Moisture changes in oak and hickory fuel chips on roofed and unroofed Louisiana air-drying grounds as affected by pile depth and turning of chips

Peter Koch

Abstract

Freshly cut whole-tree hickory chips had lower moisture content (MC) initially and dried more rapidly than those of southern red oak. Such chips spread during April 1981 in roofed trays did not dry to 20 percent MC, ovendry-weight basis, faster than those spread in October 1980. In roofed trays, unturned chips spread 4 inches deep generally dried more rapidly than if spread 8 or 12 inches deep. Times to 20 percent average MC for layers 4, 8, and 12 inches deep were 78 to 94, 79 to 136, and 81 to 150 days, respectively.

Twelve-inch-thick layers of southern red oak chips in unroofed trays increased in MC with time, but less so if turned weekly. Twelve-inch-thick layers of southern red oak chips in roofed trays dried considerably faster if turned. Even when in roofed trays and turned weekly, however, 87 days of drying were required to reach 31 percent average MC, and 151 days to reach 29 percent MC.

Fresh whole-tree oak and hickory fuel chips are nearly half water by weight. To increase their burning efficiency they can be air-dried on drying grounds, predried in machines independent of combustion furnaces, dried in conveyors enroute to the combustion zone, or dried in the combustion zone as they are burned.

Drying of fuel chips prior to storage not only increases the efficiency with which they are burned but also reduces danger of spontaneous combustion in fuel piles. This paper summarizes a study[1] of the effects of pile depth (4, 8, and 12 in.) and season (winter and summer) on time to air-dry whole-tree oak and hickory chips spread in roofed trays. A second phase of the study evaluated the effect of periodic turning (mixing) on average moisture content (MC) of whole-tree oak chips in 12-inch-deep piles air-dried in roofed and unroofed trays.

Roofed drying grounds — effect of pile depth

In November 1980 and April 1981, 1-inch-long whole-tree chips of southern red oak (*Quercus falcata* Michx.) and true hickory (*Carya* sp.) from trees 5 to 7 inches in diameter freshly cut in central Louisiana were placed in open-top boxes with solid bottoms (drain holes provided) and expanded-metal screen sides (Fig. 1, top). Trays measured 6 feet square with sides 4, 8, and 12 inches high and were replicated. Each tray had a rigid cover (with 1-ft. overhang all around) supported about 12 inches above the top of the tray and was elevated about 24 inches clear of the ground in a single row with about 8 feet between trays.

Each entire tray with chips was weighed about every 7 days to determine (after taring out tray weight) green weight of the chips. At the conclusion of air-drying, the entire contents of each chip tray were oven-dried and weighed and periodic average MCs computed.

Moisture contents of the green whole-tree chips when loaded in the trays averaged as follows: southern red oak cut in November 1980 (69%) and April 1981 (85%); hickory cut November 1980 (55%) and April 1981 (65%). Part of the difference between November and April chips was probably attributable to a several-day

[1]Koch, P. 1982. Time to air-dry hickory and southern red oak whole-tree chips spread to various depths in roofed drying trays in November 1980 and April 1981 in central Louisiana. Fin. Rept. FS-SO-3201-10, dated May 19, 1982. USDA Forest Serv., Southern Forest Expt. Sta., Pineville, La.

The author is Leader, Special Project, Utilization of Lodgepole Pine in North America, USDA Forest Serv., Intermountain Forest & Range Expt. Sta., Drawer G, Missoula, MT 59806. He was formerly Chief Wood Scientist, Southern Forest Expt. Sta., Pineville, La. This paper was received for publication in November 1982.

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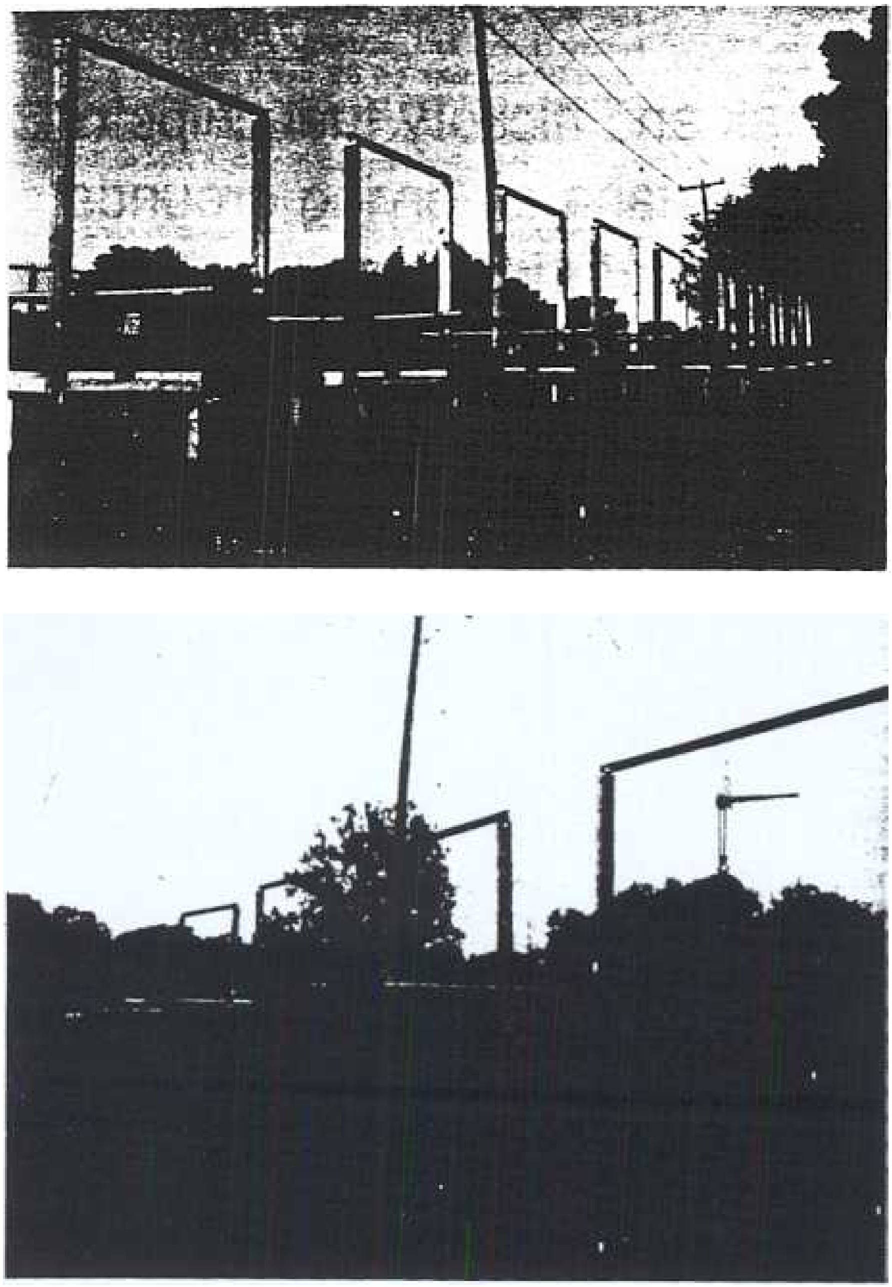

Figure 1. — Tray storage simulating drying grounds. (TOP) Roofed trays with expanded metal sides and solid, but perforated, bottoms loaded to 4-, 8-, and 12-inch depths. (BOTTOM) Roofed and unroofed trays with solid sides and perforated bottoms simulating an extensive paved drying ground on which a 12-inch layer of fuel chips could be turned with a plow or bulldozer. Weighing apparatus shown connected to tray in foreground.

delay in getting the trays constructed in November 1980, so chips were stored several days under a tarp before loading in trays.

Times to reach 40, 30, and 20 percent average MC (ovendry-weight basis) are shown in Table 1 (see Fig. 2). In most instances, chips spread 4 inches deep dried more rapidly than if spread 8 or 12 inches deep. Hickory chips had lower green MC initially and dried more rapidly than southern red oak. Chips spread in April 1981 did not dry to 20 percent MC faster than those spread in October 1980.

Roofed and unroofed drying grounds — effect of turning the chips

Paved drying grounds might be roofed or unroofed, and chips could be turned with plow or bulldozer or left unturned. To compare roofed to unroofed exposure in Louisiana and to evaluate the effect of turning the chips, an experiment was performed[1] in which southern red oak whole-tree chips were piled 12 inches deep in trays similar to those described under the previous heading, except that tray sides and bottoms were of solid sheet metal drilled for drainage (Fig. 1, bottom). Factors in the experiment were as follows:

- chips turned weekly with a shovel vs. chips not turned
- chips under roof vs. chips not roofed
- replications: two

The whole-tree southern red oak chips were harvested

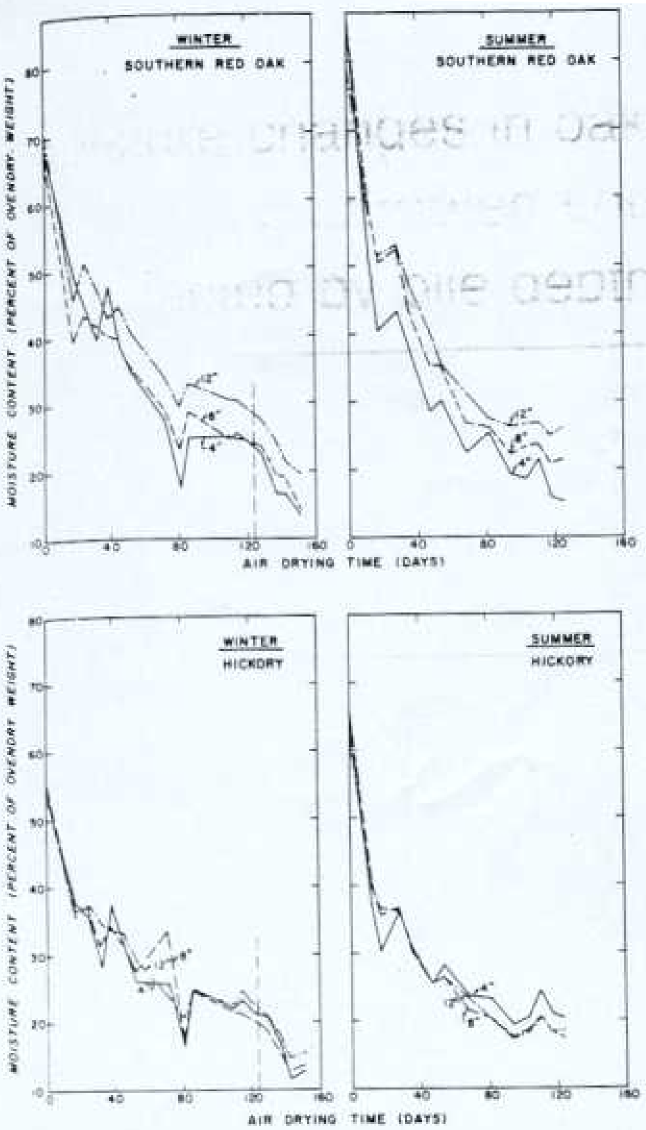

Figure 2. — Average moisture content of southern red oak (TOP) and true hickory sp. (BOTTOM) whole-tree chips vs. time in roofed 6-foot-square drying trays related to depth of chips in trays (4, 8, and 12 in.) and season. Winter-dried chips were placed in the trays in November 1980; those summer-dried were placed in the trays in April 1981.

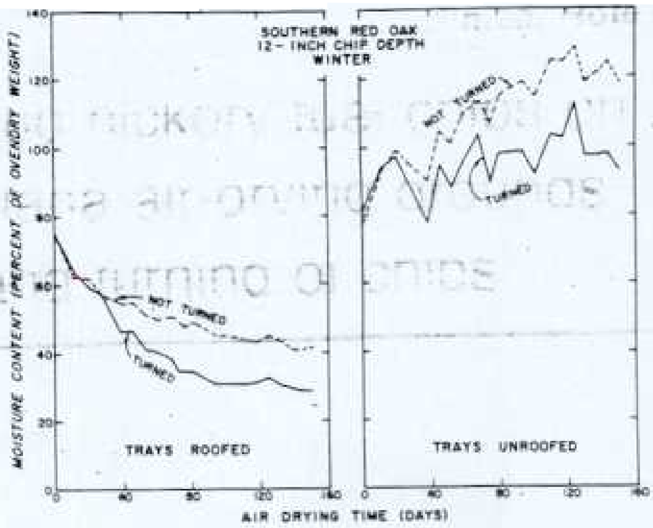

Figure 3. — Average moisture content of southern red oak whole-tree chips piled 12 inches deep related to time in roofed and unroofed 6-foot-square trays with solid (but drained) sides and bottoms—half turned weekly with a shovel, and half unturned. The freshly harvested chips were loaded in the trays October 15, 1981.

TABLE 1. — *Times to reach 40, 30, and 20 percent average moisture content (ovendry-weight basis).*[a]

MC and pile depth, in.	Southern red oak		Hickory	
	Winter	Summer	Winter	Summer
	(days required to dry)			
40%				
12	54	48	14	12
8	18	40	15	14
4	32	33	15	11
30%				
12	81	73	52	38
8	70	62	49	35
4	65	47	31	38
20%				
12	150	—	81	124
8	136	124	79	82
4	79	94	78	92

[a]Each value is the average of two replicates.

in central Louisiana on October 15, 1981, and immediately placed in trays, weighed weekly, and after 151 days ovendried and their weight recorded. Initial MC of the chips in roofed trays was 75 percent of ovendry weight; that of chips in the unroofed trays was 77 to 81 percent.

Chips in unroofed trays increased in MC with time, but less so if turned weekly (Fig. 3).

Chips in roofed trays dried considerably faster if turned. Even when in roofed trays and turned weekly, however, 87 days of drying were required for these southern red oak whole-tree chips in 12-inch-deep piles to reach 31 percent MC. At the end of the 151-day experiment, the turned chips had 29 percent MC. Those not turned had 41 percent MC, ovendry-weight basis (Fig. 3).

Conclusions

These results suggest that air-drying of fuel chips in shallow unroofed piles is probably impractical in the Midsouth.

If under roof, and turned (mixed) periodically, oak and hickory whole-tree fuel chips in piles not more than a foot deep can be dried to 30 percent average MC in 2 to 4 months in the Midsouth—both summer and winter. It seems doubtful, however, that an economic argument could be made for such a procedure.