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# A Study of the Effectiveness of BactiDomus™ Technology in the Reduction of Sludge Nutrients in Swine Manure Storage Lagoons

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*Deceased

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**Purpose**

The study was conducted at the request of Nordevco Associates LTD to evaluate the effectiveness of their BactiDomusTM Technology in the reduction of sludge nutrients and sludge levels in swine waste treatment lagoons.

**Site Description**

A swine farm that has been in operation for over 10 years was selected for the evaluation. The facility raises nursery pigs from an average weight of about 15 pounds (6.8 kg.) to an average weight of approximately 60 pounds (27 kg.). The facility is comprised of four production barns and two anaerobic waste treatment lagoons on the same parcel of land (Figure 1). Each barn houses approximately 1,520 pigs. The waste from barns 1 and 2 is flushed to Lagoon 1, while the waste from barns 3 and 4 is flushed to Lagoon 2. Lagoon 1 has a surface area of approximately 0.5 of an acre (0.2 ha.) and was constructed and placed in operation approximately 2 years prior to Lagoon 2, which has a surface area of 0.6 of an acre (0.24 ha.). The slight increase in lagoon size was due to a change in design criteria during the intervening time period.

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**Figure 1.** Aerial View of Swine Facility.


**Methods**

A sludge survey and sludge sampling were conducted one week prior to treating the lagoon and again on the day of treatment but prior to the treatment being applied. On August 25, 2005, 1,100 pounds (500 kg.) of product was broadcast across the entire surface of Lagoon 1. Sludge surveys and sampling were initially conducted every three weeks following this treatment but after three months the sampling and survey frequencies were decreased to enable a longer period of monitoring. Lagoon 2 was untreated and was used as a control.

Sludge surveys were conducted in accordance with North Carolina Department of Natural Resources and North Carolina State University guidelines (Westerman et al.). The sludge survey consists of measuring the total lagoon depth and surface of sludge with a minimum of six measuring points per surface acre of lagoon. The total lagoon depth was determined by measuring the distance from the liquid surface to the lagoon bottom using a calibrated rod. The depth from the liquid surface to the top surface of the sludge was measured with an infrared detector (Markland Sludge Gun). The sludge depth was then calculated as the difference

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between the total depth and the depth to the surface of the sludge. All depth measurements were referenced to a permanent marker on the lagoon embankment.

Three composite samples, comprised of liquid collected from six, evenly spaced locations at 1.5 ft below the water surface were transported to the laboratory for analysis. A core sample of the total lagoon liquid and sludge was also taken at six, evenly distributed locations in the lagoon. The core sample was totally mixed prior to collecting a sub-sample for laboratory analysis. The mass of total Kjeldahl nitrogen (TKN) and total phosphorus (TP) in the lagoon was calculated by multiplying the average concentrations for the 6 core samples by the total lagoon volume (liquid volume plus sludge volume). The average TKN and TP concentrations for the 3 liquid samples were multiplied by the liquid volume in the lagoon to determine the mass of TKN and TP in the lagoon liquid. The mass of TKN and TP in the sludge was then determined as the difference, (i.e. mass in sludge = total mass in lagoon – mass in liquid). The Environmental Analysis Laboratory in the Department of Biological and Agricultural Engineering at North Carolina State University conducted the sample analysis.

**Results**

The difference in initial sludge levels in the two lagoons can be partially explained by the earlier date of construction and start-up for Lagoon 1. The sludge levels in both lagoons experienced unexplained fluctuations over the course of the year although the magnitudes were greater for Lagoon 1 (Figure 2). The sludge depth in Lagoon 1 showed a slight decrease while the sludge level in the untreated lagoon (Lagoon 2) showed a slight increase. In general the upward trend of sludge level for Lagoon 2 is consistent with the sludge accumulation rates reported by many producers that is approximately 2-3 inches per year (5-7.6 cm/yr).

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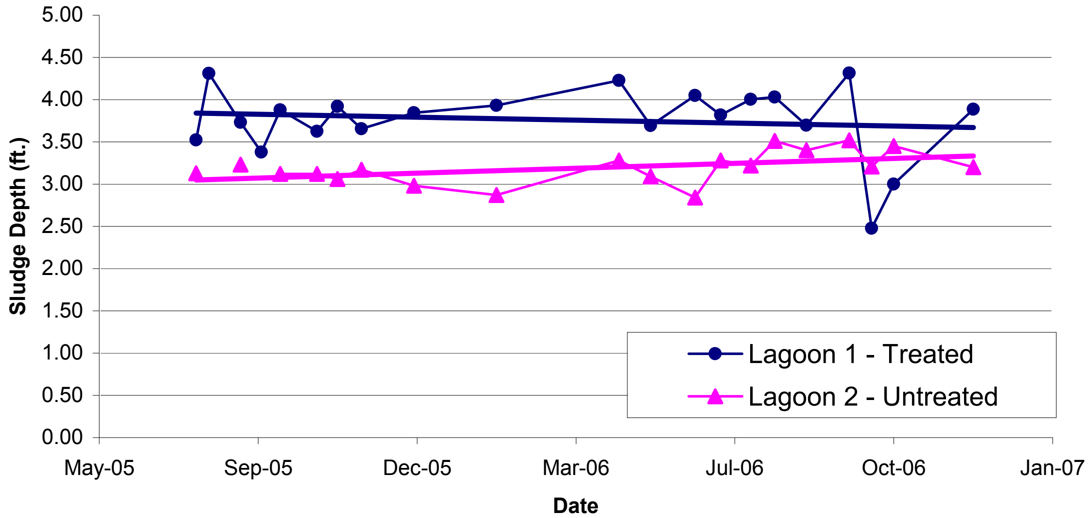
**Figure 2.** Sludge depth over time for both treated (Lagoon 1) and untreated (Lagoon 2) lagoons.




The average TKN and TP concentration of the core samples decreased over the course of the evaluation period (Figure 3). During the same time period there was an increase in the TKN and TP concentration in the liquid samples (Figure 4).

**Figure 3.** Average TKN and TP Concentration for 6 Core Samples from Lagoon 1.

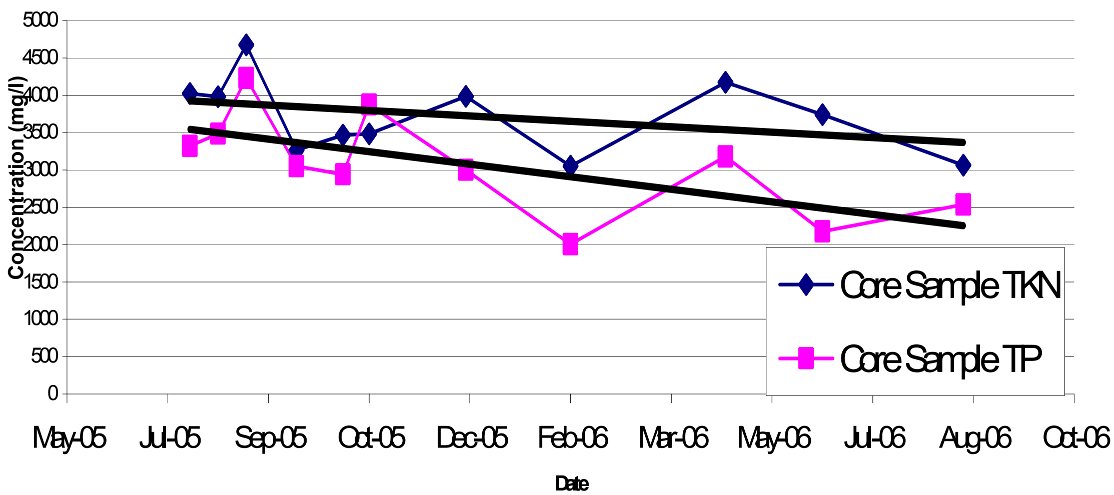


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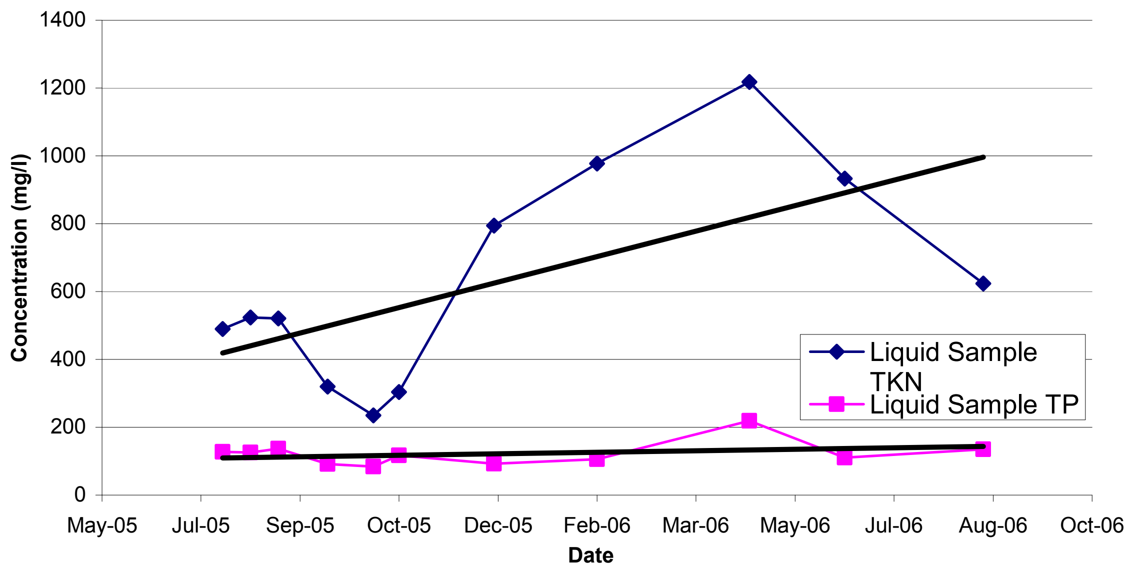
**Figure 4.** Average TKN and TP Concentration of 3 Liquid Samples from Lagoon 1.




When the concentration data are combined with the volume calculations from the sludge survey the increasing mass of TKN in the liquid offsets the decreased mass in the sludge to yield a net increase in the total mass of TKN in Lagoon 1 (Figure 5). The increased mass of TKN is not unexpected since the swine waste input was continued during the study period. On average, an additional 12,650 pounds (5,740 kg) of TKN and 5,271 pounds (2,391 kg) of TP would have been added to the lagoon during the study period. The total mass of TP in Lagoon 1, on the other hand, experienced a net decrease during the study period (Figure 6). A more detailed mass balance that accounts for the continued waste input to the lagoon as well as the land application of the lagoon liquid would insight to better understand the dynamic of the system.

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**Figure 5**. Partitioning of TKN Mass in the Lagoon 1.

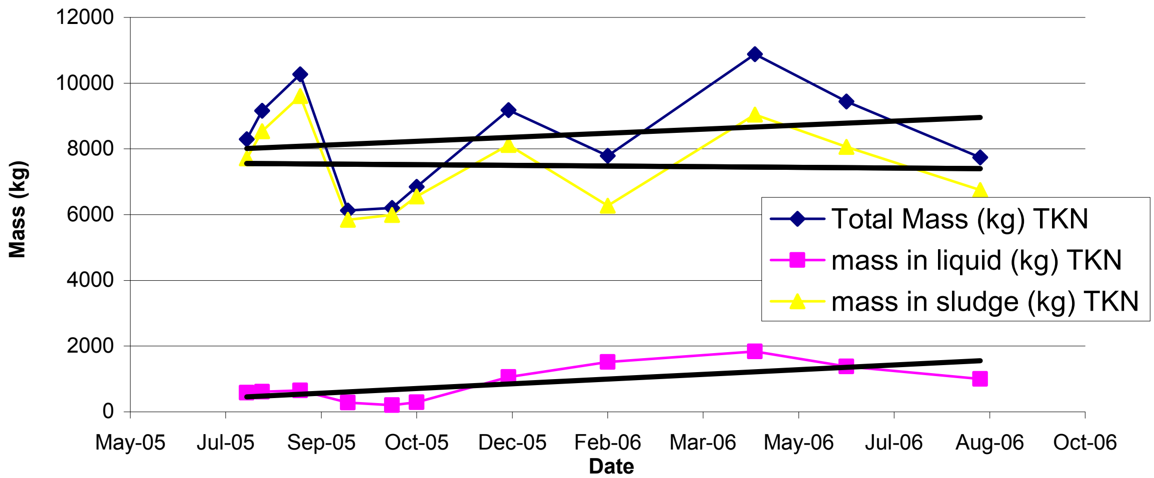
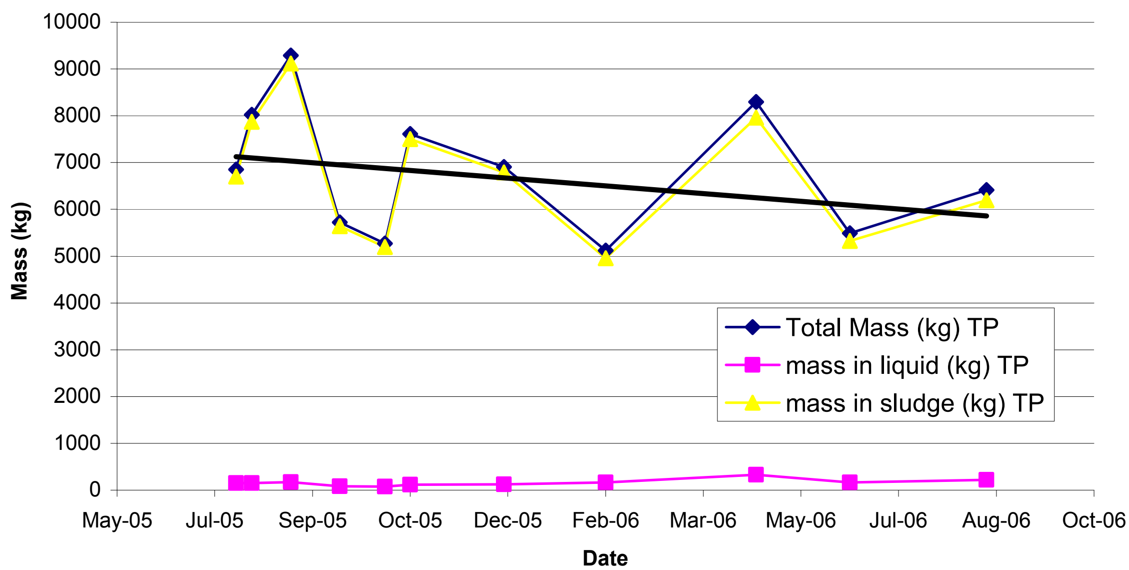



**Figure 6.** Partitioning of TP Mass in Lagoon 1.



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## Conclusions

The sludge level in the treated lagoon was decreased during the study period. The decreased volume of sludge coupled with the decrease in the sludge TKN and TP concentrations resulted in a reduction in the mass of both TKN and TP present in the sludge. Unfortunately, the fate of these elements cannot be concluded from this study.

## References

Westerman, Philip W., Shaffer, Karl A., Rice, J. Mark. Sludge Survey Methods for Anaerobic Lagoons. 2003. North Carolina State University

Markland Specialty Engineering Ltd., Toronto, Canada