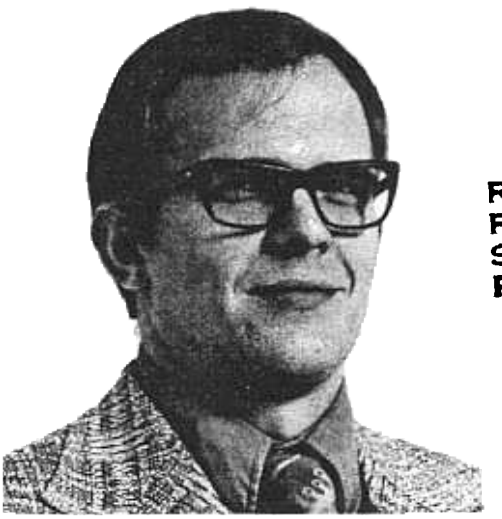
Initial Test of Large Panels of Structural Flakeboard from Southern Hardwoods



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Abstract

A strong structural exterior flakeboard from mixed southern hardwoods has been developed on a laboratory scale; the problem is transfer of the technique to pilot-plant scale in the manufacture of 4- by 8-ft panels. From the pilot-plant trial here reported, it is concluded that a specific platen pressure of at least 575 psi and a hot press closing time of about 45 seconds is required to make a 1/2-in.-thick panel (with random flake orientation throughout) having modulus of elasticity of 700,000 psi.

Introduction

In laboratory research at Pineville, Louisiana, Hse et al (1) made strong exterior flakeboard from mixed southern hardwoods flaked on a shaping-lathe headrig (2). The work here reported outlines initial progress in transferring the technique to pilot-plant scale. The ultimate objective is to manufacture and test several hundred 4- by 8-ft panels that closely approximate the laboratory panels in modulus of elasticity (MOE), modulus of rupture (MOR), and internal bond (IB).

To identify likely problems in manufacturing these hundreds of boards, a preliminary trial was deemed advisable. To this end, 500 pounds of flakes were transported to the Lewiston, Idaho, pilot plant of Potlatch Corporation for board production. The flakes were cut on a shaping-lathe headrig at Pineville, Louisiana.

Procedure

The specifications (Hse et al) call for a flake thickness of 0.015 in. in the face layers and 0.025 in. in the core. For simplicity, however, 0.015 in. thick flakes were used throughout; it was recognized that IB of the boards so constructed would be less than in the laboratory version. Also, the phenol-formaldehyde resin in use at the Potlatch pilot plant was substituted for the resin developed specifically for mixed hardwoods. Finally, the 4- by 8-ft press at Potlatch has a specific platen pressure of 450 psi whereas Hse and his associates used 575 psi. Intended fabrication details were therefore:

Fixed factors

Panel size: 4 by 8 ft

Panel thickness: 1/2 in.

Species mix: 20% each of hickory (*Carya* spp.), white oak (*Quercus alba* L.), southern red oak (*Quercus falcata* Michx.), sweetgum (*Liquidambar styraciflua* L.), and southern pine (e.g., *Pinus taeda* L.)

Flake length: 3 in.

Flake thickness: 0.015 in.

Flake moisture content before resin spread: 3-4%

Resin content: 6%

Wax content: 1%

Mat moisture content: 10% plus 0.3 lb of water sprayed per side of the 4- by 8-ft mats

Press time: 6 minutes including closing time

Specific pressure in hot press: about 450 psi

Press temperature: 340°F

Variable factors, i.e., panel construction

Random flake orientation with board density of 48 lbs per cubic ft

Face flakes oriented and core flakes randomly oriented (50% of each by weight) with board density of 46 lbs per cubic ft

Manufacture of the boards was performed during the last week of February 1975.

Results

The first two efforts to make randomly oriented 48-lb boards failed because the mats were formed with excess flakes and the press did not close to 1/2-in. gap during the 6-minute cycles. Had the 1/2-in. thickness been achieved, panel densities would have exceeded 55 lbs per cubic ft.

The flakes remaining were barely sufficient to fabricate three additional panels–a pair with oriented face flakes (random core), plus a single board with flakes random throughout. Density of the oriented boards averaged 42.5 lbs per cubic ft, while the random board weighed 45.3 lbs per cubic ft at about 5% moisture content. These densities were substantially below target values. Strength properties, evaluated from 6 specimens per panel, were as follows:

Property and direction tested	Oriented boards		Random board
	Bd 1 (psi)	Bd 2 (psi)	
MOE			
Along 8-ft dimension	891,000	925,000	586,000
Along 4-ft dimension	249,000	237,000	414,000
MOR			
Along 8-ft dimension	5,220	5,320	4,180
Along 4-ft dimension	1,860	1,820	3,350
IB			
	——53.2——		67.7
	(average of 2 boards)		

After soaking for 24 hours in water, the oriented boards increased in weight 82.5% and increased in thickness 21.6%; the random board increased 76.2% in weight and 23.1% in thickness.

Discussion

In an effort to obtain guidance from these limited data, the observed values were compared with those for the laboratory-made boards. The following tabulation shows the percentages by which 4- by 8-ft panels were weaker than laboratory panels of the same densities:

Board property	Oriented board (%)	Random board (%)
MOE (along 8-ft dimension)	6.9	20.6
MOR (along 8-ft dimension)	10.7	6.6
IB	11.3	6.0

It is well established that press closing time significantly affects MOE and MOR of flakeboard; fast closure densifies surface layers and thereby increases both MOE and MOR. In the laboratory press, closure time to stops was 45 to 60 seconds at board densities of 46 to 49 lbs per cubic ft. The press in the present trials closed much more slowly–i.e., 65 seconds on the 42.5 lbs aligned boards and 82 seconds on the 45.3-lbs random board.

Oriented Board

We conclude that the Potlatch press, at its maximum specific platen pressure of about 450 psi, is probably adequate for manufacture of our oriented-face mixed hardwood boards. It is therefore planned to make a second run in which board density is increased to 45.5 lbs per cubic ft (basis of weight and volume at about 5% moisture content). Additionally, the core flakes will be 0.025 in. thick and the resin developed by Hse will be used. Press closing time will be about 90 seconds. With this regime we estimate that MOE and IB will be 6% less in 4- by 8-ft panels than in laboratory panels of the same density and that MOR will be 11% lower:

Property	Laboratory board (psi)	Pilot plant board (psi)
MOE (along direction of orientation)	,090,000	1,024,000
MOR (along direction of orientation)	6,625	5,900
IB	82	77

Random Board

To attain a MOE in excess of 700,000 psi on random boards in 4- by 8-ft size, we conclude that specific platen pressure must be 575 psi or greater and that closing time must be about 45 seconds. This pressure and closing time appear to be attainable on new equipment at the U.S. Forest Products Laboratory in Madison, Wisconsin.

Plans now call for trial production at Madison of a few 4- by 8-ft random boards bonded with Hse's resin and made with face flakes 0.015 in. thick and core flakes 0.025 in. thick. Boards will be pressed to 47.5 lbs density (basis of weight and volume at about 5% moisture content).

Under these conditions and at this density we estimate that MOE will be 12% less, MOR will be 8% less, and IB will be 6% less in 4- by 8-ft panels than in laboratory-made panels, as follows:

Property	Laboratory board (psi)	Pilot plant 4- by 8-ft board (psi)
MOE	800,000	704,000
MOR	5,300	4,880
IB	83	78

If these properties are attained as expected, several hundred oriented and random boards will be fabricated for extensive evaluation.

References

Hse, C.-Y., P. Koch, C. W. McMillin, E. W. Price. 1975. "Laboratory-Scale Development of a Structural Exterior Flakeboard from Hardwoods Growing on Southern Pine Sites." *For. Prod. J.* 25(4): 42-50.

2. Koch, P. 1975. "Shaping-Lathe Headrig Will Convert Small Hardwoods into Pallet Cants Plus Flakes for Structural Exterior Flakeboard." *Proc. 9th Particleboard Symp.*, Washington State University.