

**Compilation of Interim Test Results
North Carolina State University
Animal Poultry Waste Treatment Center
School of Veterinary Medicine Extension Service
Microbiology Department**

December 1, 2004

This report consolidates interim results of on-going studies being conducted at North Carolina State University (NCSU) by its: Animal and Poultry Waste Treatment Center (APWTC); The School of Veterinary Medicine Extension Service; Microbiology Department. These studies are part of the overall process for assessing and validating the attributes of BioCore™ in remediation water and air problems associated with agricultural (anaerobic) ponds and CAFO operations. All studies are being conducted on working hog farms and/or at NCSU laboratories. The results fall into 4 general categories: Sludge Reduction; Swine Health and Mortality; Descalent Qualities; Pathogen Reduction.

Sludge Reduction: The purpose of these studies is to assess the sludge reducing characteristics of BioCore™. Investigations began in April, 2004 with two anaerobic lagoon case studies: a 3.5 million gallon heavily loaded “continuously flushing” lagoon; a 1 million gallon, lightly loaded, “pull plug” lagoon. Sludge levels and Dissolved Oxygen (D.O.) levels were baseline surveyed and are resurveyed at 30 day intervals. As Chart 1 illustrates, sludge levels dropped by over 58% and at a consistent rate over the first 4 months in the large lagoon with over 1.8 million gallons of sludge volume eliminated. The smaller, lightly loaded lagoon shows a more modest sludge reduction. By month 4, D.O. levels had risen from 0.00 parts per million to a sustained level of 0.23 parts per million.

In month 4, the investigation was expanded to include an additional 6 heavily loaded lagoons (3 treated pull-plug lagoons matched with 3 untreated pull-plug lagoons). Two of the three experimental lagoons have capacities of 3.5 million gallons. The third lagoon has a 1 million gallon capacity. All lagoons were baseline surveyed and re-surveyed at thirty day intervals. As Chart 1 illustrates, after 30 days of treatment, the sludge volumes in each of the larger lagoons was reduced by 125,000 gallons, respectively. Rates of sludge reduction in each of the large treated lagoons is consistent with results demonstrated in the phase 1 “Continuous Flush” lagoon. The small lagoon showed sludge volume reduced by approximately 140,000 gallons.

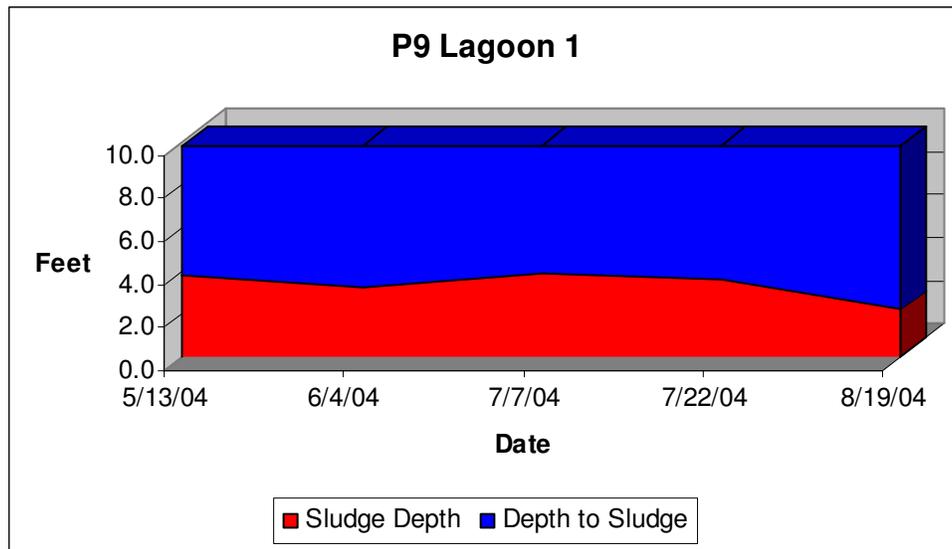
Chart 1: Sludge Reduction Levels in Treated and Untreated Anaerobic Lagoons

Sludge Reduction Study

Lagoon 1

Total Depth = 9.8 ft

Date	Sludge Depth	Depth to Sludge	Sludge Reduction
5/13/04	3.8	6.0	
6/4/04	3.2	6.6	0.6
7/7/04	3.9	5.9	-0.1
7/22/04	3.6	6.2	0.2
8/19/04	2.2	7.6	1.6

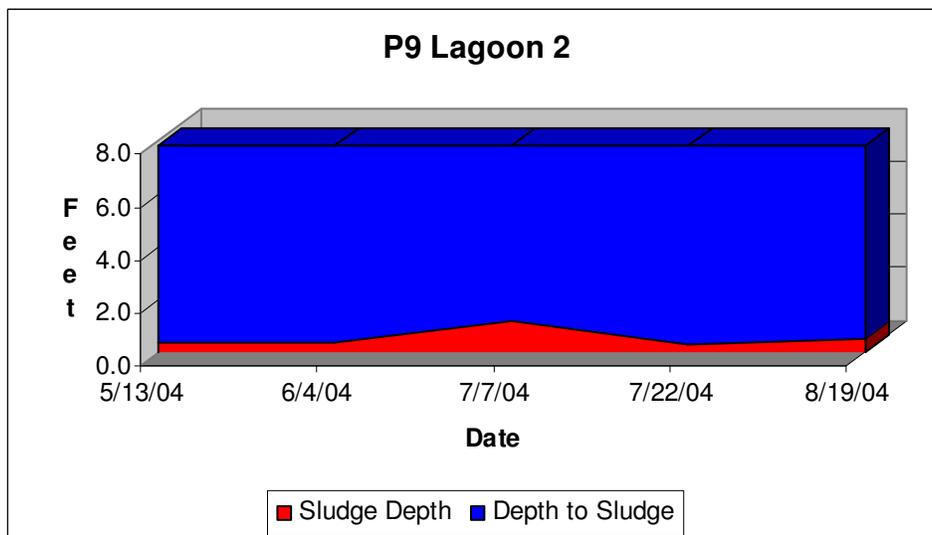


Sludge Reduction Study

Lagoon 2

Total Depth = 7.8 ft

Date	Sludge Depth	Depth to Sludge	Sludge Reduction
5/13/04	0.4	7.4	
6/4/04	0.4	7.4	0.0
7/7/04	1.2	6.6	-0.8
7/22/04	0.3	7.5	0.1
8/19/04	0.5	7.3	-0.1



Of particular interest are the anecdotal comments of farm managers, barn supervisors, and independent farmers associated with the studies, concerning odor reduction. When polled by staff about other effects they might have noticed, many of these experienced personnel commented on the immediate and dramatic reduction in ammonia and hydrogen sulfide odors in the treated barns. Some felt that the hogs were more “settled” in the treated barns.

Airborne Ammonia Reduction Studies: Confirming that BioCore™ surprises/eliminates ammonia gas is a high priority. There is a compelling economic incentive for producers to rid barns of ammonia gas in barns. Even modestly elevated levels of ammonia in hog barns are associated with depressed appetites, respiratory ailments, and increased mortality rates. From a public policy viewpoint, there is increasing evidence that ammonia gas emitted from barns is being absorbed at high levels by receiving waters (streams, rivers, lakes) and has deleterious effects on human health as well. Lastly, there is the overriding issue of odor that permeates the atmosphere surrounding any CAFO operation.

Positive anecdotal evidence gathered in the Sludge Reduction studies concerning ammonia reduction in treated barns has stimulated a second distinct line of investigation to assess the effects of BioCore™ on reducing/eliminating ammonia gas in hog barns. The study involves several thousand hogs being raised in 3 different operations (nursery, farrow, and finish). Each set of barns is matched with an equal and equivalent number of control barns and animals. BioCore™ is being introduced in experimental barns at regular intervals.

Individual barn atmospheres are monitored for levels of ammonia gas. Baseline levels have been taken and are being downloaded at two week intervals. The study is being conducted over two full “turns” (approximately 9 months). Initial results are illustrated in Chart 2. This initial finding is very encouraging for the “winter” season when barns are enclosed and ammonia levels in the untreated barns are expected to rise significantly.

It is hoped that an additional “odor reduction” portion of the study will be introduced in the first quarter of 2005 utilizing panel study techniques to judge odor reduction over a wide geographical area with treated barns at the center.

Chart 2: Ammonia Gas Levels in Treated and Untreated Hog Swine Barns.

Ammonia Level in Air %	Farm B		Farm F		Farm P	
	% of Samples		% of Samples		% of Samples	
	Treated	Control	Treated	Control	Treated	Control
0	95	33	94	89	99	38
3	4	49	2	7	1	20
5	1	9	1	2	0	12

Pathogen Reduction Studies: This line of inquiry is being pursued on three fronts by the NCSU Microbiology Department in conjunction with the APWTC. Initial bench tests begun May, 2004 introduced BioCore™ into a simulated agricultural lagoon environment. Pathogen “families” were microscopically counted prior to treatment and recounted and categorized every 30 days thereafter in both the treated and an untreated control lagoon. Pre treatment baselines showed an equal number (900+) of pathogen families present in both the treatment and control (untreated) lagoons. After 30 days of treatment, new samplings showed a 35%+/- reduction in the number of pathogen families in the BioCore™ treated lagoon with no reduction in the untreated lagoon. Furthermore, the microbial population in the treated lagoon reflected a significantly higher aerobic: anaerobic ratio than the untreated lagoon.

Two new studies were begun in September, 2004. The first of these is a field comparison of pathogen levels in the “Swine Health Study” lagoons. The purpose of this study is to compare and categorize pathogen levels in the treated v. untreated lagoons over time. Results are not expected for at least 60 days.

Perhaps of greater interest is a short term bench study focused on one specific human pathogen and the possible effects BioCore™ might have on suppressing or eliminating it. *Yesinia Enterocolitica* causes gastrointestinal disease and infections in humans. It is common to all hog farms and while hogs are constantly exposed to it and carry this pathogen, they are not infected by it. *Yesinia* is related to a number of other very nasty human pathogens, including salmonella. Should BioCore™ prove effective against *Yesinia*, the implications for expanded agricultural use are significantly broadened. The results of this study are of great interest to microbiologists who are increasingly focused on how to prevent human pathogens carried by non-human hosts (hogs) from entering the human food chain. Results from this study are expected within 60 days.

Descalant Qualities: Anecdotal evidence indicates a strong relationship between introduction of BioCore™ and reduction and elimination of Struvite in irrigation pipes, valves and pumps. Simple bench tests conducted by NCSU have shown positive results in dissolving Struvite in beakers of diluted BioCore™ (100 ppm) with no agitation.