

## Volume Reduction Technologies for Transporting Poultry Litter

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## What is Poultry Litter...

- Combination of accumulated manure, feather, spilled food and bedding materials, which is typically wood shavings, sawdust, wheat straw, peanut hulls, or rice hulls
- Historically used as fertilizer on croplands near poultry farms - low density
- Environmental issues mostly due to high P levels in soils, ground water and surface water due to prolonged use



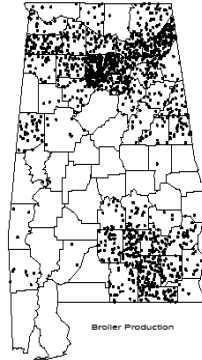
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## Motivation

- More economical and efficient way to transport large amounts of poultry litter.
- On- and Off-Site usage (or Storage).
- Energy production and land application
- Densification improves transportation costs (economics).
- Decrease soil N and P buildup in heavy poultry populated areas.

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## Why Volume Reduction??



- Economics - light density
- Dusty - biosecurity
- Close to 2 million tonnes produced in Alabama annually

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## Volume Reduction In Agroprocessing

	Bulk Density (lb/ft <sup>3</sup> )	Particle Density (lb/ft <sup>3</sup> )	Average size	Examples of material
Raw Material	4	31	-	-
Bales	10	-	96 ft x 48ft	Grass
Cubes	28	54	1.5 in x 1.5 in x 2.5 in	Grass, Wood waste
Pellets	41	68	¼ in x 1 in	All types
Briquettes	50	75	Varying shapes but size typically less than 2 in	Wastes from agro and forestry processing operations



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## Volume Reduction In Agroprocessing

- Pelletting: > 1200 kg/m<sup>3</sup> (75 lb/ft<sup>3</sup>)
- Cubing: 870 kg/m<sup>3</sup> (54 lb/ft<sup>3</sup>)
- Baling: 161 kg/m<sup>3</sup> (10 lb/ft<sup>3</sup>)

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## Objectives

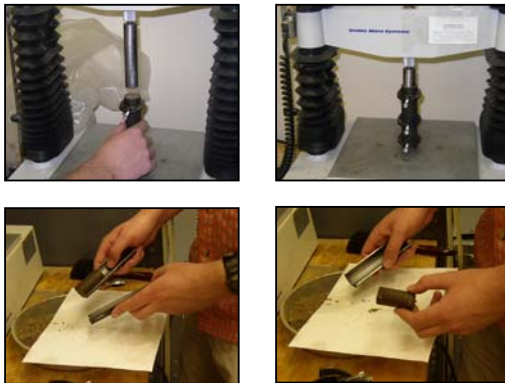
- Determine the effect of moisture content and the minimum pressure required to compact poultry litter.
- Determine the energy requirement to compact poultry litter.

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## Materials And Methods

- Poultry litter (wood shavings as bedding) obtained from poultry farm
- Adjusted to MC's of 16.5%, 24.2%, 26.1% and 29.0%. Initial MC = 21.7%
- Texture analyzer used to produce compacts in a 1" die
- Pressure used varied from 5.1 to 8.5 MPa
- Density of compacts measured 1) directly after test and 2) after 2 months of storage.
- Experimentation in duplicate

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Images of raw and compacted poultry litter

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## Results

- Density values increased with the increase of pressure and moisture content.
  - Water acts as a binder
- Minimum of 5.1 MPa is required
- Minimum of 26% MC (prior to compaction) is required
- Specific Energy of producing compacts is less than pelleting
  - < 4.68 kJ/kg compared to 32 to 80 kJ/kg

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## Specific energy (kJ/kg) required to produce poultry litter compacts.

Applied pressure (MPa)	Moisture content (% w.b.)			
	16.5%	24.2%	26.1%	29.0%
5.1	2.76	2.54	2.61	2.77
6.0	3.41	3.08	3.41	3.09
6.8	3.65	3.39	3.59	3.67
7.7	4.06	3.89	4.25	4.16
8.5	4.62	4.54	4.57	4.68

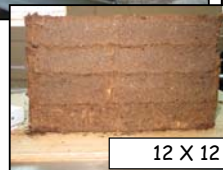
\*Note that specific energy to produce poultry litter pellets varies from 32 to 80 kJ/kg (Colley et al., 2005)

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## Compacts to Blocks



- 200,000 lb capacity hydraulic press
- Pressure: 1.4 MPa



12 X 12 X 8 inch



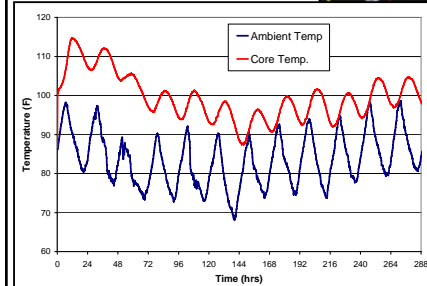
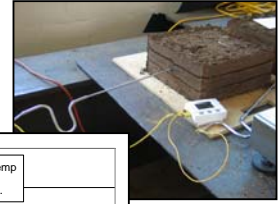
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## What we are learning...

- Must compact to  $> 1000 \text{ kg/m}^3$  (1.4 MPa)
- Must bring MC of litter to between 35-40%.
- Near 2:1 volume reduction
- Internal heating
  - 14 degree C difference during daytime
  - Start seeing differences within 15 minutes

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## Temperature Variation



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## Where we are heading...

- Attempt to increase size of compacted blocks
  - Energy requirements and economics
- Determine any chemical and biological changes in compacted litter
- Match results to possible commercial compaction equipment.

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## QUESTIONS

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