

# Poultry Litter Ash Value for Use in Fertilizers and Feed Supplements

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Project Review

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## Granulated Ash



## Poultry Litter Ash from Combustion



**Granulated Ash**



**Poultry Litter Ash  
from Gasification**

# Equivalent Values

<b>Ash</b>	<b>Poultry Litter</b>
<b>\$/ton</b>	
<b>50</b>	<b>7.50</b>
<b>100</b>	<b>15.00</b>

# PL Ash and Steam Revenues

<b>PL Ash</b>	<b>PL Ash: Steam equivalent</b>	<b>Steam</b>	<b>PL Ash</b>
<b>\$/ton</b>	<b>\$/1000 lb</b>	<b>\$/1000 lb</b>	<b>% of steam</b>
50	1.30	4.50	29
100	2.60	4.50	58

# PL Ash and Electricity Revenues

<b>PL Ash</b>	<b>PL Ash: Electricity equivalent</b>	<b>Electricity</b>	<b>PL Ash</b>
\$/ton	¢/kWh	¢/kWh	% of elect.
50	1.0	7.0	14
100	2.0	7.0	28

# Factors Affecting Realization of Potential Revenue from PL Ash

- Fertilizer vs. mineral feed supplement end use
- Poultry litter management factors
- Phytase enzyme amendment of poultry feed
- Energy conversion factors

# Nutrients of Primary Value

Nutrient	PL Ash	DCP
<b>Fertilizers</b>		
Total P <sub>2</sub> O <sub>5</sub> , %	24.4	
Total K <sub>2</sub> O, %	16.3	
<b>Mineral Feed Supplements</b>		
Total P, %	10.7	18.5
Total Ca, %	12.4	24.1



# Ash Value and Cost Factors

<b>Value Factors</b>	<b>Fertilizers</b>	<b>P Feed Supp.</b>
% of P credited		
w/o further processing	50-70	100
w/ further processing	90-100	N/A
% of K credited	95-100	0
Value-add for low F	no	yes
<b>Cost Factors</b>		
Granulation required	yes	no
Transportation	Med to High	Low

# Granule Inputs and Properties

- $\sim\frac{1}{2}$  PL ash,  $\frac{1}{2}$  phosphoric acid + ammonia
- Final product analysis  $\sim 5 \text{ N} - 40 \text{ P}_2\text{O}_5 - 5 \text{ K}_2\text{O}$ 
  - $\sim\frac{3}{4}$  of  $\text{P}_2\text{O}_5$  water-soluble
  - $\sim\frac{1}{4}$  of  $\text{P}_2\text{O}_5$  citrate-soluble
- Granule hardness  $\geq$  current commercial fertilizers
- Bulk density  $\geq$  current commercial fertilizers







# Fertilizer Ash Value: FOB Energy Plant

		Wholesale price	
		%	
P <sub>2</sub> O <sub>5</sub>	24	4.00	96.00
K <sub>2</sub> O	16	2.00	32.00
Total			128.00
30% discount			38.40
Ash trans.			12.00
Net			77.60

# Fertilizer Ash Value: FOB Energy Plant

		Wholesale price		
		%		\$/20 lb nutrient
P <sub>2</sub> O <sub>5</sub>	12		4.00	48.00
K <sub>2</sub> O	13		2.00	26.00
Total				74.00
30% discount				22.20
Ash trans.				12.00
Net				39.80



# Poultry Litter Ash in Fertilizers: Environmental Considerations

- Trace metals: As, Cd, Co, Hg, Mo, Ni, Pb, Se, Zn  
Cu, Cr
- Trace metals comply with following standards:
  - American Association of Plant Food Control Officials
  - CFR 503 for sewage sludge
  - Canadian Food Inspection Agency
- Dioxins/Furans
  - Very low, mostly below detection limits
  - No national standards

# Ash Value as Mineral P Feed Supplement

	<b>%P<sub>2</sub>O<sub>5</sub></b>	<b>%P</b>	<b>\$/ton</b>
DCP	42.4	18.5	250
PL Ash	24.4	10.7	145
Ash trans.			5
Net			140



# Ash Value as Mineral P Feed Supplement

	<b>%P<sub>2</sub>O<sub>5</sub></b>	<b>%P</b>	<b>\$/ton</b>
DCP	42.4	18.5	200
PL Ash	24.4	10.7	116
Ash trans.			5
Net			111

# Poultry Litter Ash in Feeds: Environmental Considerations

- Dioxins/Furans
  - Very low, mostly below detection limits
  - < WHO standard (1.0 pg TEQ/g mineral supplement)
- No standards for trace metals; trace metals in the ash are of feed origin

# Poultry Litter Management Factors

- Soil contamination during clean out, rototilling poultry litter
  - Dilutes nutrients
  - Silica gel formation: reduced P solubility
- Bedding material: wood vs. rice hulls
  - Rice hulls much higher in silica; affects similar to soil
- Frequency of whole-house cleanout
- Alum (aluminum sulfate) amendment of PL
  - Dilutes nutrients in ash
  - Reduces P solubility in PL; likely more important in fertilizers than feed supplements

# Phytase Enzyme Addition to Poultry Feed

- Enhances availability of P in corn and soybeans to poultry
- Enables reduction of mineral P supplement
- Reduces excretion of manure P=>less P in PL ash

# Energy Conversion Factors

- Unburned carbon: dilutes nutrients
  - Combustion vs. gasification
  - Operating conditions
- Fluidized bed sand contamination: inert, dilutes nutrients (normally minimal dilution)
- High temperatures: silica gel or glass formation
- Dioxin levels in ash, especially fly ash
- Lime ( $\text{CaCO}_3$ ) addition with poultry litter
  - Dilutes P and K; increases Ca concentration
  - Replaces some of lime normally added to feeds
  - May enhance P and K segregation
    - More of P in bottom ash; more of K in fly ash

# Summary

- PL ash is nutrient-rich (~40 units of  $P_2O_5 + K_2O$ )
- Good potential for energy plants to net:
  - \$40 to 80/ton of PL ash used in fertilizers
  - \$80 to 110/ton of PL ash used in mineral feed supplements
- Need to optimize PL management and energy conversion factors to realize these potentials
- With poor management of PL and energy conversion factors, PL ash will have minimal or perhaps even negative net value at energy plants

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