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Scoop on Poop

*An Assessment of the Solid-Liquid
Isolation System at MSU Swine Teaching & Research*

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ABSTRACT

The goals of this study were:

- 1) To determine the effectiveness of the manure isolation system, utilized in the MSU Swine Research and Teaching facility.
- 2) To determine the nutrient isolation efficiencies of this system.
- 3) To monitor odorous gas levels in conjunction with the utilization of this system.

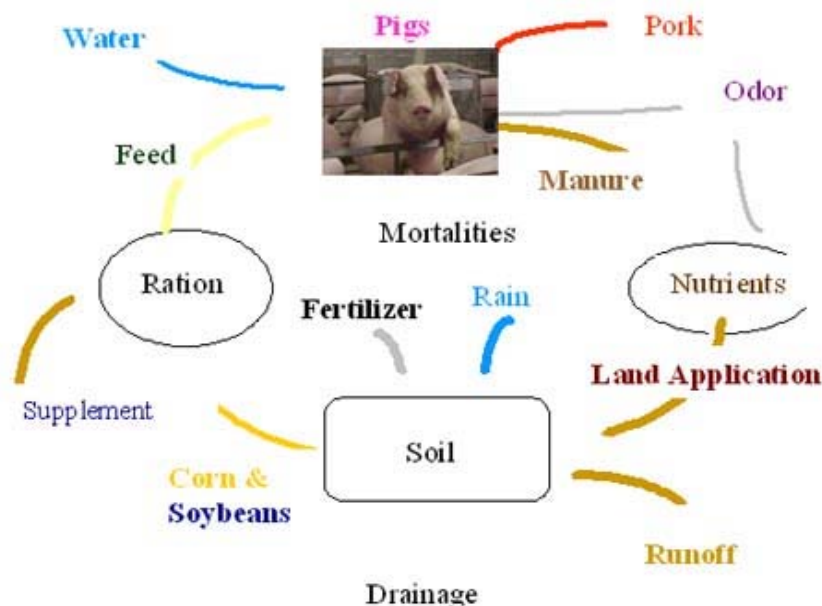


INTRODUCTION

The MSU Swine Research Facility utilizes a unique V-shaped manure isolation system, designed to separate solid and liquid manure. The system's main objective is to reduce moisture and weight in the solids, thus increasing the concentration of nutrients and allowing for more efficient land application of the manure.

However, the true efficiency of this system has not been verified. A study of the Manure system efficiency would better allow P and other nutrients to be optimized throughout the swine production cycle.

The Nutrient Cycle for Swine Production:



Economic efficiency of the Swine Production System can be maximized by

- Reducing moisture in solid manure
- Isolating nutrients in the solid or liquid manure
- Utilizing the manure to return nutrients to the land
- Decreasing the need for synthetic fertilizer.

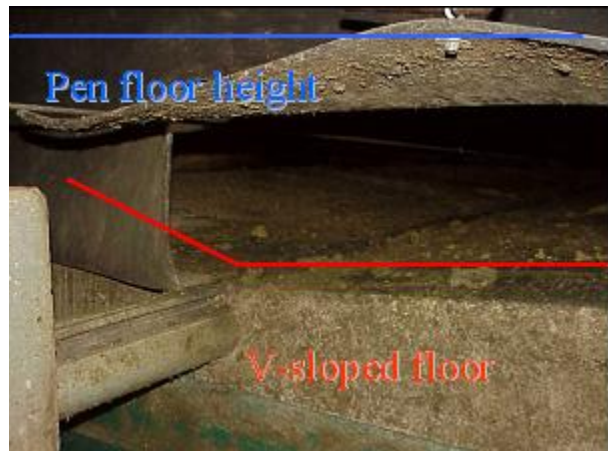
MATERIALS & METHODS

Solid and Liquid collection pans were installed beneath the manure isolation system of 2 rooms of pigs, 144 head each. Following 24 hours of collection, the full pans were weighed (with the liquid first pumped into barrels.) The empty pans and barrels were weighed, giving a net weight of the solid and liquid manure portions.

Representative Solid and Liquid Manure samples were collected weekly from each room. Feed samples were also collected. The samples were commercially analyzed for moisture/solids, macro & micro nutrients, and pH.

NH₃, CO₂, and H₂S levels were monitored on a tri-weekly basis utilizing Dräger tubes at 1.0 m above pen-floor level.

The trial was conducted on a weekly basis, for 15 weeks. Average pig sizes ranged from 40 lbs to approximately 250 lbs during the grow-out period.



A.



B.

A. & B - The Isolation System beneath the slatted pen floors

RESULTS & DISCUSSION

The Solid-Isolation System **effectively isolates liquid from solid**.

Table 1: The Avg. Percentage of Nutrient-Totals Isolated in the Solids

Nutrient	Avg % Isolation	StDev.
Phosphorus (P)	91.0	±3.8
Nitrogen (N) as NH ₄	39.1	±7.2
Potassium (K)	59.7	±4.5
Organic Carbon (C)	91.6	±1.9
Sulfur (S)	63.9	±8.2

Table 1 (above) shows that the majority of P, K, S, and organic C excreted are isolated in the solids. NH₄-N levels are higher in the liquid because the urine-based enzyme urease releases ammonia.

Economic Significance: P, NH₄-N, and K isolation in the manure allows for more efficient land application. Costs for transporting and land applying manure will decrease with the moisture reduction of the solids and more accurate nutrient-to-manure weight calculations. It also decreases the money spent on commercial fertilizer.

Land Application Rates for the manure sampled can be calculated from the nutrient isolations for different crops and limiting soil nutrients. For example,

The Swine manure required for Michigan-grown crops include:

	Feed-grain Corn	Soybean
P limited soil:	3450 kg/ha Solids	2500 kg/ha Solids
K limited soil:	27,000 kg/ha Liquid	12,500 kg/ha Liquid

Table 2: Gas Levels observed in the Rooms

	Threshold	MSU Avg	MSU Range	OSHA T.L.V.
NH3 (ppm)	2.0 **	3.22	0.7**-7.5	25
H2S (ppm)	0.5	undetectable	undetectable	10
CO2 (ppm)	100	835	300-1500	5000

NH3 and H2S were monitored as a numeric representation of odor. CO2 is an indicator of ventilation quality. All three are indicative of air quality.

Social Significance: Odor is a primary concern of swine farmers, and a primary complaint of surrounding neighbors. Odorous gases (e.g. NH3, H2S CH4) form when organic N, S, and C compounds are subjected to anaerobic conditions. The relatively low odorous gas concentrations in this facility (see Table 2) can be attributed to the manure isolation system, as it allows for:

- moisture reduction of the solid manure
- isolation of the fecal nitrogen from urease in the liquid.

CONCLUSION

The Solid-Liquid Isolation System:

- successfully separated the manure into 42±6% solids and 58±6% liquid
- isolated 90% of the P and 60% of the K in the solid manure
- isolated +60% of the NH4-N in the liquid manure

NH3 gas concentrations ranged from below threshold (2ppm) to 7.5 ppm.
H2S gas concentrations were completely undetectable at a threshold of 0.5ppm.