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9. ABSTRACT
Illustrates the feasibility of long-term storage of Philippine hardwood chips for dry-formed hardboard manufacture. Less than 10% weight loss occurred after 9 months of storage under conditions that resulted in over a 20% loss with aspen chips. High-density hardboards made from aged Philippine hardwood chips had better bending strength, internal bond, and thickness swelling than boards made with fresh chips. The tensile strength and linear movement were not as good. Fifty species of Philippine hardwoods were used for chip storage and hardboard experiments. Chips were stored for 9 months in an insulated polystyrene foam box with air inlets and outlets and fed with water saturated air. Chips were converted into hardboard quality pulp using a small batch-type pressurized refiner. Dry-formed, 1/8-inch, high-density hardboards were made from the pulps after air drying. Chip weight loss after aging was calculated from the ovendry weight of the chips before and after aging. The hardboards were evaluated by the same procedure specified in A.I.D. Report No. 5, "Hardboards From Mixtures of Philippine Hardwoods." Biological activity was apparently greater in the aspen than in the tropical hardwood mixture. The aspen chips reached a maximum temperature of 113 degrees F. and had a 22.4% weight loss compared to 92 degrees F. and 9.4% weight loss for the tropical hardwood chip mixture. Hardboards made with pulps prepared from fresh and aged chips from the tropical hardwood mixture and domestic hardwood easily met the requirements of Voluntary Product Standard PS 58-73 for standard hardboard for those properties measured.

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HARDBOARDS FROM MIXTURES OF PHILIPPINE HARDWOODS AFTER CHIP STORAGE

By

Gary C. Myers, Forest Products Technologist

October 1977

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Addendum to AID Report No. 5
"Hardboards From Mixtures of Philippine Hardwoods"

In Cooperation with the University of Wisconsin

HARDBOARDS FROM A MIXTURE OF PHILIPPINE HARDWOODS AFTER CHIP STORAGE

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Summary

This addendum illustrates the feasibility of long-term storage of Philippine hardwood chips for dry-formed hardboard manufacture. Less than 10 percent weight loss occurred after 9 months of storage under conditions that resulted in over a 20 percent loss with aspen chips. High-density hardboards made from the aged Philippine hardwood chips had better bending strength, internal bond, and thickness swelling than boards made with fresh chips, but the tensile strength and linear movement were not as good.

Experimental

Wood Mixture

Fifty species of Philippine hardwoods (table 1) were used for chip storage and hardboard experiments. The chips were made from bark-free wood in a commercial size, four-knife chipper. The nominal length of the chips was 5/8-inch, and the fines and oversize material were removed

prior to blending of individual species to obtain a mixture weighted with more of the intermediate density species (table 1). A domestic hardwood, aspen, was included as a control. Chipping and screening followed the same procedures used for the tropical hardwoods.

Chip Storage

Chips were stored for 9 months in an insulated box constructed of 8-1/2-inch thick walls of polystyrene foam, with a 3.9 cubic feet interior volume (inside dimensions 22-1/2 by 13-1/2 by 22 inches). The box was fitted with air inlet and outlet manifolds and was fed with water saturated air at ambient temperature at a measured rate.

Pulp Preparation

Chips were converted into hardboard quality pulp using a small batch-type pressurized refiner at the Forest Products Laboratory (FPL). The chips were given an initial 20-minute steaming at 85 pounds per square inch in the digester tube before entering the refiner. Pressure during refining dropped to 75 pounds per square inch and the plate gap setting was zero. No water was added to the refiner or to the cyclone. The laboratory pressurized refiner was not equipped for power determinations.

Boardmaking

Dry-formed, 1/8-inch, high-density hardboards were made from the pulps after air drying. The pulps were sprayed with 4 percent resin by weight, based on the dry fiber, while tumbling in a rotating drum. The

resin was a phenol-formaldehyde type commonly used for dry-formed hardboard. Mats (14 by 14 inches) were formed on a banjo-type former, cold pressed, and then hot pressed between platens at a temperature of 375° F. for 6 minutes. All boards were heat treated by exposing them for 1 hour in a circulating oven at 320° F.

Test Methods

Chip weight loss after aging was calculated from the ovendry weight of the chips before and after aging. The hardboards were evaluated by following the same procedures specified in AID Report No. 5, "Hardboards From Mixtures of Philippine Hardwoods."

Results

Biological activity was apparently greater in the aspen than in the tropical hardwood mixture. During storage the aspen chips reached a maximum temperature of 113° F. and had a 22.4 percent weight loss. In contrast, the tropical wood mixture reached a maximum temperature of 92° F. and had a 9.4 percent weight loss. The aspen chips were much fresher and greener than the tropical hardwood chip mixture, which might have influenced chip storage behavior.

Hardboards from the aged tropical hardwood chip mixture were stronger in static bending and internal bond, but lower in tensile strength, than boards made from fresh tropical hardwood chips (table 2). The hardboards with the aged chips had greater linear movement, but less

thickness swelling with changes in moisture, than hardboards made from fresh chips. As a comparison, high-density hardboards made from aged aspen chips were generally weaker and moved more in the linear direction than hardboards made from fresh aspen chips (table 2).

High-density hardboards made with pulps prepared from fresh and aged chips from the tropical hardwood mixture and domestic hardwood easily met the requirements of Voluntary Product Standard PS 58-73 for standard hardboard for those properties measured.

Conclusions

Philippine hardwood chips have better storage characteristics than aspen chips. A 9-month chip storage period had less serious effect on high-density hardboard properties than the same storage had on aspen.

Table 1.--Names and specific gravities of the Philippine hardwood mixture used in chip storage evaluations

Common name	Botanical name	Specific gravity	Amount in mixture
			Pct
Tangisang-bayauak	Ficus variegata	0.236	0.7
Binuang	Octomeles sumatrana	.242	.7
Kapok	Ceiba pentandra	.244	.7
Balilang-uak	Meliosma macrophylla	.260	.7
Rarang	Erythrina subumbrans	.264	.7
Kaitana	Zanthoxylum rhetsa	.296	.7
Ilang-ilang	Cananga odorata	.308	.9
Gubas	Endospermum peltatum	.316	.9
Dita	Alstonia scholaris	.316	.9
Anabiong	Trema orientalis	.319	.9
Hamindang	Macaranga bicolor	.324	.9
Balanti	Homalanthus populneus	.356	.9
Mayapis	Shorea squamata	.366	.9
Matang-arau	Melicope triphylla	.381	.9
Malasantol	Sandoricum vidalii	.394	.9
White lauan	Pentacme contorta	.401	2.2
Tulo	Alphitonia philippinensis	.422	2.2
Tangile	Shorea polysperma	.429	2.2
Pahutan	Mangifera altissima	.435	2.2
Apanit	Mastixia philippinensis	.447	2.2
Lago	Pygeum vulgare	.451	2.2
Antipolo	Artocarpus blancoi	.469	2.2
Bagtikan	Parashorea plicata	.478	2.2
Sakat	Terminalia nitens	.485	2.2
Red lauan	Shorea negrosensis	.510	4.0
Itangan	Weinmannia luzoniensis	.526	4.0
Piling-liitan	Canarium luzonicum	.549	4.0
Palosapis	Anisoptera thurifera	.554	4.0
Lomarau	Swintonia foxworthyi	.559	4.0
Malabetis	Madhuca oblongifolia	.560	4.0

(Sheet 1 of 2)

Table 1.--Names and specific gravities of the Philippine hardwood mixture used in chip storage evaluations--Con.

Common name	Botanical name	Specific gravity	Amount in mixture
			Pct
Dangkalan	Calophyllum obliquinervium	0.568	4.0
Panau	Dipterocarpus gracilis	.576	4.0
Katmon	Dillenia philippinensis	.592	4.0
Batitinan	Lagerstroemia piriformis	.597	4.0
Katong-lakihan	Amoora macrophylla	.608	2.5
Narig	Vatica mangachapoi	.618	2.5
Miau	Dysoxylum euphlebium	.623	2.5
Apitong	Dipterocarpus grandiflorus	.623	2.5
Bok-bok	Xanthophyllum excelsum	.639	2.5
Kamatog	Erythrophloeum densiflorum	.650	2.5
Dalingdingan	Hopea foxworthyi	.667	2.5
Katilma	Diospyros nitida	.679	2.5
Yakal	Shorea astylosa	.718	1.0
Kamagong	Diospyros philippinensis	.720	1.0
Katong-matsin	Chisocheton pentandrus	.725	1.0
Manaring	Lithocarpus soleriana	.736	1.0
Ipil-ipil	Leucaena leucocephala	.737	1.0
Bolong-eta	Diospyros pilosanthera	.743	1.0
Makaasim	Syzygium nitidum	.778	1.0
Alupag-amo	Litchi philippinensis	.793	1.0

Table 2.--Properties of 1/8-inch thick, high-density, dry-formed hardboards

Chip mixture	Static bending			Internal bond maximum stress	Tensile strength maximum stress	Dimensional movement			
						From 50 pct to 90 pct relative humidity		From 50 pct relative humidity to 30-day water soak	
	Density	Modulus of rupture	Modulus of elasticity			Length	Thickness	Length	Thickness
	Lb/ft^3	Lb/in.^{2}	1,000 lb/in.^{2}	Lb/in.^{2}	Lb/in.^{2}	Pct	Pct	Pct	Pct
Fresh Philippine "C"	61.1	7,390	730	508	5,470	0.10	7.86	0.09	22.60
Aged Philippine "C"	65.5	8,650	859	530	4,910	.15	7.30	.19	18.60
Fresh aspen	64.4	7,620	713	382	5,380	.26	5.52	.35	16.38
Aged aspen	64.3	6,170	677	213	3,330	.38	3.64	.58	9.61