

# **IBR PROCESS ASSESSMENT FOR TREATING SWINE MANURE**

**September 21, 1998**

## **1. TRIAL REQUEST AND CONCLUSIONS**

On behalf of the Agriculture Research Centre in Agassiz, B.C., International Bio Recovery Corporation (IBR) conducted a documented trial to digest swine manure.

Using the normal IBR process, amended only to compensate for the characteristics of the raw material, swine manure from a Fraser Valley farm was successfully treated and converted into a useful granular end product. During the trial the IBR process accomplished the following:

- produced a final product free of Fecal Coliform and Fecal Streptococci.
- conserved the nutrients in the swine manure.
- produced an organic odorless final product.

## **2. PROCEDURE**

### **A. Process**

On September 11, 1998, 9000 L of swine manure were received at International Bio Recovery. The manure plus 2000 L wash water was transferred to primary digester #1.

A normal digester load, consisting of approximately 30 tonnes of vegetables (75%) and coffee grounds (25%) was added to the swine manure already in our primary digester. 25,000L of filtrate from a previous digestion was added as inoculant during pulping. The thermophilic digesting process was initiated by heating the tank to thermophilic temperatures while aerating with bubble diffusers. Once the tank reached thermophilic temperatures, the steam flow was automatically shut off and the slurry was transferred to our secondary digester. The secondary digester was equipped with a 6 blade Shearator™, with top plate and 3/4 " ports which provided 83 cubic feet per minute (cfm) of air.

After completion of the digestion, the slurry was screened using a 1/4" mesh, and then sent to the press where it was separated into solid cake (40% w/w) and filtrate (2.5% w/w). The cake was then dried to approximately 90% solid content.

## **B. Sampling and Measurement**

Representative grab samples were taken for analyses from the pulp feed; the digestors and the final products. Air flow rate in the Secondary Digester from the Shearator™ was measured by an air flow meter. All samples were analyzed within 3-4 hours. Samples of the final product were also sent to an accredited outside laboratory, Cantest, for analysis and test results. The raw test results obtained from Cantest are attached as an appendix to this report.

## **C. Analysis**

The following analysis has been done using the standard procedures for water and wastewater with some modification for slurry and solid product (These procedures produce results that have been within a maximum of 2% deviation from the results of an accredited outside laboratory, Cantest):

- Total Solids
- Total Volatile Solids
- Total kjeldahl Nitrogen (TKN)
- Phosphorous
- Potassium

As well, Cantest laboratories performed the following analyses of the final product:

- Fecal Coliform and Fecal Streptococci
- Polychlorinated Biphenyls (PCB's)
- Volatile Organic Compounds

## **3. RESULTS AND DISCUSSION**

### **A. Substrate Characteristics (Swine manure)**

Total Solid: 7.6%

Total Kjeldahl Nitrogen (TKN): 8.5%

Phosphorous, P<sub>2</sub>O<sub>5</sub>: 3 %

Potassium, K<sub>2</sub>O: 7.21%

No analysis was done on the vegetable and coffee ground mixture before addition.

## B. Digestion Process

The digestion process proceeded as expected. As shown in Figure 1, the pH and temperature profile were typical for an IBR digestion. Initially, there was a decrease in pH, but after 8 hours the pH began to climb and reached pH 7.5. The temperature rose continuously (except at the 16 hour point, when the slurry was transferred to a cool secondary digester) and reached a maximum of 76<sup>0</sup>C after 64 hours. At this point, the digested product was screened, pressed and dried.

The increase in pH and temperature indicates a successful digestion occurred. During the digestion, there was a 23% reduction in volatile solids<sup>1</sup>. The total solids also decreased, and the total kjeldahl nitrogen increased slightly (see Appendix 1).

Applying swine manure had beneficial effects on the digestion. The raw material mixture was inoculated using filtrate from a previous digestion. However, the swine manure itself contained bacteria which also could have contributed to the digestion. Higher temperatures and shorter processing time were achieved.

## C. Pathogen Analysis

As shown by table 1, tests performed by CanTest laboratories found no detectable Fecal Coliforms or Fecal Streptococci in IBR's final product.

**Table 1** Pathogen Results

<b>CanTest Results</b>	<b>Fecal Coliforms (MPN/100g)</b>	<b>Fecal Streptococci (MPN/100g)</b>
<b>IBR Final Product</b>	below detectable limits	below detectable limits
Detection limits	20	20

MPN = Most Probable Number

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<sup>1</sup> Calculated assuming the weight of the fixed solids in the digested sludge equals the weight of fixed solids in the untreated sludge and the volatile solids are the only solid constituent of the untreated sludge lost during digestion.

#### D. Analysis for Harmful Compounds

As requested by a client, the final product was also tested for the presence of PCB's, and Volatile organic compounds by CanTest Laboratories. PCB's are aromatic compounds containing two benzene nuclei with two or more substituent chlorine atoms. They are toxic and persistent. As shown by table 2, no PCB compounds were detected in the final product.

**Table 2** Polychlorinated Biphenyls

Polychlorinated Biphenyl Compounds	Concentration (ug/g)	Detection limit (ug/g)
Arochlor 1242	<	0.03
Arochlor 1248	<	0.03
Arochlor 1254	<	0.03
Arochlor 1260	<	0.03

< = below detectable limits

Volatile Organic Compounds are organic compounds that have a boiling point of less than 100°C. They are a concern because they can be released to the atmosphere easily and pose a health risk. Out of the 39 compounds analyzed, 35 came back undetectable (see appendix 2). The other 4; ethylbenzene, styrene, toluene, and xylenes were only present at 0.000005%, 0.000003%, 0.000007%, and 0.000026% respectively.

#### E. End Product Characteristics

The digested slurry was screened and sent to the press. The cake was dried to 90% solid content and the filtrate has been collected for further use. The analysis on the solid product and the filtrate is as follows:

	Total Solid (%)	Total Kjeldahl Nitrogen (%N)	Phosphorous (%P <sub>2</sub> O <sub>5</sub> )	Potassium (%K <sub>2</sub> O)	Ammonia (%NH <sub>3</sub> )
Solid Product	89.8	3.2*	1.4*	1.3*	NA
Filtrate	2.5	6.5* 1640 mg/L **	0.45* 113.6 mg/L **	9.54* 2365 mg/L**	3.5* 868 mg/L**

\* Based on dry weight

\*\* Based on wet weight

#### **4. CONCLUSIONS**

According to the data available during the process and on the final product, it is concluded that swine manure can successfully be processed using IBR technology.

Basically the digestion process has accomplished several things:

- produced a final product free of Fecal Coliform and Fecal Streptococci.
- conserved the nutrients in the swine manure.
- produced an organic odorless final product.

## Swine Manure Digestion

Time (h)	Temp (C)	pH	AIR (CFM)	TS (%)	VS (%)	TKN (%)	Notes
0	51	6.77	90				Volume: 46,021L
2.5	56	6.4					
8	65	5.8	90				
16	68	6.02		8	80.9	4	Transferred to PD #4
20	64.2	6.15	82.9				
24	64.9	6.39	109				
40	70.7	7.46	65.4	7.1	76.2	4.18	
44.5	71.2	7.45					
48	71.9	7.47	65.4	7.1	76.4		
64	75.6	7.58	21.8	6.5			
68.5	76	7.55					

## Pulping Data

Load	# of buckets	Swine Manure (%)	Mixed Veggies (%)	Coffee (%)
1	5500L	100		
2	5500L	100		
3	-		75	25
4	-		75	25
5	-		75	25
6	-		75	25
7	Wash out			

## Appendix 2

CanTest Results

End Product: Designated P