

Ventilation of Pre-Weaned Calf Barns

Part 1: Principles and Concepts

Importance

Good calf barn ventilation is a significant contributor to the health and welfare of calves. Some diseases spread through the air, and inadequate air exchange rates can favor higher concentrations of pathogens. Therefore, to provide the calf with a healthier environment continuous fresh air should be provided in all seasons to reduce pathogen concentrations and in turn, the spread of airborne diseases. This process of using outside fresh air to replace mildly contaminated air within the barn is known as air exchange (Figure 1). Natural ventilation, mechanical ventilation, or a combination of both ventilation systems known as natural assist can provide requisite air exchange, but the best system for a particular barn depends on many factors including:

- Siting
- Orientation
- Presence of and exposure to winds
- Design
- Stocking Density
- Management

Proper ventilation reduces environmental stress on the calf by keeping the barn as close to ambient conditions as possible and in some cases through controlling air temperature and airspeeds. On the other hand, improper ventilation can cause respiratory problems, reduced feed intake and conversion efficiency rates, and have long-term effects on the calf's ability to cope with environmental stress later in life.

Air Exchange

The goal of air exchange is to ensure the barn microenvironment surrounding the calf (at the nose zone) to be fresh, clean air at all times. In the process of air exchange fresh outside air is brought into the barn, mixed and circulated to pick up slightly stale air, and exhausted resulting in higher in-barn air quality. The exchange of air impacts:

- Air temperature
- Air temperature uniformity
- Moisture level
- Moisture condensation on surfaces
- Air speed across animals
- Odor and gas concentrations
- Airborne dust and pathogen level

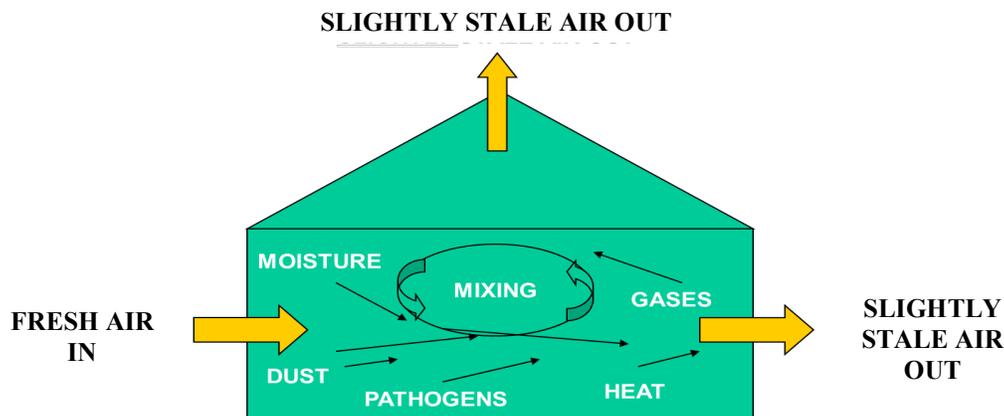


Figure 1. Air exchange through a calf barn.

As the system exchanges air, oxygen is brought in while dust, pathogens, noxious odors, excess moisture, and excess heat are diluted then removed.

Microenvironments

Overall barn ventilation does not always ensure ventilation of the calf nose zone. Calf pens are microenvironments within the barn with the potential to contain higher concentrations of pathogens, noxious odors, excess moisture, and heat accumulation without proper ventilation. Calves typically spend 100% of their time in the pens; therefore, proper system design and management is needed to ensure healthy air is provided. A ventilation system must focus the air exchange through the pen to ensure fresh air is reaching the calf and no stale air spots are within the pen environment.

Types of Barns

There are three distinct types of pre-weaned calf barns. Each is distinguished by its own conventional methods of ventilation and environmental conditions.

Cold Barns have no air tempering mechanisms and barn air temperature is very similar to ambient temperature.

Controlled Environment attempts to maintain more moderate temperatures than the ambient through the use of insulation, adjustable eaves, and ridge openings.

Modified Environment avoids extreme temperatures by heating ventilation air to a target temperature. These barns are typically

closed off from free air movement, and modify the temperature, humidity, and speed of air entering the environment.

Season Exchange Rates

Airflow requirements vary with animal size and in-barn environmental conditions. Ideally, ventilation air exchange rates must vary from just enough air to maintain air quality during very cold weather, up to rates high enough to eliminate environmental stress during hot weather. A *minimum* of three distinct seasonal ventilating rates exist; named appropriately as cold, mild, and hot.

Cold weather ventilation provides oxygen and removes moisture to maintain air quality while careful to not create drafty conditions.

Mild weather ventilation modifies temperature and removes moisture.

Hot weather ventilation reduces heat buildup and increases air movement.

Drafts

Airspeed is especially important during colder months when drafts through the calf area can draw heat away from the calf causing stress. The speed at which the air movement is considered a draft has a wide range reported, although a generally accepted number is approximately 60 feet per minute^[1]. This varying range can be explained by the many aspects that tie into what airspeed the calf will feel as a draft such as: the humidity, use of calf jackets, management, and the depth and type of bedding materials used.

FACT SHEET SERIES

Ventilation of Pre-Weaned Calf Barns

Part 1: Principles and Concepts

Part 2: Overview of Methods

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REFERENCES

[1] Chamberlain, T. (2015). Environmental aspects of pneumonia control in calf units on British dairy farms. UK-Vet Livestock Volume 20 issue 6.

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