Influence of size during thermal modification on process and resulting wood properties - comparison of industrial and laboratory treatment

Björn Källander
Stora Enso Industrial Components
Luleå Technical University - Wood Science and Engineering
Size matters???

• Does the **size of the material** treated have significant impact?
  - on the process?
  - on resulting material properties?

• How does the **size of the kiln and batch** influence?
  - compare laboratory treatment with industrial production
Industrial and laboratory treatment

• Industrial treatment together with normal production
  - Tests done in six Thermowood kilns in Finland, Latvia and Sweden

• Laboratory treatment in autoclave with X-ray CT-scanner at LTU in Sweden

Stack: 19m x 3.6m x 3.6m.

Stack: 1.2m x 0.2m x 0.2m.
Paired samples

Density and initial MC

25 planks / batch

Density and initial MC
Treatment schedules
- laboratory schedules designed to copy industrial
If we live in an ideal world

- Possible size effects will be determined
  - paired samples treated in same batches

- Laboratory treatment and industrial shall give same results
  - "almost identical" schedules
Internal wood temperature-
small samples quickly adapt to surrounding climate

Temperature (°C)

Process time

- Steam
- 10 mm sample
- 8 mm
- 16 mm
- 26 mm (core)
Exothermal reactions lead to higher internal temperatures - effect not seen in 10 mm clear wood samples
Large samples show higher reduction in EMC - similar pattern in Pine and Spruce

- Pine 50x150
- Spruce 42x98
- Pine 50x100

100 samples from same treatment, not paired to others
Mass loss lower in large samples
- opposite trend to EMC reduction
Sample size has principally different influence on EMC and mass loss
Position in cross section of the plank

- Impact
- Bending strength
- EMC
EMC and impact bending strength

EMC reduced more in core of planks

Impact bending strength reduced LESS in the core
Laboratory treatment compared to industrial

![Graph showing mass loss vs. total process time with R² values for both methods.](image-url)
Conclusions

• Size of the material treated has strong influence on process:
  > small samples quickly adapt to surrounding climate
  > exothermal reactions lead to higher internal temperature in full size planks

• The size of the material treated has strong influence on the resulting wood properties:
  > Small samples show lower reduction of EMC than large samples.
  > Small samples show higher mass loss than large samples.

• Size influence principally different on EMC and strength

• Difficult to transfer laboratory results to industrial processes
  > Treatment in laboratory led to higher mass loss than industrial treatment
  > Size effects make it difficult to compensate.