



Utah Bio-Cap ML[®] Final Report

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Introduction

Odor control is a significant issue for large confined animal feeding operations. It has been estimated that the majority of the odor traveling offsite can be attributed to the farm waste treatment systems (lagoons). In the past and presently, questions have also been raised concerning emissions of ammonia and hydrogen sulfide from these lagoon systems.

Bio-Cap Multi-Layer (ML) Covers from BEI Ag Environmental Solutions have been identified as a potential method for odor emissions reduction from anaerobic lagoon systems. Two different versions of the Bio-Cap ML cover were evaluated in this study: the Bio-Cap Ground Cover Multi-Layer (GCML) and the Bio-Cap Non-Woven Multi-Layer (NWML). The GCML consists of three different layers: a top layer of woven, UV resistant material to prolong life expectancy, foam strips in the middle to aid in the flotation of the cover and a felt like layer much like the original Bio-Cap material on the bottom. The NWML consists of three different layers as well: the top and bottom layers are non-woven material currently used in Bio-Cap covers, with foam strips sandwiched between the top and bottom layers for flotation. The Bio-Cap ML covers are expected to have twice the life expectancy with more consistent odor control than the original Bio-Cap cover. The foam component within Bio-Cap ML products cover about 40% of the total surface area of the Bio-Cap ML

Bio-Cap GCML and NWML covers have been installed on two existing swine production sites in Southern Utah.

The protocol used in this study provides an analytical method for the evaluation of the Bio-Cap ML Covers, compared to the original Bio-Cap cover and an uncovered anaerobic lagoon utilizing approved sampling protocol and evaluation of samples by a nationally recognized olfactometry laboratory. Copies of this protocol are available upon request.

Objective

The study protocol has been developed for the purpose of evaluating the effectiveness of a treatment (*Bio-Cap ML Covers*) at reducing odors and odorous emissions from two farm waste treatment lagoons.

Field evaluations were designed to compare a finisher farm utilizing a Bio-Cap GCML cover and a finisher farm utilizing a Bio-Cap NWML to a finishing farm utilizing the original BioCap cover. The original Bio-Cap cover was installed in October 2000 to a finishing farm lagoon. An uncovered control lagoon was also evaluated during the study.

All farms using the Bio-Cap System have identical construction and house approximately 8,000 hogs. The control farm also contains finishing animals but is larger in size; however the design criteria and loading rates are similar to those utilizing the Bio-Cap covers.

The overall objective of the testing is to evaluate the effectiveness of the Bio-Cap and Bio-Cap ML Floating Cover Systems at reducing odors and odorous emissions from a sample of farm waste treatment lagoons.

The evaluation protocol focuses on four main areas of concern, each of which is discussed in detail below:

Air Monitoring

Kim Weaver, Ph.D. of Southern Utah University (SUU) developed the air monitoring protocol in conjunction with Richard Dotson of SUU and Dwaine S. Bundy, Ph.D., P.E. of Iowa State University. Air samples were taken approximately every two weeks for six months. Dr. Weaver took all air samples, which were analyzed for odor, ammonia, and hydrogen sulfide by the Iowa State University Olfactory lab. The protocol developed by Dr. Weaver, Dr. Bundy and Richard Dotson is available upon request and can be viewed at www.beiagsolutions.com.

Conclusions: Overall odor detection threshold results show an 83.7 percent decrease in odor in the covered lagoons compared to an uncovered anaerobic lagoon. Statistical analysis shows that the decrease is significant (p value of 0.000). The NWML Bio-Cap reduced odor the most (358.88 odor detection units), while the GCML Bio-Cap reduced odor the least (381.42 odor detection units). All results from the Bio-Cap covers are within 23 odor detection units of each other.

Ammonia emission testing shows a 65.78 percent decrease in ammonia emissions in the covered lagoons compared to an uncovered anaerobic lagoon. Statistical analysis shows that this decrease is also significant (p value of 0.000). The GCML Bio-Cap reduced ammonia emissions the most (12.38 ppm), while the NWML Bio-Cap reduced ammonia emissions the least (37.86 ppm). All results from the Bio-Cap covers are within 25 ppm of each other.

Hydrogen sulfide emission testing also shows a 94.7 percent decrease in hydrogen sulfide emissions in the covered lagoons compared to an uncovered anaerobic lagoon. Statistical analysis shows that the decrease is significant (p value of 0.000). The original Bio-Cap reduced hydrogen sulfide emissions the most (0.113 ppm), while the NWML Bio-Cap reduced hydrogen sulfide emissions

the least (0.234 ppm). All results from the Bio-Cap covers are within 0.121 ppm of each other.

Twelve sampling events were collected and analyzed, and the results of the air monitoring data show a decrease in all parameters monitored. More complete supporting data and calculations are available upon request.

Primary Lagoon Liquid Monitoring

The primary lagoon liquid was sampled monthly by the farm's environmental resources department at all of the test sites and the control site. The test parameters sampled were total kjeldahl nitrogen, nitrate nitrogen, nitrite nitrogen, ammonia nitrogen, volatile fatty acids, chemical oxygen demand, and volatile suspended solids.

Conclusions: No significant increase or decrease in monitored parameters was observed in the individual lagoon systems. Six sampling events were collected.

Cover Durability Evaluation

The cover durability evaluation was a subjective visual appraisal during the testing period. The evaluation included monthly visual inspections of all covers.

Conclusions: Subjective visual evaluations were performed monthly on all of the Bio-Cap covers in the study. No observable wear or differences could be identified in the evaluations of the GCML and NWML. Only minor topsoil build up and color differences were observed on these covers and did not appear to affect the durability of either cover. At the Bio-Cap original site, moderate degradation of the cover was observed in one area but was easily repaired. Life expectancy of the cover seems to be in line with the manufacturer's expectations.

System Evaporation Evaluation

Data from lab studies and practical experience on evaporation rates from other areas of the U.S. indicate that evaporation from a lagoon covered with Bio-Cap is equivalent to or slightly greater than evaporation rates from an open lagoon. This hypothesis was tested utilizing twelve 5-gallon plastic buckets filled with effluent from the primary lagoon. Three buckets were open at the top, three buckets were covered with the original Bio-Cap cover material, three were covered with the Bio-Cap GCML cover, and three were covered with the Bio-Cap NWML cover. All buckets were located at the uncovered control farm near the primary

lagoon. This evaluation was only comparative in nature and was not an attempt to quantify actual evaporation rates from the primary lagoons.

Conclusions: Overall average daily evaporation rates were 45 percent less with the Bio-Cap covers. Results show that the average daily evaporation rate for the Bio-Cap cover was 0.34 inches/day versus 0.62 inches/day for the uncovered anaerobic lagoon control site. Statistical analysis shows that this difference is significant (p value of 0.000). The original Bio-Cap reduced evaporation 32 percent, the GCML Bio-Cap reduced evaporation by 65 percent, and the NWML Bio-Cap reduced evaporation by 38 percent.

System Economic Analysis

The testing farm's accounting department prepared an economic analysis of the installation costs, maintenance, cover life expectancy, and removal/disposal costs to aid in the decision making process of implementing this cover on a wide-scale basis. The cost per space of the original Bio-Cap cover is \$ 5.01 compared to a cost per space of the Bio-Cap ML of \$9.00. The annual cost per pound of finished hog for the original Bio-Cap is \$0.00173, compared to an annual cost per pound of finished hog for the Bio-Cap ML of \$0.00149.

Overall Conclusions

Overall conclusions with respect to the four main objectives of this evaluation are:

1. Air monitoring results show an overall decrease in the odor detection threshold, ammonia emissions and hydrogen sulfide emissions. These results meet or exceed published expectations from the manufacturer. Statistical analysis shows that these results are significant.
2. Lagoon liquid results show that there is no significant increase or decrease in monitored parameters in the individual lagoon systems.
3. Cover durability doesn't seem to be an issue at this point. Minor degradation of the original cover was seen during the time of the evaluation and was easily fixed. This is the oldest cover in this system approaching three years old.
4. The cover inhibits the evaporation rates significantly in this study. The researchers continue to watch the implications of this very closely. Results from this study show the Bio-Cap GCML exhibits unacceptable evaporation levels; therefore, this product will not be produced for this market.
5. The odor control performance of the multi-layer covers is not significantly better than the original cover. The cost of the multi-layered covers is

significantly more than the original cover. However, the multi-layered covers have twice the life expectancy of the original covers. The GCML covers significantly decrease evaporation rates. Due to the increased life expectancy, equal odor performance, and evaporation rates very close to those of the Original Bio-Cap, **the Bio-Cap NWML is the best value as determined by this study.**

Generally results of the evaluation show that the Bio-Cap cover is operating according to the published expectations of the manufacturer with the exception of the evaporation rates.