Loading Rates and Compaction Factors for Woodchip Vessels Visiting Australian Ports

Glen Murphy, Mauricio Acuna, Michael Berry, Rick Mitchell
Introduction

- Forest and Wood Products Australia funded USC to investigate opportunities for improving the economics of log and woodchip export supply chains

- Australia is the world’s 4th largest exporter of woodchips

- Approximately 60% of the cost of sales of woodchips to Asian markets is accounted for by shipping and port costs

- Past studies have found that terminal loading/unloading rates and the amount of material that can be loaded are two of the four most decisive factors affecting shipping costs
Research Methods

- Interviews with woodchip exporting companies
- Literature and internet review
- Analysis of detailed ship loading data provided by one company.
  - Data gathered over a 17 year period
  - Over 500 observations on loading rates and compaction factors
  - Different loading and compaction methods tried over this period
Woodchip Handling Methods

Grab bucket for loading and unloading of woodchip vessels
Woodchip Handling Methods

Mobile woodchip conveyors
Woodchip Handling Methods

Woodchip storage areas, reclaim units, and fixed conveyor systems
Woodchip Handling Methods

Gravity feed with chip distribution by dozers
Woodchip Handling Methods

Jet slinger (aka Chip flinger) distribution of chips within a vessel’s hold
Woodchip Handling Methods

Jet slinger with deflector plate used to distribute and compact wood chips
Woodchip Handling Methods

Gravity fed chips are loosely aligned (top left). Jet slingers with deflector plates are claimed to better align chips (bottom left) resulting in better compaction rates.
Definitions

Maximum Design Loading Rate

Net Loading Rate  (includes some loading delays)  ~ 85% of Max

Gross Loading Rate  (includes all delays)  ~ 70% of Net
Results: Interviews – Loading Rates

Woodchip Vessel Loading Rates (including all delays)

A to H = Australian ports, I = New Zealand, J to K = South Africa, L = Uruguay, M = Finland (barge loading only)

Delays often account for 40% of loading time
Results: Analyses – Loading Rates

Net loading rates (gmt per hour)

Conveyor Rates (gmt per hour)

Good

- Euc_Jet Slinger
- Euc_With Deflector Plate
- Euc_With Dozer
- Pine_Jet Slinger
Definitions

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\text{Stowage Factor} = \frac{\text{Available Space}}{\text{Green Metric Tonnes}}
\]

\[
\text{Compaction Factor} = \frac{\text{Available Space}}{\text{Bone Dry Metric Tonnes}}
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Each 1% improvement in compaction is worth US$20,000 to US$35,000 in additional income per vessel for the exporter.
Results: Interviews – Compaction Factors

Woodchip Vessel Compaction Factors

N to T = Australian ports, U = New Zealand, V = Brazil, W = Indonesia
Results: Analyses – Compaction Factors

![Graph showing compaction factors vs. conveyor rates for different methods: Euc_Jet Slinger, Euc_With Deflector Plate, Euc_With Dozer, and Pine_Jet Slinger. The graph indicates good results.]
Improving Compaction: Other Research

Zamora and Sessions 2016

- Bar chart showing comparisons between different loading methods (Blower and Chip-Flinger) for dry bulk density (lb/ft³) under two conditions: Conveyor-fed and Force-speed loading.

- Data source: Zamora and Sessions 2016
Improving Compaction: Other Research

Jet slinger speed

Zamora and Sessions 2016
Conclusions

- Maximising net returns can result in a trade-off between loading rates and compaction factors.
- Maximum load rates ranged between 670 and 1200 gmt/hr.
- Load rates were highly variable and affected by:
  - shore-to-ship delivery systems
  - conveyor rates
  - species being loaded
  - use of deflection plates on jet slingers
  - use of dozers in the hold to redistribute chips
Conclusions

- Compaction factors ranged between 3.90 and 5.75 m³/bdmt

- Compaction factors were affected by
  - species being loaded
  - use of deflector plates on jet slingers
  - use of dozers in the hold to redistribute chips
  - order in which holds were loaded
  - loading pattern
  - loader operator skill
Contact

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