PROCESSING OF DDGS INTO LIVESTOCK FEEDS

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Manufacturing Cost vs. Least Cost Formulation

10% Savings = $1.00

DDGS Formula Savings

Cost
- Labor
- Facilities
- Energy
- Supplies

Kansas State University | Department of Grain Science and Industry
DDGs Process Variation

• Plant design
  – Proprietary processes
  – Commodity DDGS
  – Low fat DDGS

• Processing parameters
  – Production rate
  – Drying capacity
  – Weather (humidity, temperature)
  – Storage capacity
## DDGs Variability

<table>
<thead>
<tr>
<th></th>
<th>Plant 1</th>
<th>Plant 2</th>
<th>Plant 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>8.0</td>
<td>8.3</td>
<td>9.3</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>26.0</td>
<td>29.9</td>
<td>29.0</td>
</tr>
<tr>
<td>Fiber (%)</td>
<td>15.0</td>
<td>7.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>5.5</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>Bulk Density (lb/ft³)</td>
<td>33.8 – 35.6</td>
<td>29.0 – 29.3</td>
<td>27.4 – 27.8</td>
</tr>
<tr>
<td>Packed Bulk Density(lb/ft³)</td>
<td>38.8 – 40.5</td>
<td>32.7 – 33.8</td>
<td>29.7 – 31.1</td>
</tr>
<tr>
<td>Angle of Repose</td>
<td>40.5 – 45.5</td>
<td>39.5 – 43.5</td>
<td>40.0 – 43.0</td>
</tr>
</tbody>
</table>

Adapted Rosentrater, 2012
Feed Manufacturing Flow

Receiving

- Soft Stock Additives
  - Storage
  - Grinding
    - Batching/Mixing
      - Pelleting/Other Processes
        - Cooling
          - Crumbling
            - Bulk/Bag Load Out
  - Cereal Grains
    - Steam Flaking
      - Pelleting/Other Processes

Bulk/Bag Load Out
Receiving Process

Sampling

Truck Receiving Pit

QC Checks

Rail Receiving Pit
Truck Receiving

http://www.bulkequipment.com/
http://www.haletrailer.com/
DDGS Railcar Shipments

• Unloading rail cars requires greater effort requires:
  – Time
  – Employees
  – Equipment
Unloading Solutions

http://www.brandt.ca/

http://pneumat.com/hopperpopper/
Feed Mill Flat Bottom Storage

Flat Bottom Storage

Floor Drags & Front End Loaders
### Bin Allocation Above Batching Scale

<table>
<thead>
<tr>
<th>Ground Corn</th>
<th>Ground Corn</th>
<th>Ground Corn</th>
<th>Coarse Corn</th>
<th>Limestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat Midds</td>
<td>Wheat Midds</td>
<td>DDGS</td>
<td>DDGS</td>
<td>Salt</td>
</tr>
<tr>
<td>SBM</td>
<td>SBM</td>
<td>DDGS</td>
<td>Spare</td>
<td>Phosphate</td>
</tr>
<tr>
<td>SBM</td>
<td>SBM</td>
<td>DDGS</td>
<td>Spare</td>
<td>Lysine</td>
</tr>
</tbody>
</table>
## Swine Finisher Diet

<table>
<thead>
<tr>
<th></th>
<th>Corn-Soy-30% DDGS</th>
<th>Corn-Soy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs/ton</td>
<td>lbs/batch</td>
</tr>
<tr>
<td>Corn</td>
<td>1,325</td>
<td>10,600</td>
</tr>
<tr>
<td>SBM</td>
<td>26</td>
<td>208</td>
</tr>
<tr>
<td>DDGS</td>
<td>600</td>
<td>4,800</td>
</tr>
<tr>
<td>Daily Use</td>
<td>300 T (12 trucks)</td>
<td></td>
</tr>
</tbody>
</table>

Assume 1000 ton/day of complete feed
Batching Process

Major Scale:
Computer draws multiple bins to the major scale.

Micro Scale
Computer switches to one bin and jogs at the end of the each ingredient.

Major Ingredients
- Corn
- SBM
- Midds
- DDGS
Automation Control System
Screw Conveyors

Long Hopper Transition

Multiple Screw Conveyors

Single Screw Conveyors
Screw conveyors transfer ingredients from the bins to the scale.

Air gates open and close to add material to the scale.
Ingredient Batching Scales
Mixer Sizes

Hayes & Stolz Single Shaft Carbon Steel Mixers

200 CF Mixer

Feed (lbs/cft)
- 35 - 7000 lbs
- 40 - 8000 lbs
- 45 - 9000 lbs
Effect of Die Size and Material Hole Count

11/32 Vs 12/32 Hole Counts

- **7932-11**
  - 4.5mm CP x 3.25” x 1.75” SPSTGSPTRVR C+
  - Total Holes = 16,896
  - 4.5mm CP x 3.25” x 1.50” SPSTGSPTRVR Blue
  - Total Holes = 18,304
  - 4.5mm CP x 3.25” x 1.563” SPSTGSPTRVR C+
  - Total Holes = 17,280

- **7932-12**
  - 4.5mm CP x 3.25” x 1.75” SPSTGSPTRVR C+
  - Total Holes = 19,584
  - 4.5mm CP x 3.25” x 1.50” SPSTGSPTRVR Blue
  - Total Holes = 21,216
  - 4.5mm CP x 3.25” x 1.563” SPSTGSPTRVR C+
  - Total Holes = 19,968

1106 Sq Inches of Die Face
1251 Sq Inches of Die Face

Shockley, 2013
Pellet Coolers

- Types
  - Horizontal Coolers
    - Single Pass
    - Double Pass
  - Counter-flow Cooler
    - Round design
    - Square design
Factors that Affect Pellet Quality

- Die: 43%
- Formulation: 23%
- Conditioning: 33%
- Grinding: 0.5%
- Feed Rate: 0.5%

Behnke, 1994

- Drying / Cooling: 5%
- Die: 15%
- Conditioning: 20%
- Formulation: 40%
- Grinding: 20%

Fahrenholz, 2012
Effect of DDGs on Pelleting

Production Rate

P < 0.05

Production Rate (lbs/hr)

- Control
- 10% DDGS
- 20% DDGS
- 30% DDGS

Fahrenholz, 2013
Effect of DDGs on Density

Production Rate

P < 0.05

Mash Bulk Density
- Control
- 10% DDGS
- 20% DDGS
- 30% DDGS

Pellet Bulk Density
- Control
- 10% DDGS
- 20% DDGS
- 30% DDGS

Fahrenholz, 2013
Effect of DDGs on Pelleting

Electrical Energy Usage

<table>
<thead>
<tr>
<th>kWh/ton</th>
<th>Control</th>
<th>10% DDGS</th>
<th>20% DDGS</th>
<th>30% DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

$P > 0.05$

Fahrenholz, 2013
Impact of DDGS on PDI

Slide provided by Wilmer Pacheo

A, B P < 0.01
DDGS – Pellet Quality

745 µm DDGS

482 µm DDGS

Slide provided by Wilmer Pacheo

A, B, C $P < 0.01$
Bulk Truck Loading Systems

Shuttle Conveyor

Weigh Lorry
• Feed manufacturers manage a wide variety of ingredients and small changes the inclusion amount, in-bound quality, and processing environment can significantly change mill operations and efficiency.

• Educate your buyers about the ethanol manufacturing process.

• Consistency of raw ingredients is the key to the efficient operation of a feed mill.