PFI ANNUAL CONFERENCE

The Omni Grove Park Inn – Asheville, North Carolina

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Pellet Durability Index: What Does it Really Measure?

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3.1.3 *Pellet Durability Index (PDI)* – a standardized parameter for specifying the ability of the fuel pellets to resist degradation caused by shipping and handling.

Kansas State University - *Mechanical Durability of Feed Pellets, Call Number*: LD2668 .T4 1962 Y68

ASAE S269.4: Cubes, Pellets, and Crumbles--Definitions and Methods for Determining Density, Durability, and Moisture Content.
Outline of Procedure

1. Pellet sample (~1100 grams)
2. Screen sample, remove fines; weigh
3. Tumble 500 gram sample for 500 rotations at 50±2 RPM
4. Rescreen sample, remove fines, reweigh
5. Repeat with another 500 gram sample
6. Calculate PDI

\[
PDI = \frac{\text{Final Pellet Weight}}{\text{Initial Pellet Weight}} \times 100\]
Methods

Common tumble box

Pneumatic, small sample- O NORM M 7135

European Tumbler-EN-15012-1
Tests

• Duration of tumbling – is 10 minutes really enough to see anything?

• Effect of moisture content on durability

• Effect of moisture content on pellet strength

• Effect of furnish particle size on durability
Before We Begin:
When Does Fracturing and Breakdown Occur?
Results

Fines Generation vs Tumbling Time
Pellets After 30 Minutes of Tumbling

Softwood 0% MC (d.b.)

Softwood 13% MC (d.b.)
Pure Softwood

Mass Lost As Fines After Durability Test

<table>
<thead>
<tr>
<th>Total Percent of Original Mass Lost</th>
<th>0% MC (d.b.)</th>
<th>6% MC (d.b.)</th>
<th>13% MC (d.b.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 Minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 0% MC (d.b.):
  - 10 Minutes: 0%
  - 20 Minutes: 2%
  - 30 Minutes: 4%

- 6% MC (d.b.):
  - 10 Minutes: 0%
  - 20 Minutes: 2%
  - 30 Minutes: 4%

- 13% MC (d.b.):
  - 10 Minutes: 0%
  - 20 Minutes: 2%
  - 30 Minutes: 4%
Pure Hardwood

Mass Lost As Fines After Durability Test

Total Percent of Original Mass Lost

<table>
<thead>
<tr>
<th></th>
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<th>6% MC (d.b.)</th>
<th>13% MC (d.b.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Minutes</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>20 Minutes</td>
<td>11%</td>
<td>21%</td>
<td>31%</td>
</tr>
<tr>
<td>30 Minutes</td>
<td>12%</td>
<td>22%</td>
<td>32%</td>
</tr>
</tbody>
</table>

Legend:
- Blue: 10 Minutes
- Red: 20 Minutes
- Green: 30 Minutes
Mixed Hardwood/Softwood Blend

Mass Lost As Fines After Durability Test

Total Percent of Original Mass Lost

- 0% MC (d.b.)
- 6% MC (d.b.)
- 13% MC (d.b.)

0.00% - 12.00%

10 Minutes
20 Minutes
30 Minutes

- 10 Minutes
- 20 Minutes
- 30 Minutes
Results – Mean Length Change
**Softwood**

![Chart showing mean length (mm) for different moisture contents (MC) before and after 30 minutes of tumbling.](chart.png)

- **0% MC**
- **6% MC**
- **13% MC**

- **Before Tumbling**
- **After 30 Minutes Tumbling**
Hardwood

Mean Length (mm)

<table>
<thead>
<tr>
<th>Moisture Content</th>
<th>Before Tumbling</th>
<th>After 30 Minutes Tumbling</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% MC</td>
<td>12.00</td>
<td>10.00</td>
</tr>
<tr>
<td>6% MC</td>
<td>11.00</td>
<td>9.00</td>
</tr>
<tr>
<td>13% MC</td>
<td>10.50</td>
<td>8.50</td>
</tr>
</tbody>
</table>
Softwood/Hardwood Blend

Mean Length (mm)

- Before Tumbling
- After 30 Minutes Tumbling

0% MC
6% MC
13% MC
Length Distribution After Tumbling

**Before Tumbling**

**After 10 Minutes**

**After 20 Minutes**

**After 30 Minutes**

Softwood/Hardwood Blend, 13% MC (d.b.)
Compressive Strength Tests
Instron Compressive Strength Tests
Results - Compressive Strength Test

Stress (lbf)

- 0% MC (d.b.)
- 6% MC (d.b.)
- 13% MC (d.b.)

Softwood  |  Hardware  |  Blend
What About Particle Size?

![Bar chart showing particle size distribution](chart.png)
Conclusions
Conclusions

• Pellet samples of 13% MC (d.b.) show a significant decrease in durability and strength

• Pellet samples of 0% and 6% MC (d.b.) do not show a significant decrease in mean length after 30 minutes in the tumble test

• Pellet furnish size may be important
Adding water or pre-steaming

- Increases durability
- Decreases energy consumption
- Increases die life
Acknowledgements

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Thank You.