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August 2001

Item: Notes on IG Micromed Environmental Inc Laboratory Testing

Product: Broiler Litter

Review:

Raw broiler waste collected from a single litter (8 week) operation was accumulated and introduced to the KDS Micronex™ for processing with the following criteria:

- Broiler waste had a moisture content of approx. 20% to 24%
- Broiler waste was processed "as is"...no special pre-treatment or drying
- KDS machine was set up with all vents (intake and output) closed
- KDS was set with classifier and airflow at high speeds

Objective: The test was designed to evaluate the pathogen kill at various temperatures of operation as well as determine the moisture reduction capabilities with minimal venting and mechanical moisture removal. Testing was designed to identify base operational values. Additional testing will use results a benchmarks against which further results may be measured.

General results:

- Broiler waste was processed with little or no impediment to throughput noticed
- KDS machine operated with smooth efficiency. Little fluctuations in Htz rates
- Output product met a physical criteria for particle size and moisture (observable)
- Lab results met or exceeded expectations

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These are the revised results of the samples submitted July 30 continued.

Reference No: 45302

Tests Performed:	180° F Processed Chicken Manure	190° F Processed Chicken Manure
Standard Plate Count:	2×10^8	3×10^8
Total Coliforms:	<2	<2
Fecal Coliforms:	<2	<2
Escherichia coli:	Negative	Negative
Salmonella species:	Negative (<3)	Negative (<3)
Percent Moisture	12.5	13.7

All results are for cfu's per gram for 25 grams or for MPN per gram of sample.

*N,P,K testing results to follow for 160° F Processed Manure Sample.

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Microbiologist.

GG/ag

NORWEST LABS

Compost Analysis and Interpretation

- **Recommended Methods Of Analysis**
  - **CCME Metals** are analyzed using the EPA 3051 microwave digest and read on trace ICP.
  - Note: Environmental regulations regarding land application of materials requires this test to be done on finished composted products. Limits have been set on the amounts of each of these trace metals that can be land applied. The CCME metals are sometimes done on the starting materials to give an indication of any potential problems. A rough factor of 2 times the starting material results gives a close approximation of final composted results.

  - **Total and Fecal Coliforms:** The sample is diluted and plated on a selective growth media and the number of colony forming units are counted. The presence of fecal coliforms would indicate animal fecal matter is present.
  - Note: High levels of coliforms will be present in the starting material especially if manure is one of the feedstocks. The high temperatures achieved during composting will reduce the coliforms to lower levels. Excess coliform bacteria could be transmitted to foodstuffs grown for animal use.

  - **Salmonella** is also diluted and grown in selective media for salmonella detection.
  - Note: Salmonella also comes from animal fecal matter. And as with coliforms, they are destroyed by the heat generated during the composting process. This is a disease causing bacteria and is easily transmitted to humans. The presence of any salmonella in the composted material is unacceptable.

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Compost Analysis and Interpretation

- ## Recommended Methods Of Analysis
  - **Soil Paste** analysis can be done on very heavily manured soils. The soil is dried, ground, and a saturated paste is prepared. The paste is then filtered and the solution analyzed for the various nutrient levels. Manual on Soil Sampling and Methods of Analysis, Mckeague, 1978, pp69, 3.2 Soluble Salts
  - Note: Saturated soil paste analysis is the standard method used when looking at the environmental impact of various elements. The saturated paste method will give results for nutrients that are readily soluble in soil/water solution. These soil test results are a good indicator of potential leaching problems for phosphorus, chlorides, and nitrates. The calcium, magnesium and sodium are useful in determining the SAR value in the soil. For fertility status the standard farm soil methods should be used.

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Compost Analysis and Interpretation

- **Interpretation**
  - **Normal Nutrient Ranges** on dry matter basis: Note: The levels will vary significantly according to the starting materials, as well as status of composting.

• Total Nitrogen	1.0 - 2.0	TN	%
• Total Phosphorus	1.0 - 2.0	P_2O_5	%
• Total Potash	1.5 - 3.0	K_2O	%
• Total Sulfur	0.2 - 0.5	TS	%
• Total Sodium	0.5 - 2.0	TNa	%
• Total Calcium	1.0 - 3.0	TCa	%
• Total Magnesium	0.3 - 0.6	TMg	%
• Nitrate/Nitrite	<0.01	NO_3N	%
• Ammonia	0.1 - 0.3	NH_4N	%
• pH	6.5 - 7.5	pH	
• Electrical Conductivity	25 - 50	EC	ms/cm
• Aluminum	0.5 - 1.5	Al	%
• Iron	0.3 - 0.6	Fe	%
• Zinc	100 - 300	Zn	ppm
• Boron	20 - 100	B	ppm
• Manganese	200 - 500	Mn	ppm
• Copper	20 - 50	Cu	ppm
• Molybdenum	5 - 25	Mo	ppm
• Total Carbon	15 - 30	TOC	%
• Organic Matter	25 - 40	OM	%
• Ash	60 - 75	Ash	%
• Sodium Absorption Ratio	<7.0	SAR	
• Mineralizable Nitrogen	100 - 4000	MAS	ppm
• Moisture	25 - 50	Mois	%
• Chloride	0.25 - 0.75	Cl	%
• Carbon/Nitrogen Ratio	< 25:1	C/N	
• Available Carbon	1/4 of TOC	AC	%
• Avail Organic Matter	1/3 of OM	AOM	%
• Available Nitrogen	1/3 of TN	AN	%

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Compost Analysis and Interpretation

- **Agriculture Canada Guidelines**
  - **Salmonella** - must be not detectable
  - **Fecal Coliforms** - less than 1000 cfu/g
  - **Sharp Foreign Objects** - less than 3 mm dimension
  - **Guarantees**
    - Organic Matter - minus 15% of label
    - Moisture - plus 15% of label
  - **CCME Elements** on a dry matter basis

• Arsenic	< 75	ppm
• Cadmium	< 20	ppm
• Chromium	< 1060	ppm
• Cobalt	< 150	ppm
• Copper	< 757	ppm
• Mercury	< 5	ppm
• Molybdenum	< 20	ppm
• Nickel	< 180	ppm
• Lead	< 500	ppm
• Selenium	< 14	ppm
• Zinc	< 1850	ppm

    - The above guidelines are for application rates of 4400 kg/hectare and by reducing rate of application by half, the elements above may be doubled. For the plant nutrients copper, molybdenum and zinc, higher amounts would require labeling as far as the concentrations present.
  - **Maximum Cumulative** addition limits

• Arsenic	15	kg/ha
• Cadmium	4	kg/ha
• Cobalt	30	kg/ha
• Chromium	210	kg/ha
• Copper	150	kg/ha
• Mercury	1	kg/ha
• Molybdenum	4	kg/ha
• Nickel	36	kg/ha
• Lead	100	kg/ha
• Selenium	2.8	kg/ha
• Zinc	370	kg/ha

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Compost Analysis and Interpretation

General Comments

- Temperatures of the compost need to be maintained above 55*C to ensure weed seeds and detrimental micro-organisms are destroyed.
- Frequent turning of compost piles is required to ensure aeration and the introduction of oxygen. The oxygen is needed for the composting process to occur (aerobic process).
- Smaller particle size of the starting material encourages faster composting and ensures a more consistent product.
- The composting process usually reduces the organic matter content by half of the original starting levels.
- Small reductions in organic matter levels and low rates of composting usually indicates a potential problem involving one or more of the following:
  - low oxygen levels
  - sterile starting materials
  - toxic components that reduce microbial activity
  - very high or very low pH
  - low temperature due to pile dimensions or external weather
  - a carbon to nitrogen ratio that is too high
  - high levels of cellulose (ie: wood fibre) that degrade very slowly
  - low levels of nutrients needed for microbial growth
  - too low or too high of a moisture content
  - particle size excessive
- Carbon to nitrogen ratio in a finished compost should be less than 25:1 and preferably around 15:1.
- Organic matter content in a fully composted product should be in the range of 20-40% (dependent on the starting materials).
- Maintaining pH levels at or slightly below neutral will reduce losses of nitrogen to the atmosphere.
- Moisture levels should be between 30-50%.
- High levels of oil or fat will reduce composting rate and usually will require an additional source of nitrogen.
- High organic matter materials will silage under low oxygen levels and composting will not occur (anaerobic conditions).