

# Compost Bedded Pack Barns – Can They Work For You?

Marcia I. Endres

University of Minnesota, Department of Animal Science, 1364 Eckles Avenue, St. Paul, MN 55108

E-mail: [miendres@umn.edu](mailto:miendres@umn.edu)

## ■ Take Home Message

Success with compost bedded pack barns depends on various practices:

- Bedded area space per cow should be at least 7.4 m<sup>2</sup> (80 ft<sup>2</sup>) for Holsteins and similar size breeds and 6.1 m<sup>2</sup> (65 ft<sup>2</sup>) for Jerseys. Some producers provide 9.4 m<sup>2</sup> (100 ft<sup>2</sup>) per cow. More space per animal will reduce the frequency of bedding addition.
- Fine, dry wood shavings or sawdust is the ideal material for bedding. Other small particle materials such as finely processed straw, flax shives and wheat straw by-product can also work.
- The bedded pack should be aerated twice daily, at least 25 cm deep, to keep it aerobic and fluffy. Biological activity generates heat and helps dry the pack.
- When bedding begins to adhere to the cows, clean material should be added to the pack. Bedding supply should be readily available so clean material is not added too late and the cows get dirty.
- Adequate ventilation of the barn is essential to remove the moisture generated by the cows and the pack (in winter too).
- Excellent cow preparation procedures at milking time are a must and one of the most important practices to achieve low somatic cell counts.

## ■ Introduction

Dairy housing systems have a substantial impact on the overall health and longevity of dairy cattle. Compost bedded pack barns (generally known as compost dairy barns) are an alternative loose housing system for dairy cows that appear to offer very good cow comfort for lactating, dry and special needs

cows. The first compost dairy barn in Minnesota was built in late 2001 by Tom and Mark Portner. Many more compost barns have been built in the state since that time.

Compost dairy barns require excellent pack and ventilation management for the barns to perform well. Producers need to use appropriate bedding in adequate amounts. The bedded pack needs to be aerated twice daily to refresh the surface and enhance microbial activity in the pack. Compost barns will not perform well if the cows are overcrowded. Producers must use excellent cow preparation procedures at milking time. Producers can have problems with compost barns if these guidelines are not followed. Compost barns are another option to house dairy cows and are not the answer for every dairy producer. It is important to always match the manager with the system in order to be successful.

We have conducted on-farm studies with compost barns for the last three years. Results of some studies have been recently published (Barberg et al., 2007a, Barberg et al., 2007b and Endres and Barberg, 2007). Additional field observations have also been reported (Janni et al., 2007).

We learned that the main reason producers adopt this alternative housing system is for improved cow comfort and longevity. A compost barn allows cows more freedom of movement than conventional tie stalls or freestalls. These barns may also provide a reduction in manure storage costs and needed space, and a savings in labor and manure handling.

## ■ Barn Layout

Compost barns are similar in many respects to conventional freestall dairy barns. Both have feed mangers, feed alleys and waterers. The key difference is that the freestalls and freestall alleys are replaced with a bedded pack area that is aerated at least twice daily.

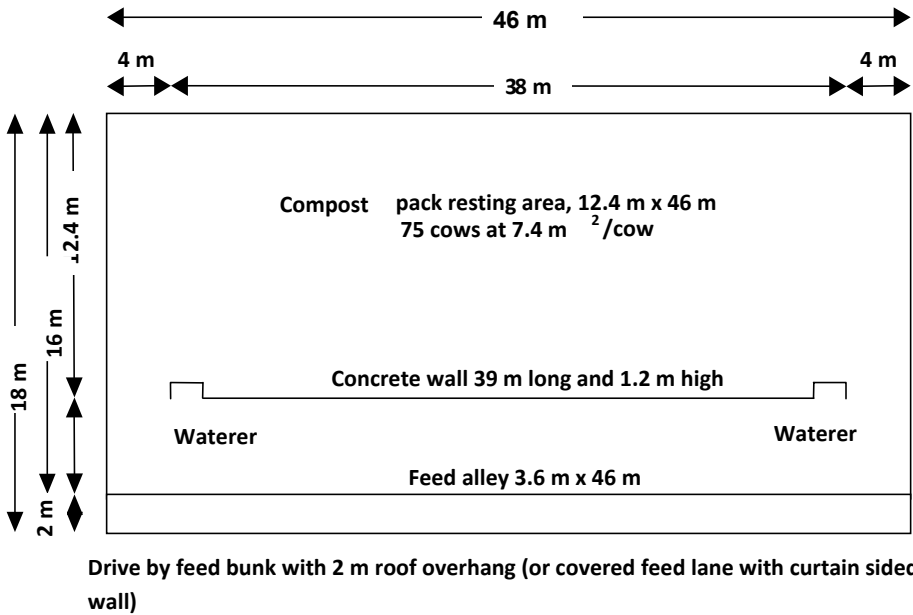
Figure 1 shows a typical drive-by compost barn layout. Compost barns can be laid out for drive-by feeding, covered feeding, or drive-through feeding with pens on both sides. They can also be used with feed bunks under roof or outside.

In general, compost barns have a concrete feed alley, a bedded pack (resting) area, and a 1.2-m high wall surrounding the pack on three sides and separating the pack and the feed alley. The wall separating the pack and the feed alley has one to four walkways for cows and equipment to access the pack. This wall is typically of poured concrete construction.

Walkways, at least 4 m wide, are recommended at each end of the wall

separating the bedded pack and the feed alley (as a minimum) for cow and equipment access to the pack area. Long barns will require additional walkways.

Waterers are located along the feed alley. Waterers can be located on either side of the feed manger or adjacent to the concrete wall separating the bedded pack and the feed alley. Waterers are not located in the bedded pack area to minimize wetting of the pack, to keep the waterers cleaner, and to avoid having to adjust waterer height as pack depth increases.



**Figure 1. Compost dairy barn layout (not to scale) for 75 cows with 2 walkways, drive-by feeding and 2-m overhang. Waterers are against the concrete wall separating the compost bedded pack area from the feed alley and are accessed from the feed alley only (from Janni et al., 2007).**

Compost barns are recommended to have 0.9-m eave overhangs to minimize the chance of roof runoff and rain being blown into the barn onto the bedded pack. Roof gutters will help reduce roof runoff from being blown onto the pack. The ground surrounding a compost barn should be sloped to minimize rain and snow runoff from entering the barn and wetting the bedded pack.

## ■ Pack Management

Bedded area space per cow should be at least 7.4 m<sup>2</sup> (80 ft<sup>2</sup>) for Holsteins and similar size breeds and 6.1 m<sup>2</sup> (65 ft<sup>2</sup>) for Jerseys. Some producers provide 9.4 m<sup>2</sup> (100 ft<sup>2</sup>) per cow. More space per animal will reduce the frequency of bedding addition. Initially 30-45 cm of loose dry fine wood shavings or sawdust is put down to start a compost barn pen. The bedding material is aerated to a depth of 25 cm twice daily while cows are being milked, most often using a modified cultivator on a skid loader or small tractor. It is proposed that aeration is essential to incorporate oxygen for aerobic decomposition and to provide a fresh surface without accumulated manure for cows to lie down on after returning from the milking parlor or feeding. Some producers in Minnesota are aerating the pack deeper (about 35-40 cm) using a chisel plow type of equipment, and they have observed a reduction in bedding needs and increased pack temperatures.

Clean bedding is added every time the bedded pack becomes moist enough for it to adhere to the cows. Typically, a semi-truck load of clean material (approximately 18 tons) is added every 1 to 5 weeks, varying by season, weather conditions, barn size, and cow density. Some dairies prefer to add a smaller amount of bedding more frequently, such as once weekly. There are a small number of other dairies adding a thin layer of bedding every day.

Typically no bedding material is removed from the pack area during the year, except in fall and spring. Several farms remove a portion of the pack material in the spring to provide space for bedding accumulation during the summer. The bedded pack area is cleaned out entirely once a year in October. The soiled bedding is spread on the fields according to the farm manure management plan. Some producers pile the spent bedded material and work with it in order to produce finished compost. In a recent study with alternative bedding materials for compost barns, we observed that it took approximately 4 months after material was removed from the barn to produce finished compost.

A truck load of clean material is typically added after removal of the soiled bedding to provide a bedding layer 30-45 cm high to start the new pack. Some producers leave about 6 cm of old material in the barn to help initiate microbial activity. By the end of summer, most packs average 1.2 m high.

Adequate ventilation (air exchange) is needed to remove cow heat and moisture, as well as the heat and moisture that the biologically active pack generates. Sufficient air exchange is needed in cold weather to remove moisture from the pack and extend the time between bedding additions. Large amounts of moisture are commonly seen as steam rising from the pack during aerating in cold weather. This moisture needs to leave the barn with the ventilation air. Compost barns are recommended to have 5-m sidewalls to

provide better ventilation, access for bedding trucks and to accommodate the sidewall opening lost due to the bedded pack walls. Many compost barns have mixing fans located to blow air downward onto the bedded pack to help dry the pack surface. The fans must be hung high enough to provide head room for aerating equipment at the maximum pack height.

## ■ Pack Temperatures

The bedding temperature measured at various depths was 42.5°C and the pack surface temperatures were similar to the ambient temperature in one study with 12 farms (Barberg et al, 2007a). Temperatures were greater in the areas of the pack that were fluffier, that were not as heavily soiled or packed by the cows. This observation is consistent with the need for oxygen for microbial activity that promotes composting. In another study currently being summarized, temperatures were 21.6°C in the winter and 38.1°C in the summer in six compost barns.

## ■ Economics

Barn building costs ranged from US\$33,000 to \$300,000, with a cost per cow ranging from US\$625 to \$1,750 (barn only, does not include milking parlor). The building costs ranged widely depending on the amount of on-farm labor utilized and amenities added to the barn (Barberg et al. 2007a).

Bedding material costs ranged from US\$0.35 to \$0.85 per cow per day, depending on the source of sawdust and from how far it had to be transported to reach the dairy. Bedding costs and availability of bedding materials was by far the major concern expressed by the producers. Alternative bedding options are currently being tested. Preliminary results indicate that sawdust is the best option for these types of barn, but combinations of sawdust with other materials such as finely ground soybean or flax straw, finely processed corn cobs, wheat straw byproduct or wood chip fines can work relatively well. Producers in Canada have indicated that flax shives can also work well.

## ■ Herd Performance and Udder Health

Historical analysis of DHIA data indicated that 89% of the dairies in the Barberg et al. (2007b) study had a significant increase in 305 mature-equivalent milk production when moving their cows from the previous housing system to the compost barn. The average increase was 955 kg/cow per year (range of 395 to 1,331 kg/cow per year). It is important to keep in mind that other changes were made to the dairy operation in most cases (e.g. feeding a

totally mixed ration) when moving cows to the compost barn, which most likely also contributed to the significant increase in milk production. The average herd size for the herds enrolled in this cross-sectional study was 73 cows. The DHIA rolling herd average was 10,457 kg/cow per year (range of 8,321 to 12,411 kg) and SCC were 325,000 cells/mL (range of 88,000 to 658,000) for the test date nearest to our visit. In a more recent study with six compost dairy barns, SCC were 372,500 cells/mL (range of 163,000 to 710,000 during the year).

We found that 67% of the dairies had a reduction in mastitis infection rates (defined as % of cows with a SCC>200,000 in each DHIA test date) when moving to a compost barn. However, only 43% of the dairies had a significant reduction in bulk tank SCC, with one dairy having a significant increase (Barberg et al, 2007b). In general, a low level of contagious pathogens was detected in the milk bulk tank samples. *Streptococcus agalactiae* and *Staphylococcus aureus* were detected in 8.3% of the dairies whereas 50% of the farms had high levels of Non-ag *Strep* and 42% of the farms had high levels of coliforms (i.e., *E.coli*, *Klebsiella*, and *Enterobacter*) in the milk.

It is interesting to note that udder health and milk quality were not necessarily compromised when housing cows in this bedded pack system, especially when total bacteria counts in the bedding material were 9,122,700 cfu/mL (range of 2,035,562 to 22,562,604). It has been suggested that bedding should have less than 1 million cfu/mL in order to reduce the risk for mastitis. Therefore, excellent cow preparation procedures at milking time and healthy teat ends are essential in a compost dairy barn system.

In terms of reproductive performance, 57% of the dairies had an increase in heat detection rates and 71% of the dairies had an increase in pregnancy rates when moving to a compost barn (Barberg et al., 2007b). Herd turnover rates averaged 25.4% before and 20.9% after change in housing.

## ■ Cow Welfare and Behavior

It appears that compost barns can provide a comfortable lying surface for dairy cows, resulting in improved feet and leg health. In Barberg et al. (2007b) lameness prevalence was 7.8% (locomotion score  $\geq 3$ ), with 2 herds having no lame cows. Previous studies with freestall barns indicated prevalence of lameness to be 24.6% (Espejo et al., 2006) and 27.8% (Cook et al., 2003) in those systems. Overall, 25.1% of cows exhibited a hock lesion, with 24.1% having hair loss and 1.0% having a swollen hock. Seven of the 12 herds had no severe lesions. Hock lesions that occurred in the previous freestall or tie stall barn were most likely still present or healing in the compost barn. Weary and Taszkun (2000) reported that 73% ( $n = 1,752$  cows) of cows housed in freestalls had at least one hock lesion, nearly 3 times the prevalence we

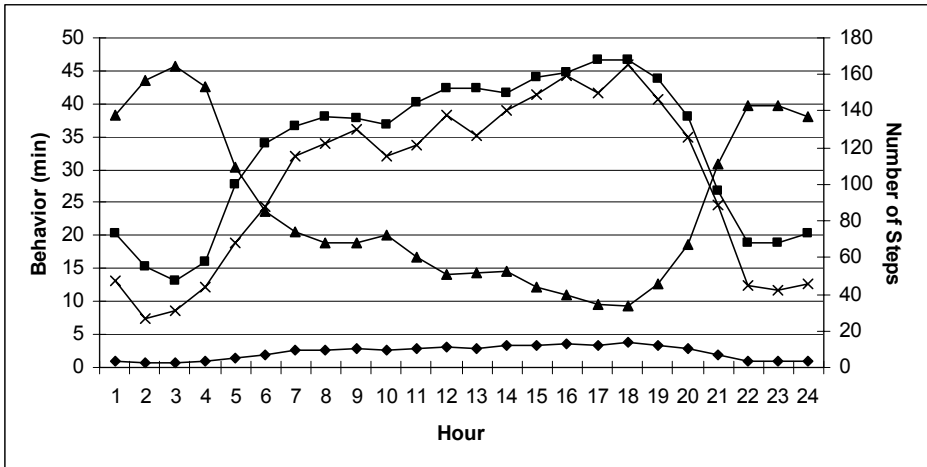
observed in compost barns. Furthermore, Endres et al. (2005) observed in freestall herds ( $n = 5,328$  cows) that 14.1% of cows housed on mattress based freestalls and 1.8% of cows on sand based freestalls had swollen hocks.

We conducted a behavioral study with 147 cows housed in 12 compost barns (Endres and Barberg, 2007). Cows were able to assume all of the natural lying positions without obstruction in most of the barns. All four natural lying positions were observed in nine of the bedded packs. Three barns did not have cows exhibit flat on side position during the observation period. A majority of the cows (84.6%) observed lying down assumed the head up position. Head back lying position was assumed 8.8%, head on ground 5.4%, and flat on side 0.8% of lying events.

Cows were able to move freely on the bedded pack. A total of 96 continuous hourly observations of social interactions were recorded. Occurrences of chasing away and pushing were 0.94 times per hour each. The third agonistic interaction recorded was head butting with 1.4 incidences per hour. The positive social interaction of allogrooming, or social licking, was recorded 2.3 times per hour. Social interactions of cows in the compost barns appeared to be similar to pasture situations, suggesting that compost dairy barns are an adequate system for housing lactating cows from a social structure standpoint.

The daily lying time for all cows was 9.3 hours. The daily lying time for 2 herds that had access to pasture was 6.5 hours. In comparison, cows that did not have access to pasture spent 10 hours per day lying down. Measurements were taken during the summer, and cows have been shown to reduce their lying time (from 10.9 to 7.9 hours/day) at higher temperature-humidity indexes in a freestall barn (Cook et al, 2007). The same appears to happen in compost barns. However, because of the soft surface they stand on, negative effects on hoof health were not apparent.

Cattle housed in compost barns exhibited a significant pattern of temporal cyclicity in their lying behavior, similar to what was observed in other housing systems. The cows spent a greater amount of time lying at night (2000 h to 0800 h) than during the day (0800 h to 2000 h). The cows housed in compost barns spent 56.8% (34 min) of each hour lying down at night, for a total of 6.8 h, compared to 23.1% (14 min) of each hour lying down during the day, for a total of 2.8 h (Figure 2).



**Figure 2.** Number of minutes each hour of the day (Hour 1 = 0100 h, Hour 24 = 2400 h) spent standing (■), lying (▲), and active (◆) and the average number of steps (×) taken each hour for 147 cows housed in compost dairy barns (from Endres and Barberg, 2007).

Lying behavior had an inverse relationship with the temperature-humidity index (THI) during the study. Cows in the compost barns spent fewer minutes per hour lying down as the THI increased. Additionally, cows increased the number of steps taken as the THI increased. These changes in behavior could be an indication of restlessness or stress and/or a greater need to walk to the water trough during warmer periods. We compared lying time when the  $\text{THI} \geq 72$  or  $< 72$  during the entire study period. Cows spent 12.7 hours lying per day when  $\text{THI} < 72$  and 7.9 hours per day when  $\text{THI} \geq 72$ . Cook et al. (2007) measured the time budgets of 14 cows housed in a 3-row freestall pen using video recordings. Mean lying time decreased from 10.9 to 7.9 hours per day with increasing THI (56.2 to 73.8) during the observation period. This relationship seems similar for cows housed in compost dairy barns, emphasizing the importance of heat abatement in dairy cow facilities in order to improve cow comfort and optimize productivity.

## ■ Conclusions

Based on current observations, compost dairy barns can be an adequate housing system for lactating dairy cows, especially for small to medium size dairies (up to 200 cows), or as a special needs barn in larger freestall dairies. Like any system, optimum management is absolutely necessary to achieve desirable results. There are many housing options for dairy cattle, and producers should choose the option that will work best for them.



## ■ References

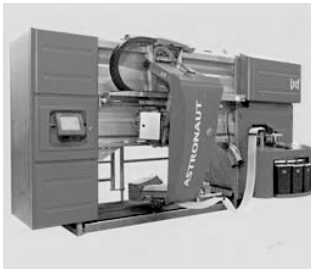
- Barberg, A.E., M.I. Endres, and K.A. Janni. 2007a. Dairy compost barns in Minnesota: a descriptive study. *Appl. Eng. Agric.* 23:231-238.
- Barberg, A.E., M.I. Endres, J.A. Salfer, and J. K. Reneau. 2007b. Performance, health and well-being of dairy cows in an alternative housing system in Minnesota. *J. Dairy Sci.* 90:1575-1583.
- Cook, N.B., R.L. Mentik, T.B. Bennet, and K. Burgi. 2007. The effect of heat stress and lameness on the time budgets of lactating dairy cows. *J. Dairy Sci.* 90:1674-1682.
- Cook, N. B. 2003. Prevalence of lameness among dairy cattle in Wisconsin as a function of housing type and stall surface. *J. Am. Vet. Med. Assoc.* 223:1324-1328.
- Endres, M.I. and A.E. Barberg. 2007. Behavior of dairy cows in an alternative bedded-pack housing system. *J. Dairy Sci.* 90:4192-4200.
- Endres, M.I, L. A. Espejo, and J. A. Salfer. 2005. Effect of stall surface on the prevalence and severity of hock lesions in dairy cows housed in free stall barns. *J. Dairy Sci.* Vol. 88(Suppl. 1):247. (Abstr.)
- Espejo, L.A., M.I. Endres, and J. A. Salfer. 2006. Prevalence of lameness in high-producing Holstein cows housed in freestall barns in Minnesota. *J. Dairy Sci.* 89:3052-3058.
- Janni, K.A., M.I. Endres, J.K. Reneau, and W.W. Schoper. 2007. Compost dairy barn layout and management recommendations. *Appl. Eng. Agric.* 23:97-102.
- Weary, D. M., and I. Taszkun. 2000. Hock lesions and free-stall design. *J. Dairy Sci.* 83:697-702.





— innovators in agriculture —

[WWW.PENNERFARMSERVICE.COM](http://WWW.PENNERFARMSERVICE.COM)



Come see us at the trade show and learn more about how we can help you with your milking needs with the Astronaut A3 Robot. At Penner Farm Service we carry the full line of Lely equipment including the new Lely Juno Feed Pusher

Come see us and ask how we can help you get more milk from your cows and your life a little easier



# WHAT THE LEADER GIVES YOU



Pioneer Hi-Bred offers a full lineup of seed products to help maximize the productivity and profitability of livestock producers.

Contact your local Pioneer Hi-Bred sales representative to learn more about the Pioneer® brand corn hybrids, alfalfa varieties and Sila-Bac® brand forage inoculants that are suitable for your operation.

[www.pioneer.com/canada](http://www.pioneer.com/canada)



**PIONEER®**  
BRAND · SEEDS

®, SM, TM Trademarks and service marks licensed to Pioneer Hi-Bred Limited. All purchases are subject to the terms of labelling and purchase documents. © 2009, PHL.



## **Lely Heatime Heat Detection System**



— innovators in agriculture —

***Do you think heat detection 24 hours a day,  
365 days a year is impossible?  
Westgen has a solution!***

***Lely Heatime technology monitors the activity of cattle and identifies when the animal should be bred. The 'stand alone' system does not need to be linked to any milking system or computer making it very affordable for any loose housing environment.***

- |   |  |
|---|--|
| • <b><i>Lely Heatime is on the job 24/7<br/>reliably detecting heats for you!</i></b> | • <b><i>Highly accurate at detecting<br/>abnormally low or high activity</i></b> |
| • <b><i>Simple to set up, easy to use</i></b>   | • <b><i>Saves time, lowers days open</i></b>                                     |
| • <b><i>Well proven technology</i></b>  | • <b><i>Improves preg rates</i></b>  |
| • <b><i>Excellent solution for heifer barns</i></b>                                   | • <b><i>Lowers semen expense</i></b>   |
| • <b><i>User friendly graphic display</i></b>   | • <b><i>Very cost-effective</i></b>  |



***Western Canadian Farmer Owned***

***Contact your Westgen rep***

***1-800-563-5603 / [www.westgen.com](http://www.westgen.com)***