

Negative Air Pressure Covers For Earthen Manure Storages

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Controlling odour is a major challenge affecting expansion of the livestock industry in Western Canada. Manure-storage facilities account for about 30 percent of the complaints about livestock odours. Covering these facilities can reduce odour and gas emissions by 70 to 95 percent. This report describes the results of:

- Field tests on a full scale prototype that demonstrated the concept of a negative air pressure (NAP) cover for earthen manure storages
- A survey of neighbours living around two earthen storages covered with NAP covers
- Monitoring of the manure quality in a NAP covered earthen storage.

Project Goals

The project goals were to:

- Demonstrate and evaluate the performance of the negative air pressure cover system under field conditions;
- Evaluate different ways to anchor the cover's edge;
- Evaluate the cover's effectiveness in reducing odour; and
- Evaluate the cover's effect on nutrient conservation and stabilization of the manure.

How the Project was Carried Out

Concept

The site for the prototype cover was a two cell earthen storage for a 600 sow farrow-to-finish operation. The cells were covered with 20 mil reinforced polyethylene plastic. The secondary cell cover is permanently anchored in an anchor trench. The primary cell is anchored with a continuous sand bag and a keyway. A system of perforated pipes and fans maintains a negative pressure under both covers. Four additional NAP covers have since been installed.

Odour Survey

An odour survey was conducted of all residents within 3.5 km of the prototype cover that is located near Selkirk, Manitoba. A second covered storage on a 3000 sow farrow-to-wean operation near Drumheller, Alberta, was also included, with all residents within 5.5 km surveyed. A questionnaire was filled out and residents were asked to provide additional comments. The interviews were conducted over two days at each site in August, 2000. The Manitoba cover had been in place for over a year and the Alberta cover had been used for approximately 10 months. The first person to answer the door (excluding children) was interviewed.

Manure Quality

Nutrient conservation and manure stabilization were evaluated by monitoring the prototype-covered storage near Selkirk, Manitoba, as well as a nearby uncovered control storage. Monthly manure samples were collected at each farm in both the barn's wet well and the manure storage. Storage temperatures were also recorded. The samples were analyzed for pH, alkalinity, volatile solids, chemical oxygen demand, volatile fatty acids, total and ammonia nitrogen, and total and dissolved phosphorus.

Results

Concept

The covers are extremely stable under a variety of weather conditions, including high winds up to 115 km/h. Precipitation, including rain, snow and ice remain on top of the cover until they can be pumped off. Snow and ice had no detrimental impact on the cover.

Odour from the storage basins was negligible. Subjective evaluation of odour around the storage basins and exhaust fan outlets indicates that the cover system virtually eliminates odour. Only slight odour was detectable downwind and 3 to 5 metres from the fan outlets during the summer months.

The cover system reduced odour because:

- The stored manure was not directly exposed to the air;
- The surface of the manure was not disturbed by wind; and
- Gases and odorous compounds were gradually discharged at low air flows.

The accumulation of gas under the covers was observed in the form of gas bubbles; their number, size and frequency varying significantly, depending on weather conditions, the amount of precipitation accumulating on the covers, and the level of manure in the basins. These gas bubbles were not persistent, decreasing to almost nil under windy conditions, especially when manure levels were high.

Low concentrations of ammonia, hydrogen sulfide and methane were recorded in the exhaust gas. These low levels are due to the very low release of gas when the measurements were taken, not to lack of biological activity. The fan exhaust air was diluted by air leakage through the cover system.

Odour Survey

The residents living adjacent to the two survey barns are generally experiencing minimal impact due to odour. Only one out of 43 respondents claimed to frequently experiencing odour. Few people were concerned about odour from the Manitoba site; there was therefore a lower number (1/3) that noticed a change due to the cover. Approximately one-half of neighbours around the Alberta site have experienced a reduction in odour. Nineteen of twenty-one Alberta residents questioned, experienced odour seldom or occasionally.

Residents familiar with the technology offered very positive comments and testimonials to the effectiveness of the cover. The comments indicate that the cover has resulted in a significant reduction in the small amount of odour that they have experienced.

Manure Quality

The covered EMS lost 7% of the total nitrogen compared to 38% in the uncovered storage.

Significant biogas production accrued in June in the covered EMS. The uncovered EMS required an additional month to produce significant biogas. The average temperature in the covered EMS was 5°C higher than the uncovered EMS during the period of June to September.

Summary

The cover system has a number of advantages:

- Controls odour from manure storage basins all year;
- Cost-effective;
- Increases the fertilizer value of manure; and
- Prevents precipitation from entering storage basins.

The project demonstrated the feasibility and practicality of the negative air pressure cover system under Manitoba climatic and field conditions. DGH Engineering Ltd. has patented this technology and commercialization of the technology began in 1999. This technology will benefit hog producers by providing a simple and inexpensive way to eliminate odour and by preserving more of the nutrient in manure for use as crop fertilizer. This system will also benefit people living near livestock facilities by reducing odours and greenhouse gases.