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SUNFLOWER STALKS AS A RAW MATERIAL FOR PARTICLEBOARD

The objective of this study was to compare the strength, dimensional stability, and durability of laboratory particleboards from 100% sunflower stalks (Helianthus annuus L.) to those from 100% aspen (Populus tremuloides Michx.) planer shavings. In addition, the effects on board properties of removing pith from the sunflower stalk particles and of mixing stalks 1-to-1 with planer shavings also were evaluated. All boards were bonded with phenol formaldehyde adhesive.

The stalk particle furnishes were produced from baled stalks of an oil bearing sunflower variety. The composition of the bales is shown in Table.

Hammermilling was chosen as the method of stalk breakdown for this study primarily because it resulted in less fines (passing though the 75 mm screen) as compared to disk refining. Fines were roughly 12% of the total weight.

Pith was removed from a portion of the hammermilled stalk furnish to determine the effect of its removal on board properties. The pith was separated out quite easily with an air stream because of its lower density relative to the other stalk parts. Less than 10% of the pith remained using this technique.

Aspen planer shavings produced from dry aspen boards were hammermilled (no screen). Fine accounted for 7% of the total weight.

Four board types (raw material compositions) were used: 100% sunflower stalks (2); 100% sunflower stalks with pith removed (1); 100% aspen planer shavings (4); 50% stalks, 50% planer shavings (3).

Two board densities (nominal): 42 and 48 pcf (670 and 770 kg/m^3). Two phenol formalde-

Table

Percentage Composition of Sunflower Stalk Bales

Components of sunflower stalk bales	% of total bale weight
Stalk pieces[1]	71.3
Stalk fragments[1]	9.2
Heads	13.2
Straw & weeds	1.0
Dirt & fines	5.3
Total	100

[1]Stalks averaged 15% pith by weight. Therefore pith comprised approximately 12% of the total bale weight.

hyde resin contents: 5% and 10% solids (oven dry basis).

Resin type: liquid phenol formaldehyde.

Replications: 2 (32 boards manufactured).

Board construction: homogeneous.

Regression lines of board properties as a function of density and the standard errors of estimate of the lines were calculated for each resin level and raw material type. Comparisons for significant differences among board types at the 95% confidence level were made at 45 pcf (721 kg/m^3) density. Both board density and the property measured were considered to be normally distributed variables; therefore board types had to differ by plus or minus two standard errors of estimate to be statistically different at the 95% confidence level.

No serious manufacturing difficulties were encountered using sunflower stalks although we did find that the higher equilibrium moisture content of the stalks as compared to wood could result in pressing problems if this factor was not taken into consideration. The stalk boards were similar in appearance to typical wood-based particleboards, and no obvious differences in sawing or surface sanding were noted.

When compared to the 100% planer shavings board (0% stalks), sunflower stalk boards had a lower MOR but higher MOE, and, as expected, the 50% stalk boards exhibited properties intermediate to the 100% stalk and 100% planer shavings boards. Removal of pith resulted in a statistically significant increase in the modulus of rupture (MOR) at the 10% resin level but had no effect on the modulus of elasticity (MOE).

Internal bond strengths (IB) were determined before and after the 2-cycle VPS durability test. The most serious drawbacks of sunflower stalks as a particleboard raw material relative to planer shavings are evident here. These are its resulting low initial IB and excessive

loss of IB by the durability test. Removal of pith greatly improved initial IB but reduced the loss of IB only at the 10% resin level. Adding planer shavings (the 50% boards) was not as effective in improving initial IB as was pith removal, but it resulted in less IB loss from the VPS test. This indicates that the pith was a primary cause of low initial IB, but that the excessive swelling of the stalk particles themselves probably accounted for the loss of IB by the durability test. The greater the swelling, the greater the degree of bond breakage and the lower the resulting IB. The increase in resin content considerably reduced IB and durability test losses in all the four board types. As was the case with MOR and MOE, initial IB increased with an increase in board density. Because of the excessive loss of IB by the durability test, it appears that particleboards from sunflower stalks could be used for interior applications only. Linear and thickness swellings of particleboards, induced by an increase in moisture content were defined too. The stalk boards had a better linear stability, but this can be attributed, at least in part, to their greater thickness swelling during the corresponding moisture content increase.

General conclusions of the study are:

1) Sunflower stalks make acceptable particleboards providing that or particularly if the pith is removed and/or wood planer shavings are added to the stalks.
2) Because of the excessive swelling of the stalk particles during a durability test, stalk boards appear to be suitable for interior applications only.

Specific conclusions are:

1) Sunflower stalks increased MOE (stiffness in bending) and linear dimensional stability but decreased MOR (bending strength), IB (internal bond strength), thickness dimensional stability, and durability (resistance to exterior exposure).
2) Removal of pith increased MOR and IB.
3) Adding planer shavings to stalks increased MOR, IB, thickness dimensional stability, and durability.
4) An increase in resin content generally improved all board properties.
5) An increase in board density increased all strength properties.