Quality Evaluation Methods for DDGS

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Reality or Fiction??

Photo credit: National Corn to Ethanol Center
Ethanol Plant Flat Bottom Storage

Photo credit Lee Johnston
University of Minnesota
Feed Mill Flat Bottom Storage Option

Flat Bottom Storage

Floor Drags & Front End Loaders
Unloading Rail Cars of DDGS requires:

- Time
- Employees
- Equipment
DDGS Variability

- Ethanol plant design
  - Old generation
  - New generation

- Processing method
  - Production rate
  - Drying capacity
  - Weather (humidity, temperature)

- Storage capacity
  - Solubles
  - Distillers grains
Physical Methods of Evaluation

- Flowability measurements
- Bulk density
- Angle of repose
- Particle size
- Coefficient of friction
Ingredient Flow Evaluation

Manufactured by:
Hanson Research
ACuPowder International, LLC is the Exclusive Sales Agent to the Metal Powder Industry.
Funnels with different size openings measures the flow characteristics of different ingredients.
Ingredient Bulk Density

Cereal Grains – Quart Method
Ingredient Bulk Density

- Loose Pack Density
- Vibrated Density
- Compacted Density
Loose Density Measurement

Carefully screen off top to level material to box top level
Vibrated Density Measurement

- Tap box gently on each side in sequence making circle around box.

Courtesy of Fred Fairchild
Kansas State University
Compacted Density Measurement

- Place spacer blocks on top of board in box to clear top edge of density box.
- Place board on top of the blocks and stack the appropriate weight on top of board.

Courtesy of Fred Fairchild
Kansas State University
# Bulk Density Measurements

<table>
<thead>
<tr>
<th>Material</th>
<th>Moisture %</th>
<th>Loose Density lbs/ft³</th>
<th>Vibrated Density lbs/ft³</th>
<th>Compacted Density lbs/ft³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Corn</td>
<td>12.70</td>
<td>49.45</td>
<td>52.75</td>
<td>53.34</td>
</tr>
<tr>
<td>Ground Corn</td>
<td>12.70</td>
<td>39.00</td>
<td>48.00</td>
<td>48.00</td>
</tr>
<tr>
<td>SBM</td>
<td>12.20</td>
<td>47.95</td>
<td>48.25</td>
<td>48.56</td>
</tr>
</tbody>
</table>

Fairchild (2005)
Angle of Repose
Drain Angle of Repose

Photo credit Lee Johnston
University of Minnesota
Drain Angle of Repose

Johnston et al., 2007

ab (P < .05)

9% MC  11.6% MC

57.7\textsuperscript{a}  65.7\textsuperscript{a}

64.6\textsuperscript{b}  67.6\textsuperscript{a}
Particle Size

- ASAE method
  - DGW
  - SGW
- Short stack
- Selected Screens
- Over/Thru
Particle size and density of DDGS.

<table>
<thead>
<tr>
<th></th>
<th>Particle Size, dgw (μm)</th>
<th>Density lbs/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1282</td>
<td>36</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>305</td>
<td>2.79</td>
</tr>
<tr>
<td>Range</td>
<td>612 - 2125</td>
<td>30.8 – 39.3</td>
</tr>
</tbody>
</table>

Knott et al. (2004)
Take Home Message

- Develop ingredient specification sheets
  - Moisture (analysis method)
  - Density (analysis method)
  - Particle size (analysis method)
- Minimize the number of supplier plants
- Conduct ethanol plant visits
- Communicate with supplier, logistics, and nutritionist