

THE SIGNIFICANCE OF WOOD ORIENTATION WHEN MAKING FLAKES FOR WAFERBOARD

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Introduction

The waferboard and orientated strandboard (OSB) industry is approximately 25 years old. In the last few years, it has grown at an increased rate and therefore significant technology has yet to be developed. Some of the fundamental characteristics of wafers and strands are still being studied and evaluated. This report looks at the significance of the wood grain orientation to the machining plane when making wafers and strands, and presents test results on flake strength and fines production.

Discussion

In Figure 1, the feedworks of a waferizer, logs can become misaligned due to wood irregularity such as knots, crook, etc. In the vertical disc waferizer, the logs are gripped on their ends and the ability exists for the operator to skew wood in the feedworks to re-align it to the disc (see Figure 2). In some waferizers, notably the drum waferizers and the horizontal disc machines, the wood is gripped on its side and this ability to skew does not exist. With these gravity feed machines, there is a domino effect since when one block is skewed it tends to skew the ones behind it and there is no recourse for correction.

When wood is cut skewed, the board strength is reduced, caused mainly by the reduction in wood strength because of wood's non-homogeneity and anisotropic strength properties. This phenomena has been mathematically modelled by Hankinson's formula (1), which gives reasonable predictions for compressive strength and is often used for other strength properties as well.

Hankinson's Formula

$$N = \frac{PQ}{P \sin^n \theta + Q \cos^n \theta}$$

Where 'N' is a strength at an angle θ to the fibres, 'P' is the strength parallel to the fibres and 'Q' is the strength perpendicular to the fibres. Small 'n' is an empirically derived exponent ranging from 1.5 to 2 for the strength properties which would most affect fines production, i.e. tensile, bending and impact strengths. For tension, Aspen has a strength parallel to the grain, $P = 9800$ psi, and perpendicular $Q = 607$ psi. Figure 3 shows the predicted tensile strength vs. fibre angle for Aspen for 'n' = 2. Note that a 10° fibre angle strength is approximately 60% of the parallel strength.

In 1975, Heebink (2) published results of experiments to show that the theory applies similarly to waferboard. This work was done using Douglas-fir machined at various fibre angles from 0 to a slope of grain of 1:5. These findings showed that, when compared to solid Douglas-fir, there was a good correlation (see Figure 4). In addition, Heebink found that the surface texture was rougher at higher angles and that thickness swell, linear expansion and springback were affected in qualitatively predictable ways, when the wafer was made into boards.

Work done at CAE Machinery Ltd. and presented by Beer showed that the average tensile strength of individual strands is also reduced with increased slope of grain and in addition, there were significant fines increase. Figures 5, 6 and 7 show these results.

To show more clearly the effects of fines on small angle changes on Trembling Aspen, straight grained Aspen blocks were selected to eliminate the effect of spiral grain and decay. The logs were cut at three angles, then quartered. Each of the quarters was fed into a laboratory flaker. Figure 8 shows the average 3/16 and 3/8 screened results for Aspen. Estimates for other screen sizes commonly used in mills are also shown.

A 5° misalignment in a production plant is highly probable when operators do not have or use the skewing ability of the machine. The average misalignment may be much worse if little attention is paid to slashing the blocks to consistent lengths and with square ends, or if the operators do not straighten the blocks on the infeed conveyor. From the graph Figure 8, it can be seen that approximately 1% increase in fines will result from a 5° misalignment. The effect of this is an annual loss of approximately \$25,000 U.S. per machine year, based on two hundred oven dried tons per day through the machine. These are figures based on typical values of \$40 per cord for delivered logs and \$6 per cord for the value of fines as a fuel.

Conclusion

Correct grain orientation to the cutting medium is important in wafer and strand production to maintain wood strength and minimize fines. The ability of the waferizer's infeed system and the willingness of the operator to adjust to eliminate wood skew are both desirable.

The numerical data given is a result of a small number of tests and therefore is not statistically significant. Nevertheless, a clear trend in reduction of strength and increase in fines in relation to increase in grain angle to cutting angle has been established.

In the future, it is possible that the orientation of incoming wood to the waferizer will be scanned and the skewing of the wood accomplished automatically.

References

1. Forest Products Laboratory Forest Service USDA, Wood Handbook, 1974.

2. Heebink, B. G. 1975. Grain angle through flake thickness: Effect on properties of a structural flakeboard. USDA Forest Service Research Paper FPL 257. Madison, Wisconsin.

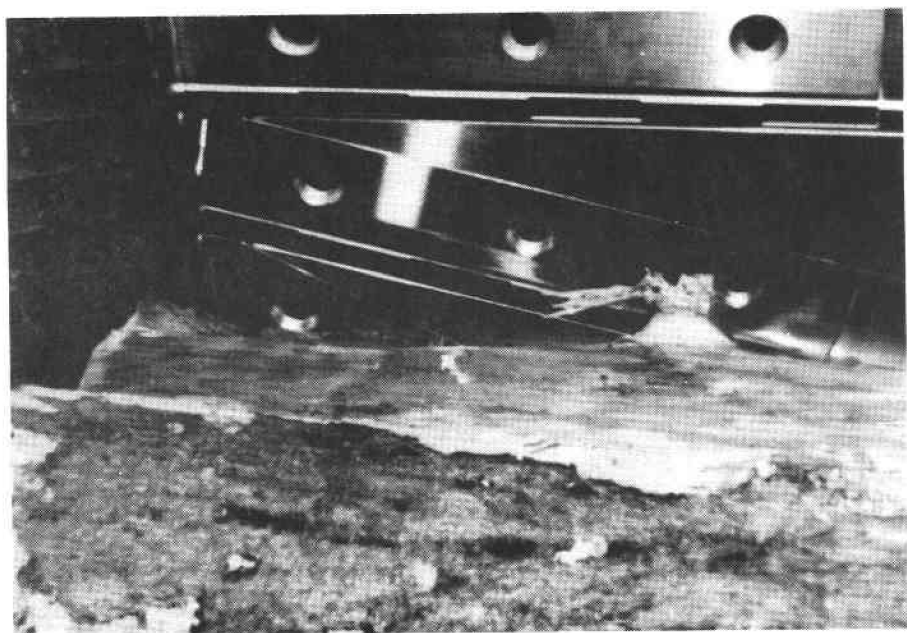


Figure 1. Feedworks of Waferizer.

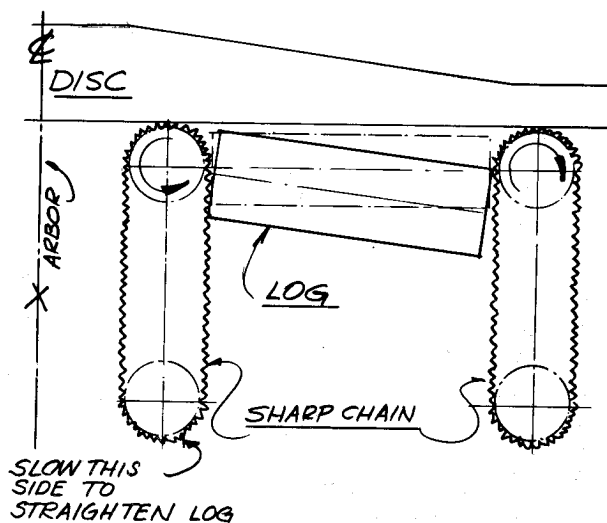


Figure 2. Skew Wood in Feedworks.

STRENGTH vs FIBER ANGLE
for TREMBLING ASPEN

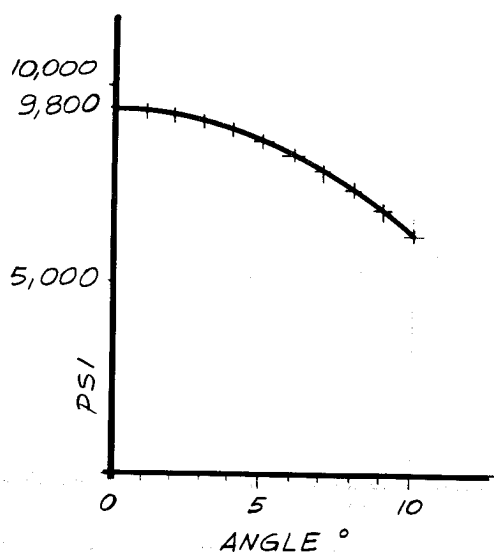


Figure 3. Strength vs. Fiber Angle for Trembling Aspen.

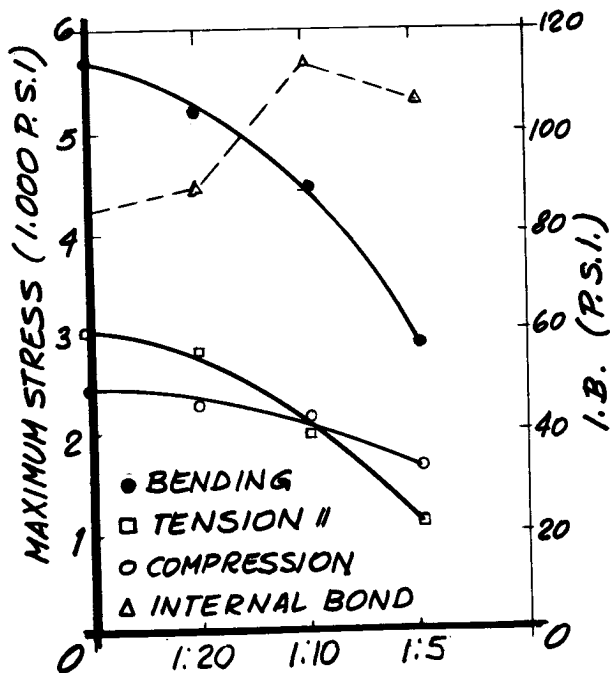


Figure 4. Slope in Grain Through Flakes.

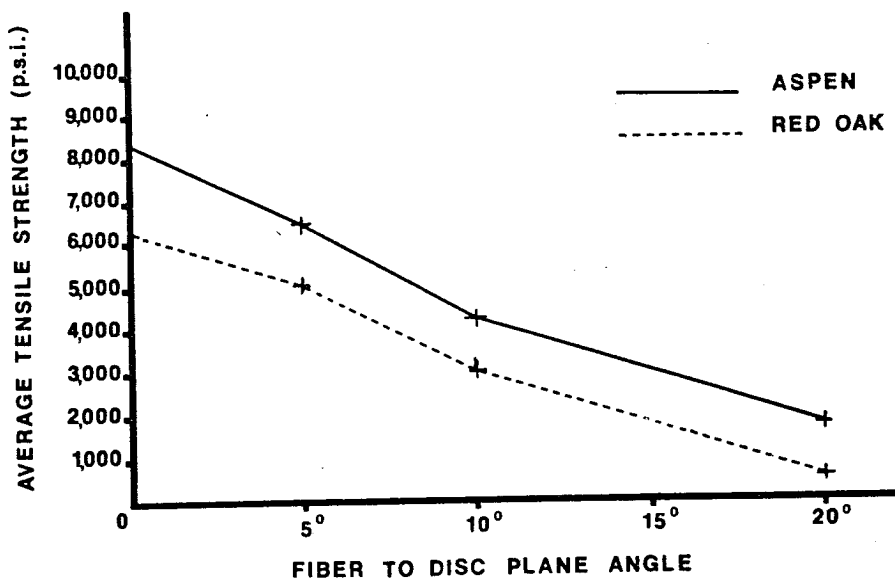


Figure 5. Graph of Average Tensile Strength of Individual Strands vs. the Angle of Fiber to Plane of Disc.

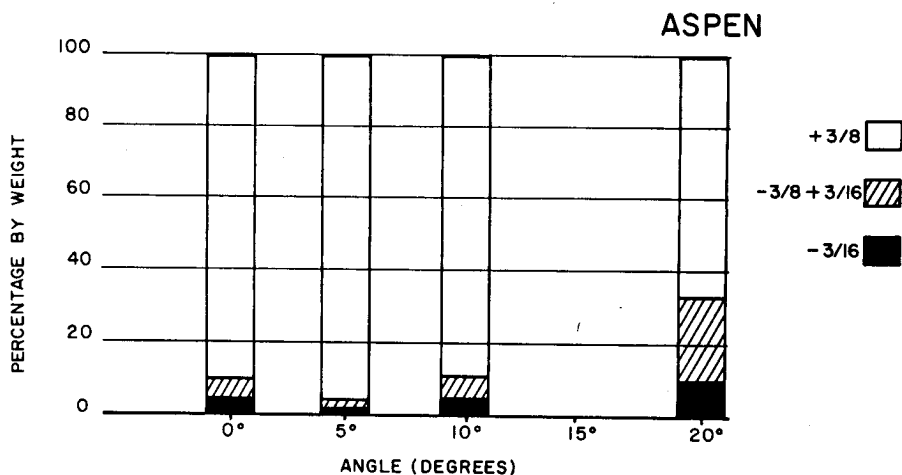


Figure 6. Effect of Slope of Grain.

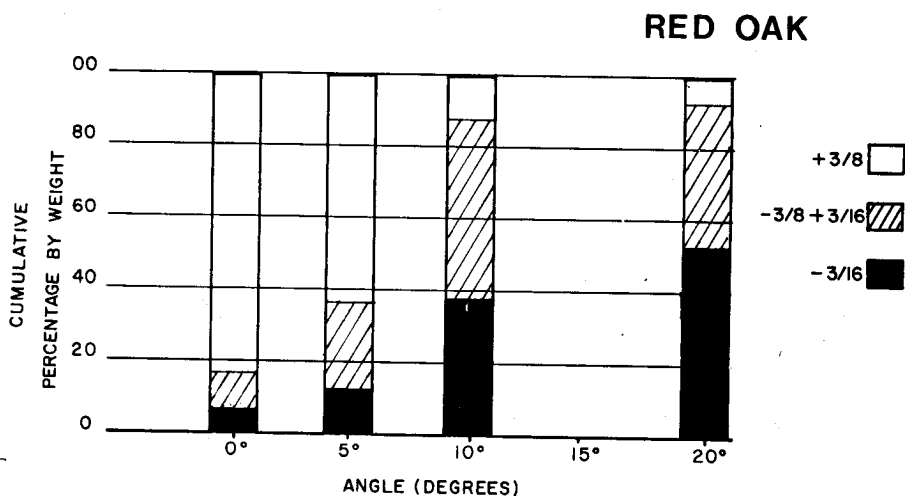


Figure 7. Effect of Slope of Grain.

SCREEN % FRACTION OF FINES vs FIBER ANGLE

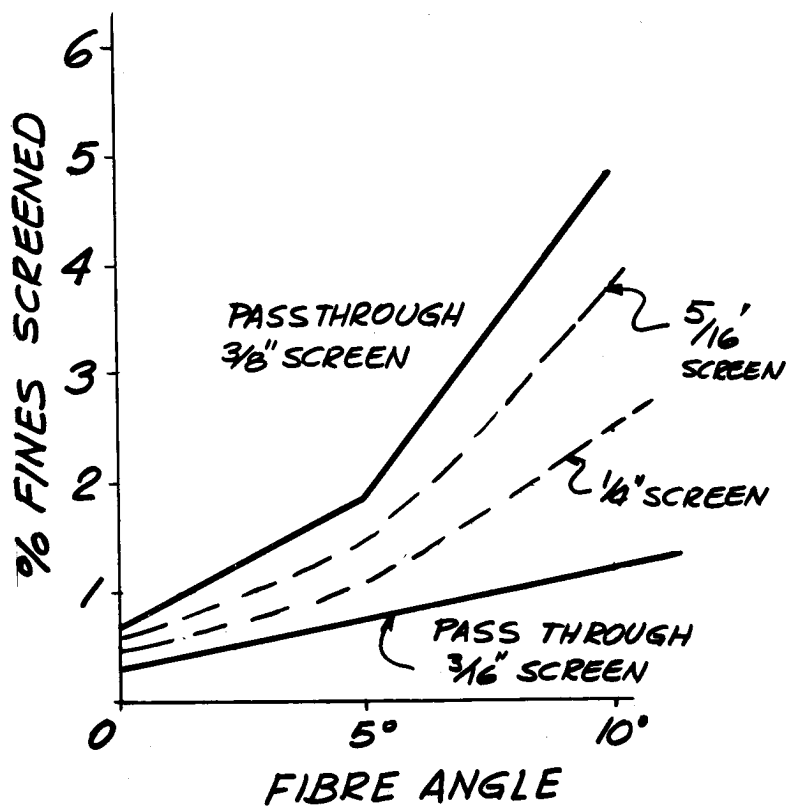


Figure 8. Screen Percent Fraction of Fines vs. Fiber Angle.