NC STATE UNIVERSITY

Quality Evaluation Methods for DDGS

Charles Stark
Feed Science and Management
Department of Poultry Science
North Carolina State University

COLLEGE OF
AGRICULTURE & LIFE SCIENCES
ACADEMICS ▲ RESEARCH ▲ EXTENSION

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

DDGS Railcar Shipments

- Unloading Rail Cars of DDGS requires:
  - Time
  - Employees
  - Equipment

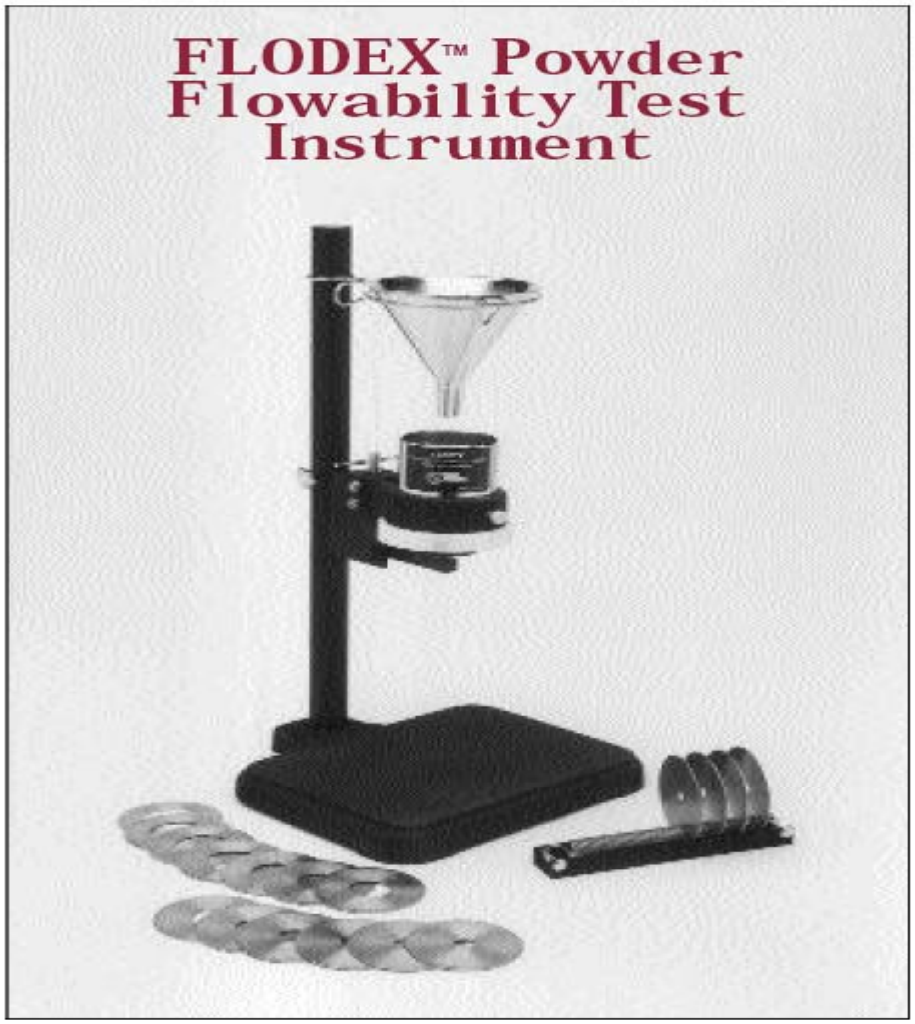
DDGS Variability

- 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

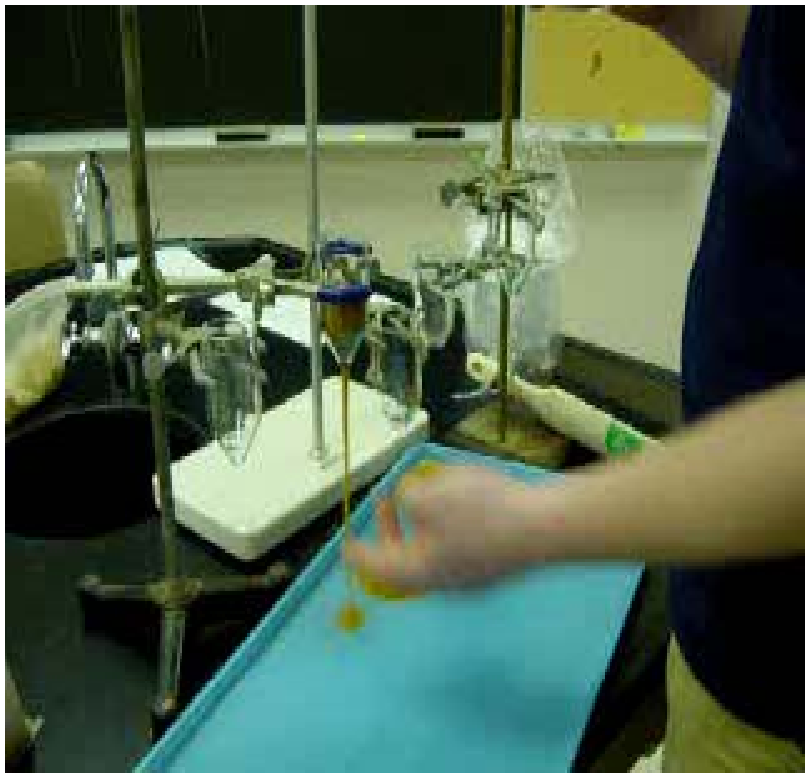


Manufactured by:

Hanson Research

ACuPowder International, LLC is the Exclusive Sales Agent to the Metal Powder Industry.

Ingredient Flow Evaluation



- 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**

Courtesy of Fred Fairchild
Kansas State University

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.**

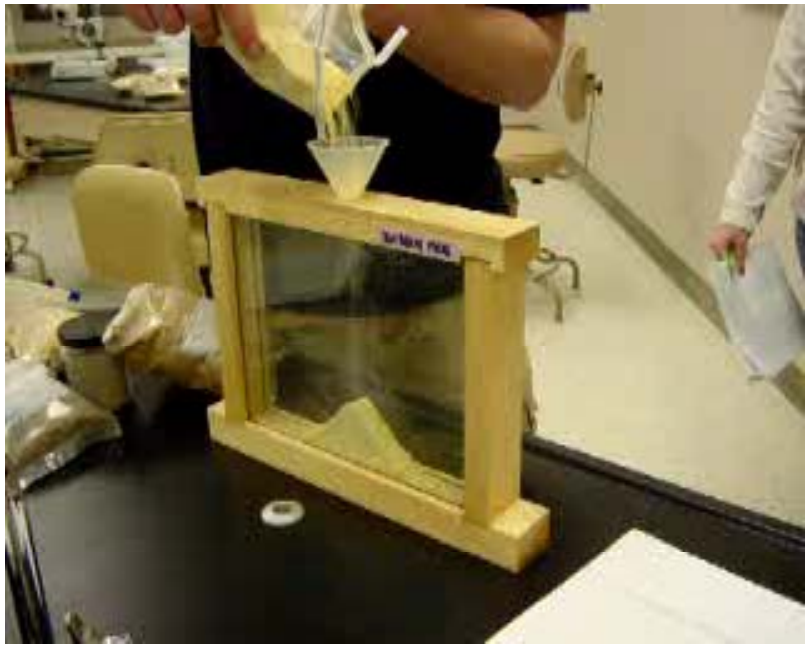
Courtesy of Fred Fairchild
Kansas State University

Bulk Density Measurements

Material	Moisture %	Loose Density lbs/ft^3	Vibrated Density lbs/ft^3	Compacted Density lbs/ft^3
Whole Corn	12.70	49.45	52.75	53.34
Ground Corn	12.70	39.00	48.00	48.00
SBM	12.20	47.95	48.25	48.56

Fairchild (2005)

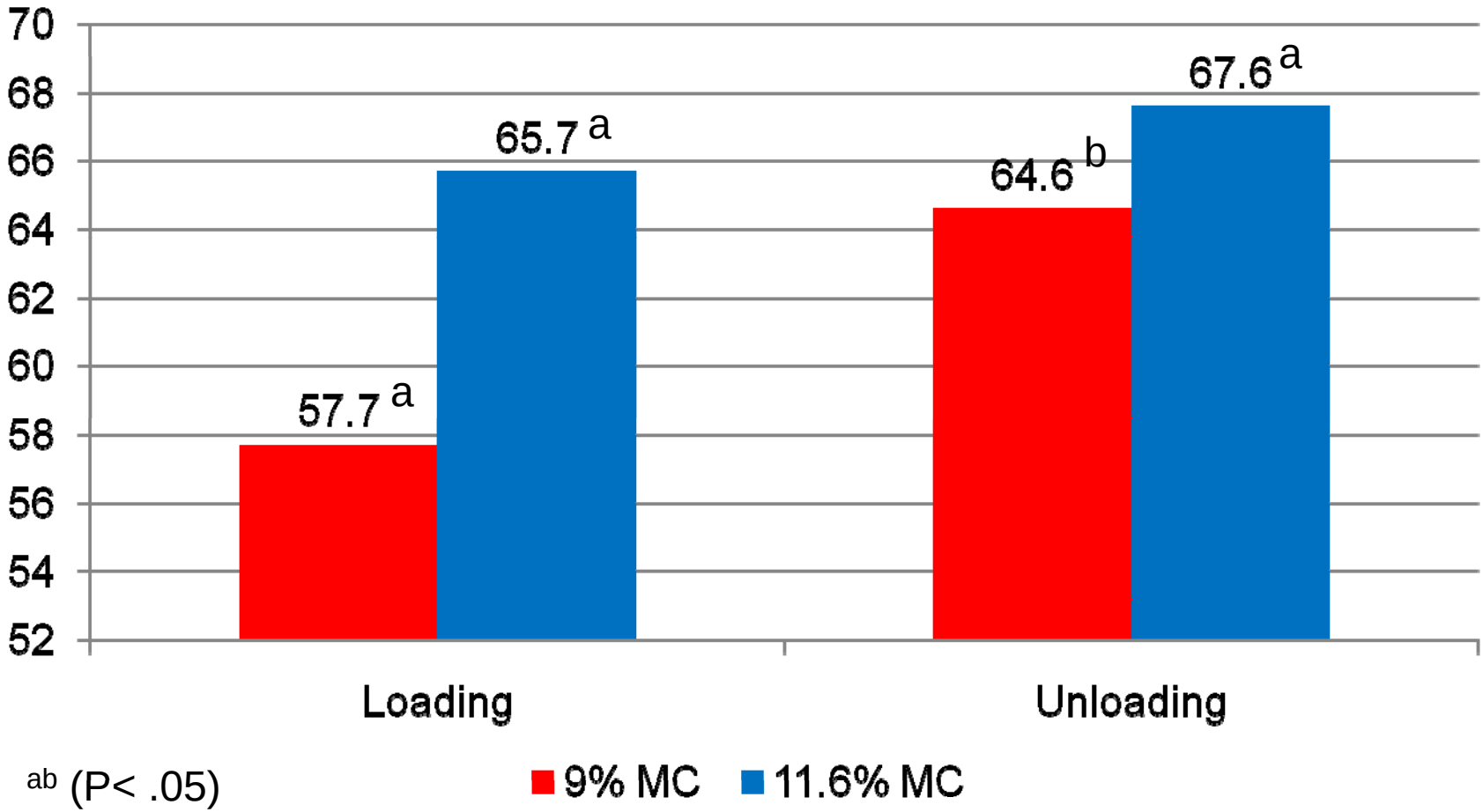
Angle of Repose



Drain Angle of Repose

Photo credit Lee Johnston
University of Minnesota

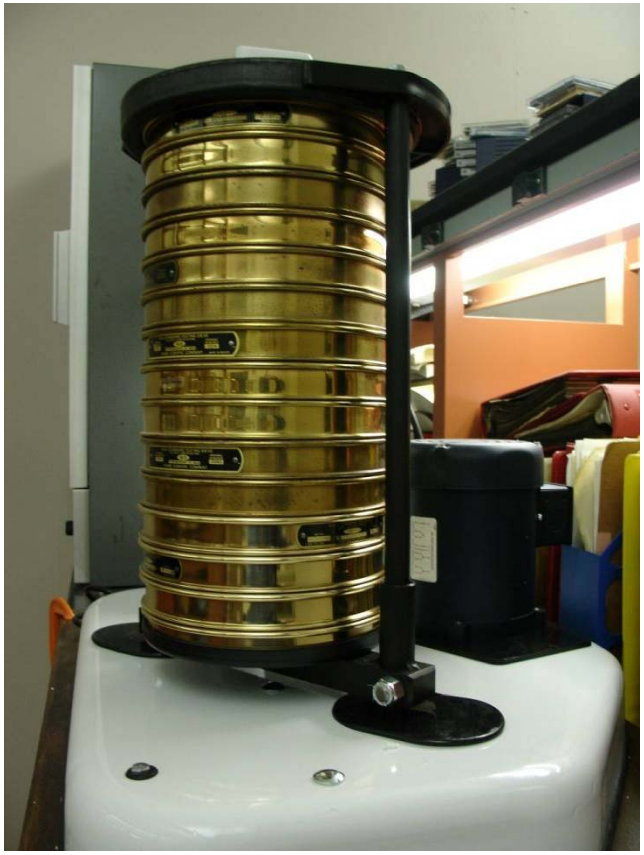
Drain Angle of Repose



[ab] (P< .05)

Johnston et al., 2007

Particle Size



- ASAE method
  - DGW
  - SGW
- Short stack
- Selected Screens
- Over/Thru

Particle size and density of DDGS.

	Particle Size, dgw (µm)	Density lbs/ft^2
Average	1282	36
Standard Deviation	305	2.79
Range	612 - 2125	30.8 – 39.3

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