

# Compost Barn Basics

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Composting bedded pack dairy barns, commonly called compost barns, are generating a lot of interest among Minnesota dairy producers who are upgrading their milking herd facilities. Minnesota has at least six compost barns in operation and more under construction. Producers interested in modernizing their dairy housing facilities are considering compost barns as an alternative to freestall barns for milking herd and special needs housing.

The experience of Minnesota dairy producers with compost barns has been very positive to date. From their experience it is apparent that when the composting bedded-pack is managed well, the cows are clean, comfortable, have fewer lameness problems, and lower SCC.

Composting bedded pack dairy barns require proper design, location, and exceptional management to provide a well-ventilated, dry place for cows to lie down. Well-managed compost barns can provide excellent cow comfort. Current design and management recommendations are based on the experiences of Minnesota dairy producers who have compost barns. The Minnesota systems were based on systems being used by dairy producers in Virginia.

## Building Layout

Minnesota composting bedded pack barns are the same width as either two-, three- or four-row freestall barns. These building widths allow the barns to be remodeled into a freestall barn in the future if desired. In a compost barn, the freestalls and freestall alleys are replaced with a composting bedded pack. Compost barns have a concrete feed alley, a composting bedded pack, a 4-ft high wall separating the pack and feed alley, and 4-ft high walls around the other three sides of the bedded pack area. The 4-ft wall separating the bedded pack and the feed alley has a fence to prevent cows from walking over the wall, and walkways at each end for cow and equipment access to the pack area.

In Minnesota the bedded pack is sized to provide a composting bedded pack area of 80 ft<sup>2</sup> per cow. This allows all cows to lie down at the same time and still have space for a cow to get up to go eat or drink. A 52-ft by 115-ft compost barn with a 12-ft wide feed alley can house 57 milk cows. In Virginia the bedded pack was sized to provide 100 ft<sup>2</sup> per cow.

## Bedding and Aeration

Minnesota compost barn owners use dry fine wood shavings or sawdust for bedding. The fine particles improve handling, mixing, aeration, and composting. Straw and corn stalks do not work as well as the fine wood shavings. Until there is research on bedding alternatives, dry fine wood shavings and sawdust are recommended. Green or wet sawdust or shavings are not recommended.

The composting bedded pack is stirred (aerated) at least two times each day when the cows are being milked. Experienced compost barn operators suggest that the pack should be stirred to a depth of 10 to 12 inches twice a day. Bedded pack stirring is done with a cultivator attached to the front of a skid loader. The stirring aerates the pack to enhance composting. Stirring also mixes manure and urine on the surface into the bedded pack to provide a fresh surface for cows to lie on after returning from the milking center and eating.

A semi load of fine wood shavings typically lasts between 18 and 40 days, depending on weather. Fresh bedding is added when the bedded pack becomes moist enough for it to stick to the cows after they rise from lying down on the composting bedded pack.

### **Manure Handling**

The concrete feed alley is scraped twice a day. The collected manure and bedding is stored in an approved manure storage unit until land applied according to a manure management plan. One producer installed a mini-pit at the end of the compost barn for short-term storage.

The bedded pack area can have a clay base. Care must be taken to avoid disturbing the clay base during clean out and pack stirring when the bedded pack is less than 1 ft deep. The composting bedded pack is typically cleaned out and land applied in the fall after corn silage is harvested. Fall clean out allows time for a new pack to accumulate and begin composting before cold weather sets in. Some operators remove some of the bedded pack in the spring before fields are planted to make sure there is sufficient space for pack accumulation during the summer when cropland is not available for manure application.

### **Ventilation and Location**

Good ventilation is needed to remove cow heat and moisture as well as the heat and moisture that the composting pack generates. Minnesota composting bedded pack barns are naturally ventilated, which makes location very important. Locate naturally ventilated barns in an open area where summer winds can blow through open sidewalls and the ridge in warm weather. Compost barns should be located at a slight elevation to the surrounding terrain to minimize rain and snow melt runoff from entering the barn and wetting the bedded pack.

Sufficient sidewall height is critical for enhancing natural ventilation and providing equipment clearance to the composting bedded pack. The sidewall height for a bedded pack is recommended to be higher than that for a freestall barn to accommodate the sidewall opening lost due to the manure pack walls. Minnesota compost barns have 14-ft sidewalls but some owners say they would go to 16 ft for their next barn to provide better access for bedding trucks.

The compost barns in Minnesota are all curtain-sided, naturally ventilated barns with open ridges that range from 1 to 3 inches per 10 ft of building width. One Minnesota compost barn has eight 3-ft diameter mixing fans located on the south side blowing air downward toward the middle of the composting bedded pack, hung high enough to provide room for stirring equipment at the maximum bedded pack height. Minnesota compost barns have 3-ft eave overhangs to minimize the chance of roof runoff and rain being blown into the barn onto the bedded pack.

### **Water**

Waterers are located along the feed alley. Some barns have waterers on the cow side of the feed manger. Some barns have waterers located adjacent to the concrete wall separating the composting bedded pack and the feed alley. Waterers are not located in the bedded pack area to minimize wetting of the pack and to keep the waterers cleaner.

## **Composting Bedded-pack**

Management of the composting bedded-pack is critical to the success of compost barns. A composting bedded pack is not a conventional bedded-pack where bedding (usually shavings, straw or corn stalks) is added periodically to cover the soiled surface. A composting bedded-pack is a deep bedded-pack that is aerated to support active composting.

Composting is a natural aerobic (requires oxygen) process where microorganisms consume oxygen and produce carbon dioxide, moisture and heat. Cow manure and urine provide nutrients (carbon, nitrogen, moisture, and microorganisms) for composting.

## **Composting and Pathogens**

There is no detailed research on the effect of composting on mastitis pathogens. Other compost studies indicate that optimum composting conditions can inactivate pathogens and viruses. These results suggest that composting, if done well, would probably be detrimental to mastitis pathogens too. Some Minnesota compost barn owners have reported significant drops in SCC with the composting bedded-pack.

Composting can generate temperatures between 130° and 150°F within the composting materials. These temperatures are needed to inactivate pathogens and viruses. Maintaining a temperature of 130° to 150°F for 3 to 4 days favors destruction of weed seeds, fly larvae, pathogens, and viruses. Properly composted materials have minimal odor and provide a poor breeding substrate for flies and other insects.

## **Composting and Moisture**

Composting requires sufficient moisture for active microbial activity but not so much moisture to hinder aeration. Moisture levels between 40 and 65% are generally recommended for composting most materials. Urine, wet manure, and moisture from microbial activity are the moisture sources in a composting bedded-pack. Stirring the pack both aerates and mixes moisture and manure into the composting bedded-pack. Good ventilation helps dry the freshly turned bedded-pack surface to retard bacterial growth on the surface and keep cows cleaner since dry bedding does not stick to the teat or leg surfaces. Minnesota compost barn owners recommend adding fresh bedding when the bedded pack becomes moist enough to stick to cows.

## **Composting Bedded-pack and Cow Comfort**

Minnesota compost barn owners report that composting-bedded pack barns provide excellent cow comfort. The cows spend most of their time either eating or resting and chewing their cud. Compost barn owners report that cows with leg or feet problems can recover in a compost barn.

## **Compost Barn Costs**

Detailed cost comparisons between compost and traditional freestall barns are not available. Compost barns are expected to have higher costs for longer poles for sidewall heights from 14 to 16 ft versus 12 to 14 ft for freestall barns and the 4-ft concrete wall around the composting bedded pack. Compost barns have lower costs because freestalls and mattresses are neither purchased nor installed, there is less concrete for manure alleys and curbing, and the equipotential plane is smaller. Labor for stirring and aerating the composting bedded-pack is expected to equal that needed to scrape the manure alleys.

Compost barns provide solid manure storage, which is expected to reduce the size of a manure storage needed for a freestall barn. The feed alley is scraped twice a day and the manure needs to be stored until land applied. Compost barns may require access to solid manure and liquid manure handling equipment.

Compost barns need to be larger than comparable freestall barns to house the same number of animals. The composting bedded-pack is sized to provide at least 80 ft<sup>2</sup> of composting bedded pack per cow. The comparable square footage in a two-row freestall barn for the freestalls and freestall alleys would be 52 ft<sup>2</sup> per cow assuming 100% stocking density and 4-ft wide freestalls. In a three-row freestall barn it would be 47 ft<sup>2</sup> per cow.

Compost barns generally use more bedding than freestall barns. Fine wood shaving use varies by weather and humidity level. A semi-load lasts between 3 to 5 weeks. Bedding costs range from 34 to 50 cents per day per cow.

### **Bottom Line: Based on What we Know Today**

- Composting bedded pack barns are an alternative housing system for milking and special needs cows that provide very good cow comfort.
- Bedding management is critical to encourage composting and minimize pathogen exposure.
- Fine wood shavings or sawdust is best for the composting bedded pack. This is contrary to the advice for freestall bedding where fine sawdust is not recommended because bacteria growth (environmental mastitis) is faster, increasing teat exposure to pathogens. In the composting bedded-pack, microbial growth is encouraged to increase the composting bedded pack temperature to inactivate pathogens. Reports from Virginia indicate that other bedding types (straw and corn stalks) do not work as well as fine wood shavings.
- The composting bedded-pack MUST be mixed and aerated two times per day at 10 to 12 inches deep. Mixing incorporates oxygen to enhance composting and aerobic decomposition of the manure and urine, and it removes manure and urine from the bedding surface.
- Ventilation is critical to remove heat and moisture from the cows and composting bedded-pack. Drying of the bedded surface will retard bacterial growth and keep cows cleaner because dry bedding does not stick to teats or leg surfaces.
- Excellent pre-milking cow prep is required when using a composting bedded-pack to remove bacteria from the teat surface. Excellent cow prep will reduce the number of bacteria that end up in the milk and in the teats when air slips (squeaks and squawks) occur during milking, which can establish a new mastitis infection.
- Compost barns are generally built taller than freestall barns to have the same sidewall opening above the bedded pack for ventilation, aeration equipment, and the sawdust semi. Building widths have been similar to freestall barns to allow easy remodeling in the future.