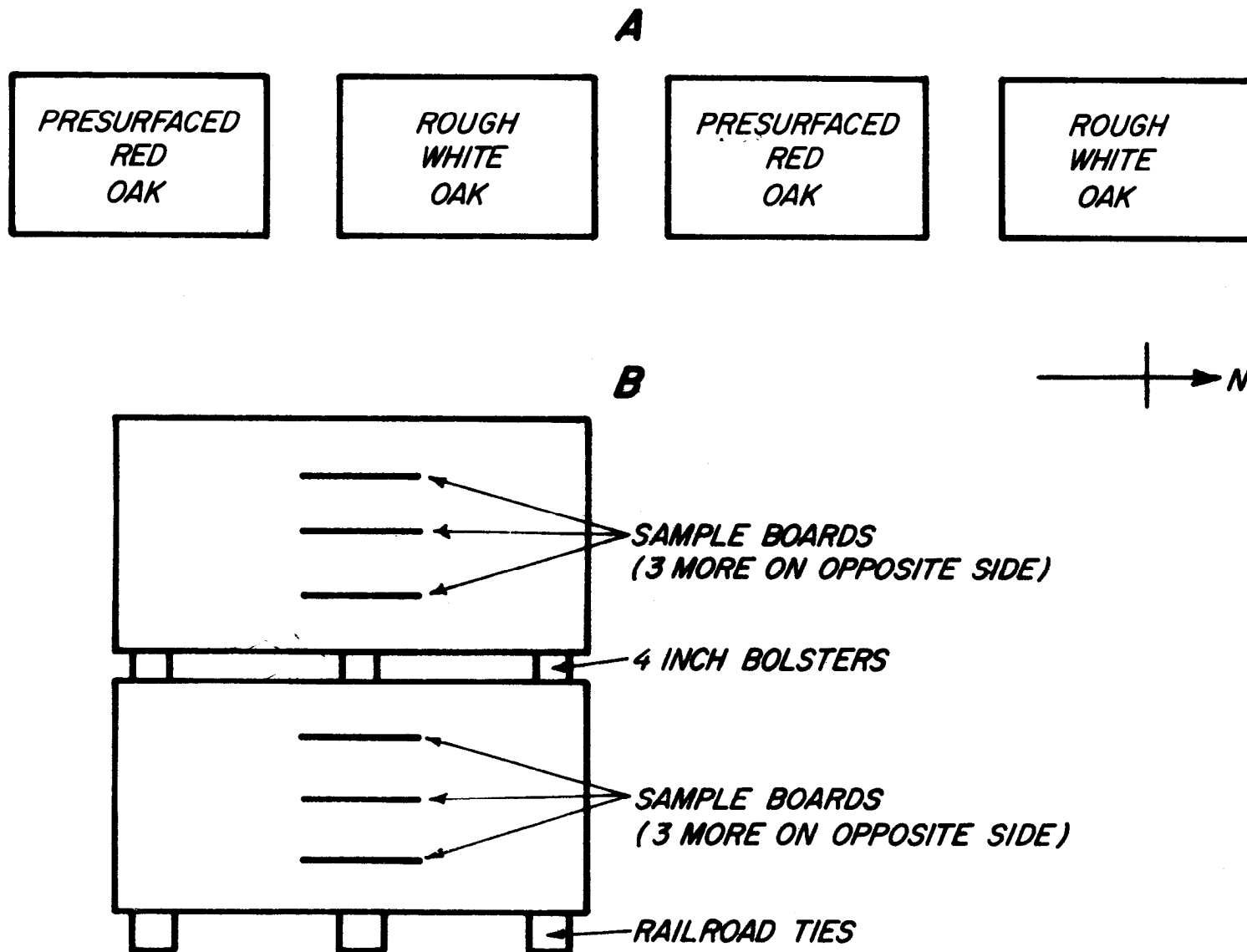
1964. Checking of planed and rough red oak during kiln drying. Forest Prod. J. 14(3): 103-105.

McMillen, J. M.

1969. Accelerated kiln drying of presurfaced 1-inch northern red oak. U.S.D.A. Forest Serv. Res. Pap. FPL 122.

Wengert, E. M., and Baltes, R. C.

1971. Accelerating oak drying by presurfacing, accelerated schedules, and kiln automation. U.S.D.A. Forest Serv. Res. Note FPL-0214.



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Figure 1.--Schematic of lumber piling details in air drying study.
 (a) Top view of piles.
 (b) Side view of single pile.

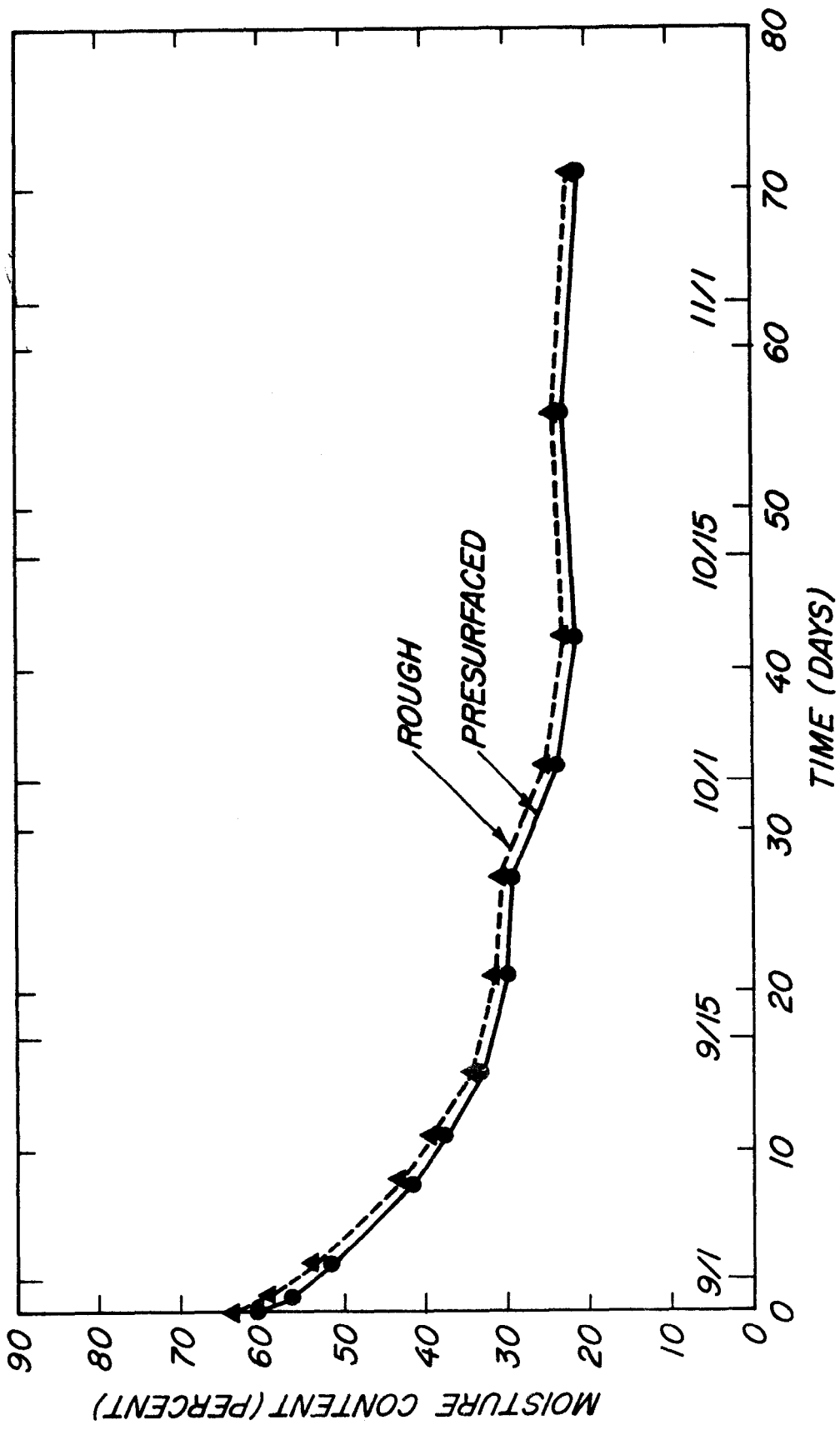


Figure 2.--Air drying curves for rough and presurfaced white oak.

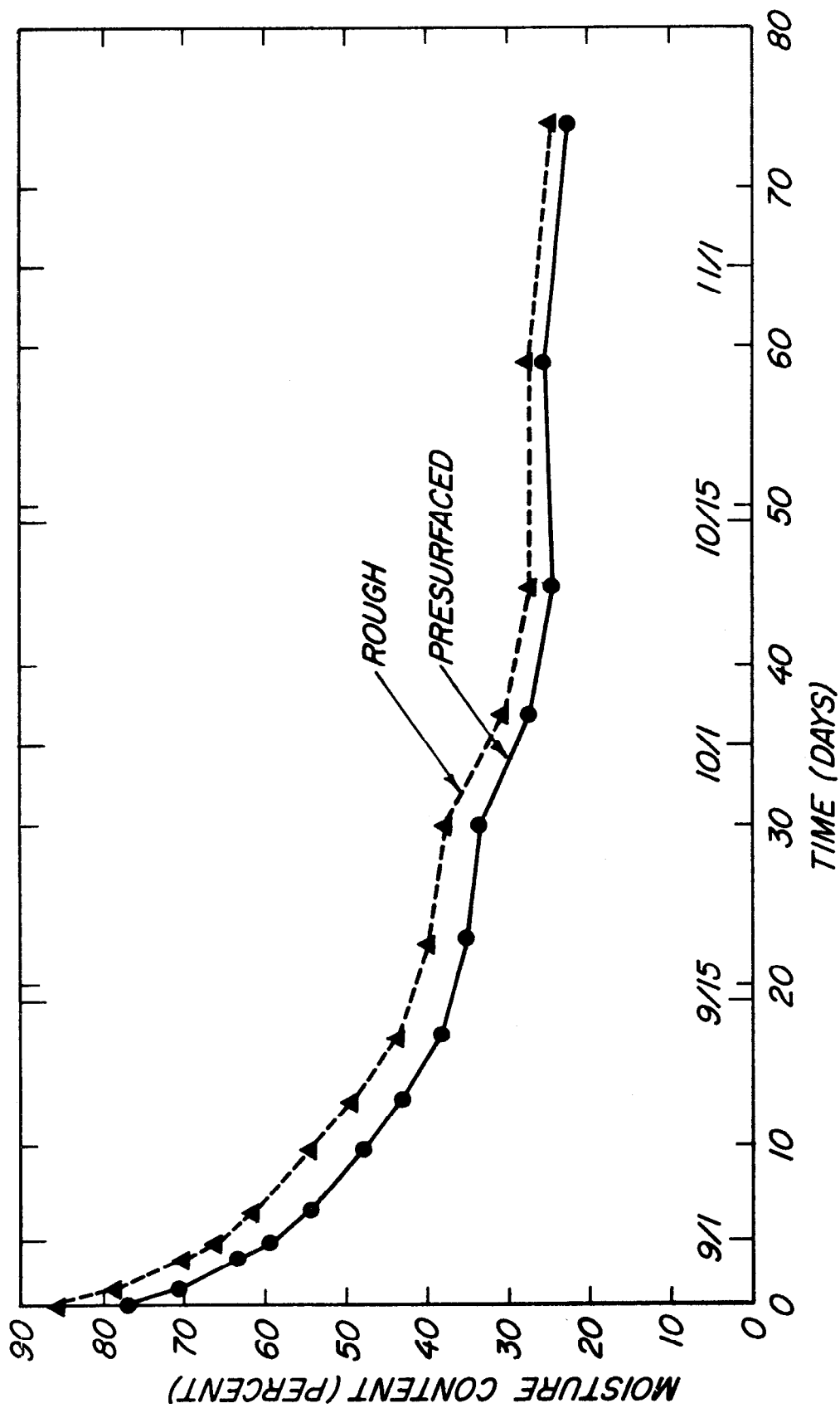


Figure 3.--Air drying curves for rough and presurfaced red oak.

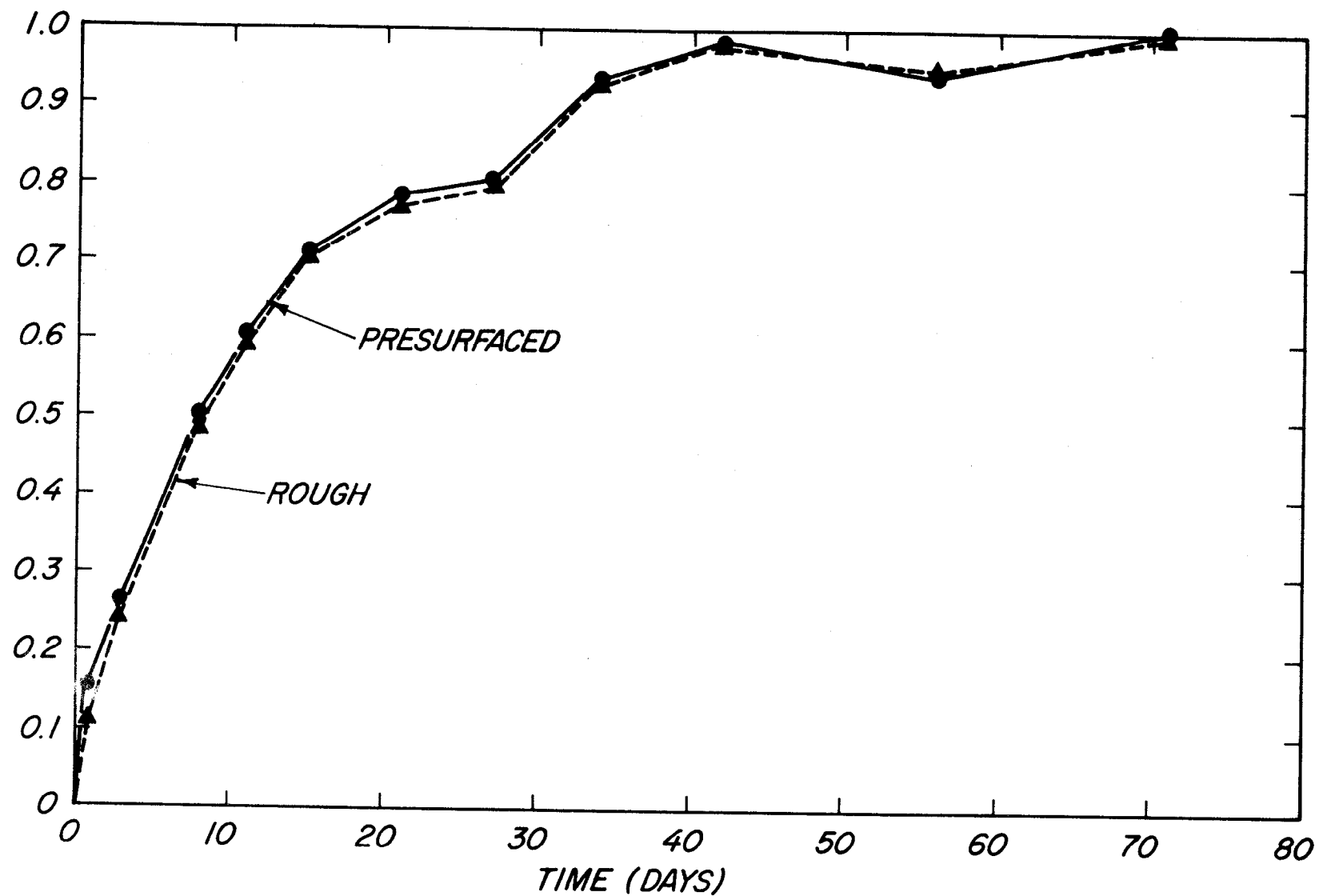


Figure 4.--Fractional air drying curves for rough and presurfaced white oak.

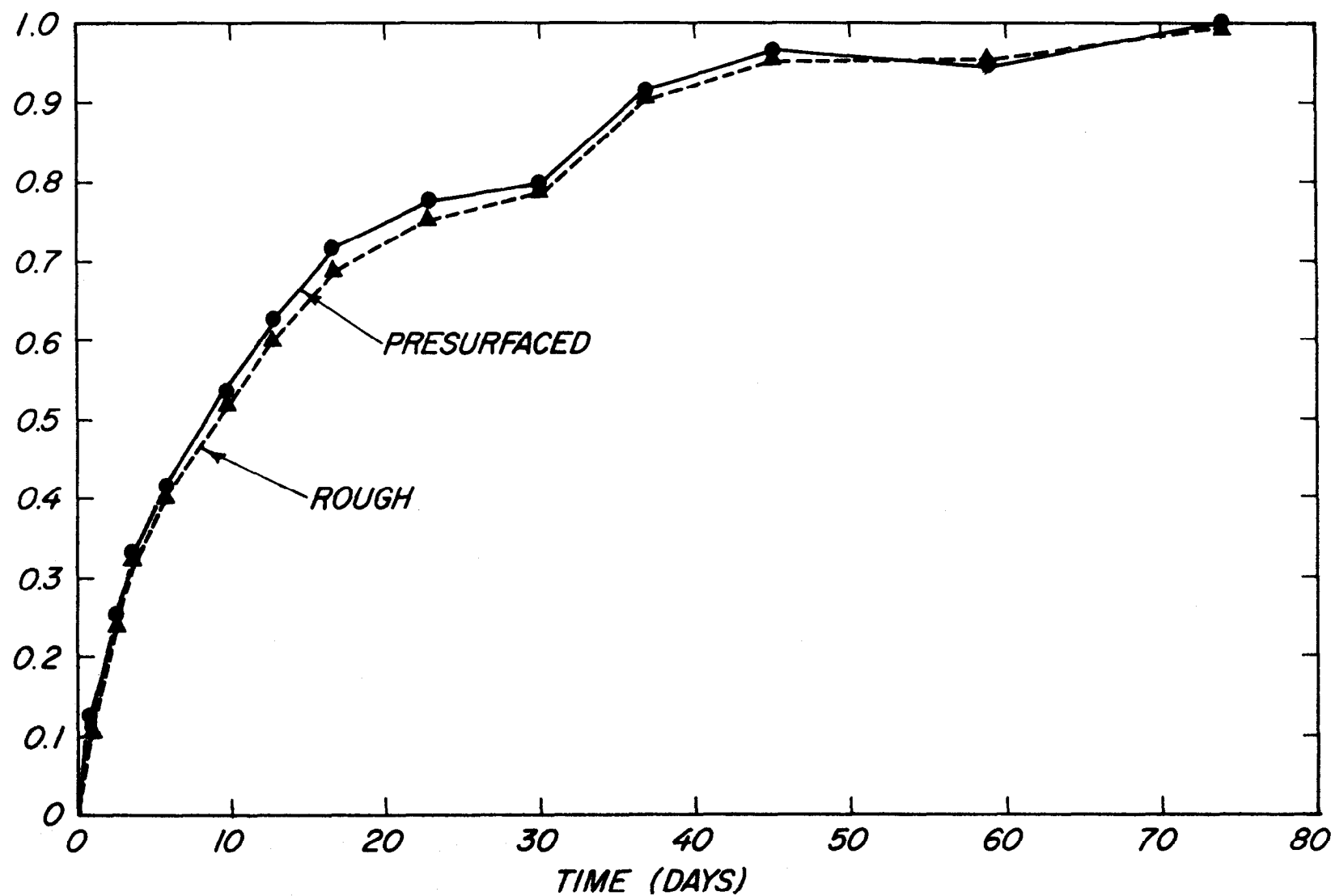
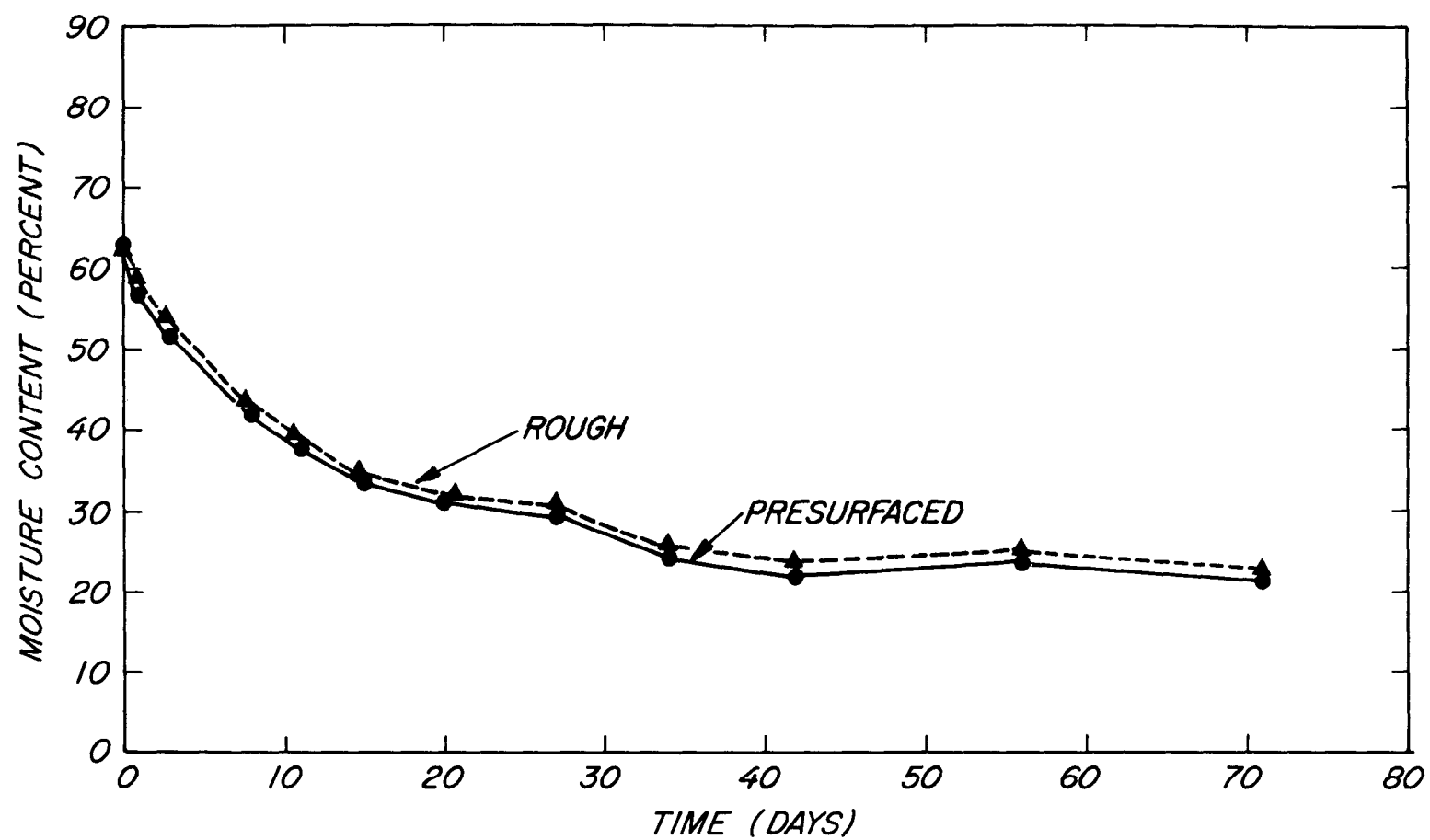


Figure 5.--Fractional air drying curves for rough and presurfaced red oak.



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Figure 6.--Adjusted air drying curves for rough and presurfaced white oak.

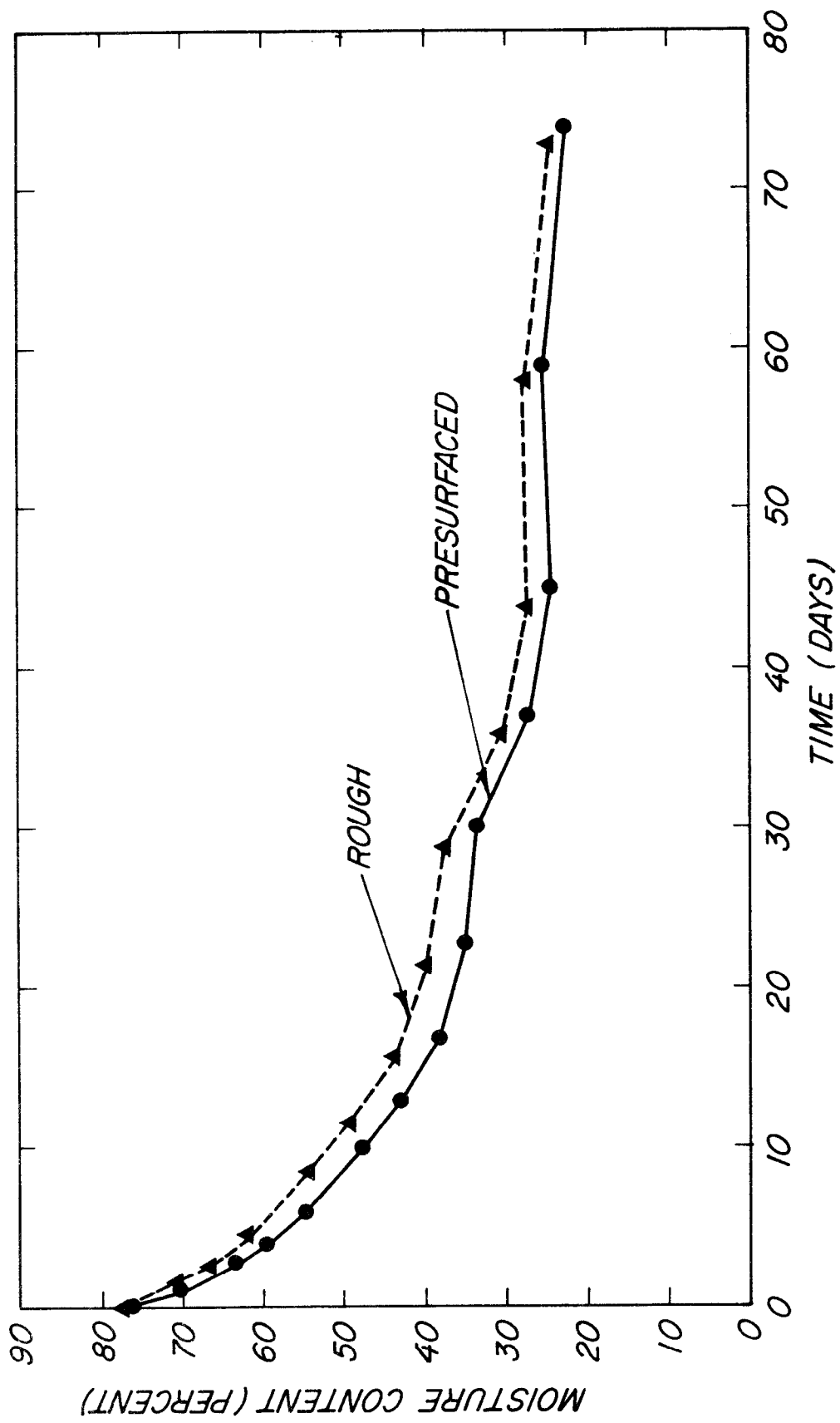


Figure 7.--Adjusted air drying curves for rough and presurfaced red oak.