Manure Belt Dryers in Alberta Layer Barns

Project Overview

In Collaboration with Egg Farmers of Alberta

A team from Alberta Agriculture and Forestry (AF) and Egg Farmers of Alberta (EFA) investigated gaps related to benefits, costs and challenges of using manure belt dryers in Alberta layer barns. Main goals for the investigation were to understand:

- Manure moisture and nitrogen content after being dried
- Economics of purchasing and operating manure belt dryer systems
- In-barn ammonia (NH_3) and dust levels

Egg Farmers of Alberta

Industry Background

As part of their sustainability strategy, Alberta egg farmers strive to be socially responsible, environmentally sound and economically viable. The key pillars of the strategy: Healthy Birds, Healthy Eggs, Healthy Farms and Healthy Communities allow for a collaborative approach to building public trust and a sustainable egg industry. The adoption of new manure handling technologies are ways that egg farmers can continuously improve their efforts toward achieving industry sustainability.

Drying Poultry Manure

Most of the nitrogen (N) (about 60 – 70%) in poultry manure is from uric acid and urea, the remaining N is undigested protein. If oxygen and water are present, uric acid converts to volatile ammonia. Ammonia reduces the fertilizer nitrogen value of the manure and can negatively affect air quality in both the barn and the environment.

Figure 1. Aviary

Research has shown that reducing litter pH to 4, manure temperature to 10°C, or drying manure to a minimum moisture content of 40%,

For more information, visit: https://www.alberta.ca/manure-management.aspx

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can significantly decrease ammonia formation and subsequent losses or emissions.

The use of driers has the potential to:

- help manage in-barn air quality,
- improve manure nutrient value,
- decrease manure volume and weight,
- reduce transportation costs and
- allow for further secondary processing such as litter pelletizing.

However, the advantages and potential challenges, as well as economic impacts of adopting manure belt dryer systems in Alberta is not well known.

Alberta Benchmarking

In 2016, the team conducted a phone survey with 31 egg farmers across Alberta to learn more about manure belt dryer systems and operating practices. Staff asked questions about the number of hours manure was dried and days between manure removals, as well as compiled general comments on manure moisture content and manure handling practices. From this survey, AF staff visited 15 farms with manure drying systems for additional information. Of the barns visited, seven had conventional cage housing, five had furnished-cage housing and three had aviary housing systems. From these farms, the team selected two layer barns, an aviary and a furnished barn, for in-barn testing.

Figure 2. Furnished cage

In-Barn Testing

Benchmarking information was used to develop nine scenarios to test in-barn manure belt drying effectiveness (Table 1).

Table 1. Testing Scenarios

Manure Drying Time	Manure Removal Frequency		
	1 Day	3 Day	7 Day[i]
No drying	Nd1	Nd3	Nd7
10 hrs	10h1	10h3	10h7
20 hrs	20h1	20h3	20h7

[i] During winter testing the seven day removal scenarios were dropped to six days due to high in-barn ammonia levels.

Key items monitored during a summer and winter period included:

1. Manure moisture content
2. Manure nitrogen content
3. In-barn ammonia (NH_3) levels
4. In-barn dust levels
5. Energy use

Figure 3. In-barn ammonia sampling

In addition to the in-barn testing, staff completed an economic cost/benefit analysis to assess the installation of manure belt dryers into layer barns.

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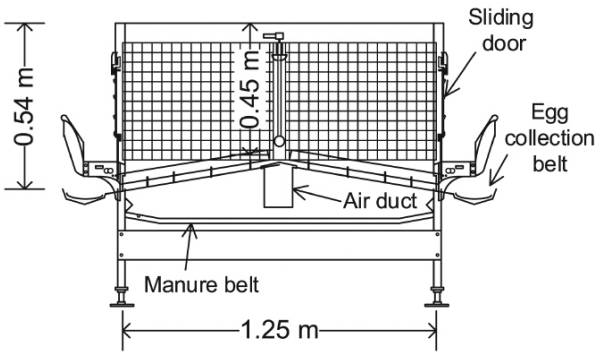

Figure 4. Cross section of a furnished cage indicating locations of manure dryer duct and manure belt. (Source: http://ps.oxfordjournals.org/ by guest on January 5, 2016)

Manure moisture and nitrogen content

- In summer, barn temperatures, humidity and ventilation affected manure moisture content more than the drying system. In winter, the drying system was more effective in drying the manure.
- No significant trends were observed with manure nitrogen content due to variability of the manure and small sample sizes. Theoretically, there should be increased nutrient content with drying manure. A more controlled research study is required to identify nitrogen retention trends.
- Economic analysis showed that potential revenue from manure is heavily dependent on nitrogen content. The benefits of drying were not realized, as the nitrogen contents of the dried and undried manure were similar.

For recommendations to improve manure dryer efficiencies and reduce operational costs, see the following factsheets:

- Manure Moisture and Nitrogen
- In-barn Air Quality
- Overall Economics and Learnings

For more information on this project, read the Evaluating Manure Belt Dryers in Alberta Layer Barns Final Report.

Manure Belt Dryer Economics

- When installing and operating a manure dryer system, the manure removal frequency had the biggest impact on the cost per bird.
- Net Present Value (NPV) calculations that include purchase, annual operation, labour and hauling costs showed no economic return on the installation and operation of manure dryer belts.

In-barn ammonia and dust levels

- Increasing manure removal frequency was more effective than manure drying for the reduction of in-barn ammonia.
- Winter manure drying reduced the in-barn ammonia levels up to 50% in some cases.
- Dust levels did not increase with the use of manure dryers at either farm.
- Energy measurements showed power use by the manure belts is minimal compared to the manure dryer fans. Thus, it is cheaper to run the manure belts more frequently than it is to run the dryers.

Other key learnings

- Reasons for installing and operating manure belt dryers were initially thought to capitalize on the nitrogen value of manure from layer barns. However, during the course of the project, reduction of in-barn ammonia emissions was often the main reason.
- Manufacturer supplied sensors to monitor and record in-barn ammonia levels were not reliable and did not respond quickly to changing barn conditions.