CHARACTERIZING WOOD QUALITY AND RELATED VALUES WITH ACOUSTIC TOOLS

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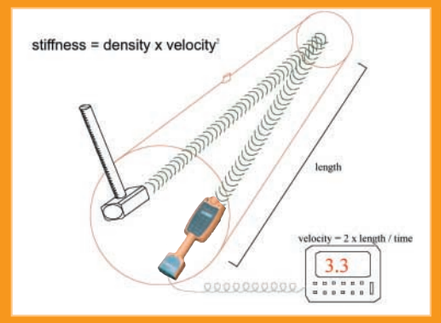
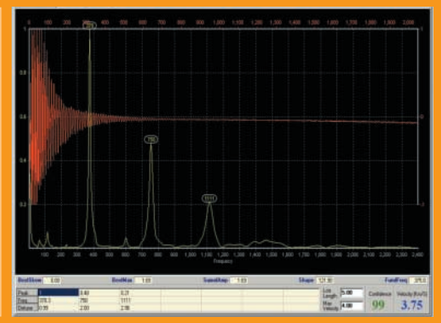
ABSTRACT: Non-destructive testing (NDT) of wood products, such as lumber and veneer, for stiffness and strength evaluation has been proven and commercialized for many years. The NDT concept has been extended and commercialized in acoustic tools for testing trees, logs and lumber. This poster describes operating principles of tools and presents examples of their use with various species. The potential effects of temperature and age on results from these tools are discussed. Results show good correlations between acoustic measures wood properties at all stages in the production process.

Acoustic tools – how they work

RESONANCE TOOLS

- Velocity is derived from resonant frequency and length
- Tools detect frequency from hammer blow
- Green density is relatively constant
- Stiffness = density x (velocity)^2





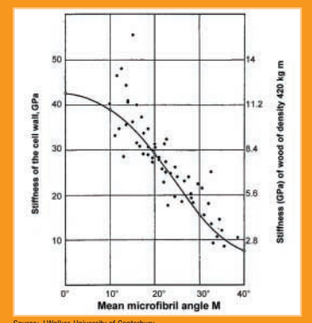
TIME OF FLIGHT TOOLS

- Single pass of sound wave from point to point
- 'Time of flight' outerwood velocity measure is higher than resonance measure
- Velocity correlates strongly with resonance velocity at stand level

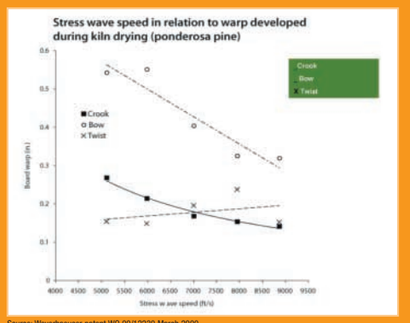
Related Findings

WOOD PROPERTIES

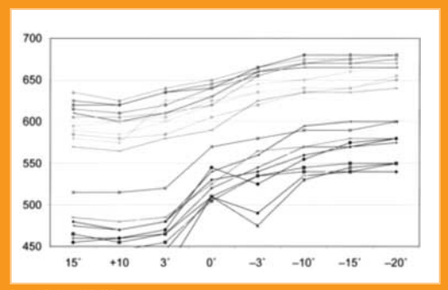
- High level of interest in other properties – strong correlations with microfibril angle, longitudinal shrinkage, and distortion



Source: J Walker, University of Canterbury



Source: Weyerhaeuser patent WO 00/12230 March 2000



Source: L Bjorklund, VMR, SDC

EFFECT OF TEMPERATURE ON VELOCITY

- Acoustic velocity increases with decreasing temperature
- Rate of change not well defined
- Moisture content changes may compensate on logs, but not in trees

Standing tree sampling

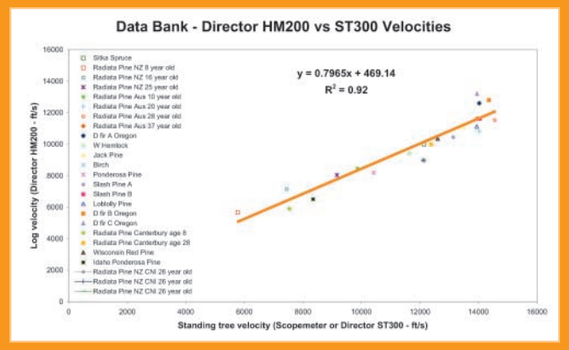
SINGLE TREES

- Intensive sampling
  - Variation around stem
  - Knot location
  - Transverse
  - Compression wood
  - Hit variability
- 3 sets of 3 hits, in each of 2-4 locations around stem
- High productivity (>60 sample sets/hour)
- Correlation between standing tree and log velocity improves as sample intensity increases

STANDS

- More extensive sampling procedure to match need
- Stand average measure
- Link sampling to pre-harvest assessment
- Cover the stand – plots of 5+ trees
- Cover diameter range
- Variability between trees is greater than within tree
- Sample as many trees as possible in least time
- 1 set of 3 hits/tree on 35+ trees/stand
- Productivity dependent upon terrain and vegetation

LOCATION/S ON TREE	TAPS	R^2
Upper side	3	0.44
Upper side	3	0.48
Upper side	3	0.43
Upper side (A)	9	0.50
Upper side (B)	9	0.45
Random side (D)	9	0.60
Mean A+B	18	0.61
Mean A+D	18	0.62
Mean A+B+D	27	0.67

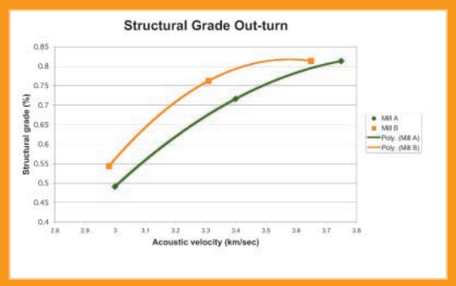


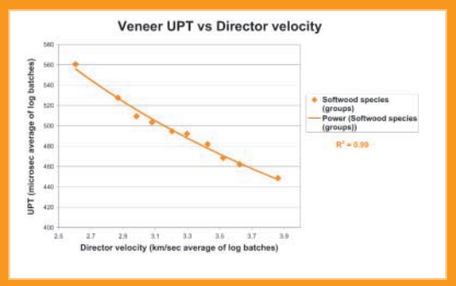
- Correlation with log measures good
- Absolute conversion varies with velocity

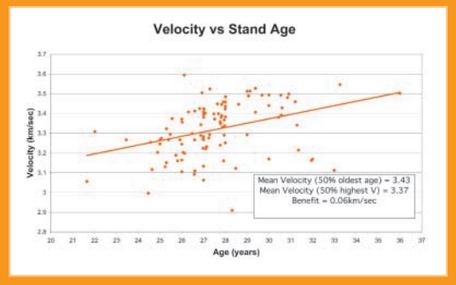
Results

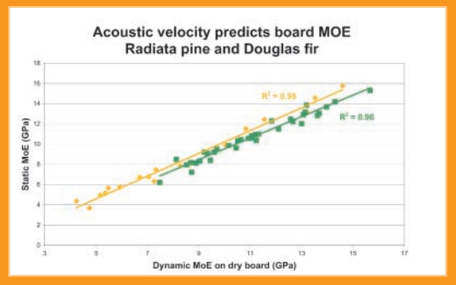
PROCESSING

- Many trials undertaken in NZ, Australia and North America
- Tools predict stiffness (MoE) across all species tested
- Increased MoE improves grade out-turn, plus MSR and LVL veneer yields
- Acoustic velocity increases with increasing age

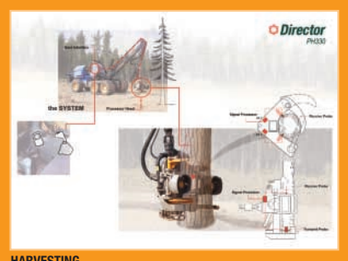









STANDING TREE



HARVESTING


LOGS


LOG DECK

GREENCHAIN


GREENCHAIN

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