ABILITY OF LOW PROFILE CROSS-VENTILATED FREESTALL BARNS TO IMPROVE ENVIRONMENTAL CONDITIONS FOR DAIRY CATTLE

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Summary

Recently, there has been interest in constructing mechanical ventilation with evaporative pads to improve the environmental conditions for cows during periods of heat stress. Low profile cross-ventilated freestalls with evaporative pads (LPCV) have become a popular system. The purpose of this study was to evaluate how well these LPCV systems improve the temperature-humidity index (THI) under different ambient conditions. As ambient humidity increases, ability of the LPCV to reduce THI is decreased. Producers wishing to construct LPCV barns should carefully evaluate the climate in which they want to construct LPCV structures.

(Key words: THI, heat stress, cross ventilation.)

Introduction

Recently, producers have used cross-ventilation with evaporative pads to cool the air around the cow. As water is evaporated into the air, temperature will drop, and humidity will increase. Expected changes in THI, under different environmental conditions, using evaporative cooling, is presented in Figures 1 and 2. As humidity increases, it becomes more difficult to change the environment in which the cow is housed. It is important to have realistic expectations about the ability of these systems to change the environmental conditions in which they will be operated.

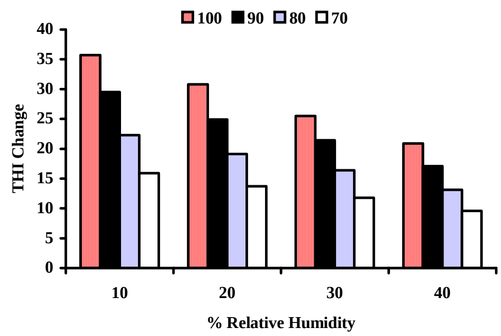

Figure 1. Potential THI Change in Response to Water Evaporation at 100°, 90°, 80°, and 70°F in a Low Relative Humidity Environment (Adapted from ASHRAE Handbook, 1993).

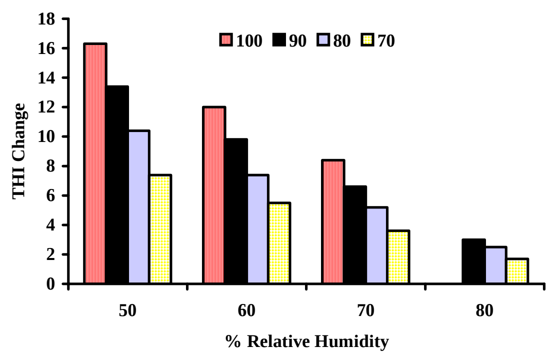

Figure 2. Potential THI Change in Response to Water Evaporation at 100°, 90°, 80°, and 70°F in a High Relative Humidity Environment (Adapted from ASHRAE Handbook, 1993).

Procedures

During the summer of 2006, data loggers were used to evaluate an 8-row, low-profile, cross-ventilated, freestall barn with evaporating pads to determine the ability of this system to reduce heat stress under different environmental conditions. The facility evaluated was 210 feet wide by 420 feet long, with a sidewall height of 13 feet, and a roof pitch of 0.5 feet in 12 feet. Two data loggers were installed to monitor ambient, barn intake, and barn exhaust temperature and percent relative humidity every 15 minutes. The THI was calculated for ambient, barn intake, and barn exhaust locations.

Results and Discussion

Temperature data collected in this study demonstrates the limitation of the LPCV system to improve the environment inside the structure during periods of high humidity. Ambient barn intake and barn exhaust temperature, relative humidity, and THI for 4 different days (July 1, 4, 26, and 29, 2006) with different ambient conditions are presented in Figures 3 through 14. These figures demonstrate that as ambient humidity increases, ability to reduce temperature with evaporative cooling (evaporative pads) and cross ventilation is compromised. Individual climates should be evaluated to set realistic expectations on how well the LPCV system will improve environmental conditions. Further research is needed to investigate the combination of soaker and evaporative cooling to reduce potential heat stress during periods of high relative humidity and high temperatures.

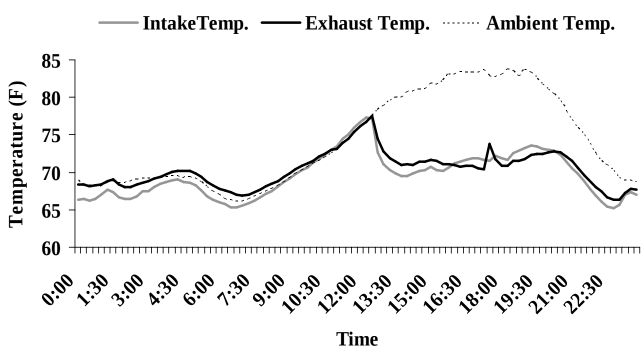

Figure 3. Typical Day Temperatures (July 1, 2006).

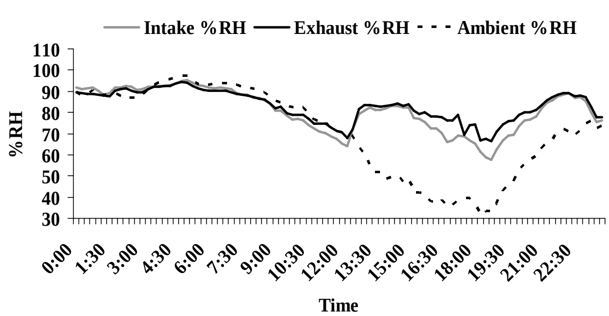

Figure 4. Typical Day Relative Humidity (July 1, 2006).

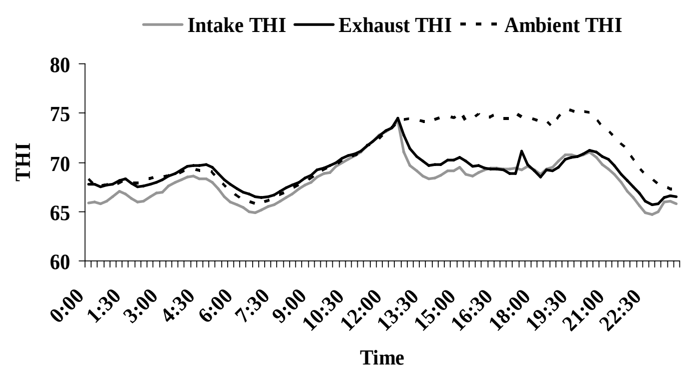

Figure 5. Typical Day THI (July 1, 2006).

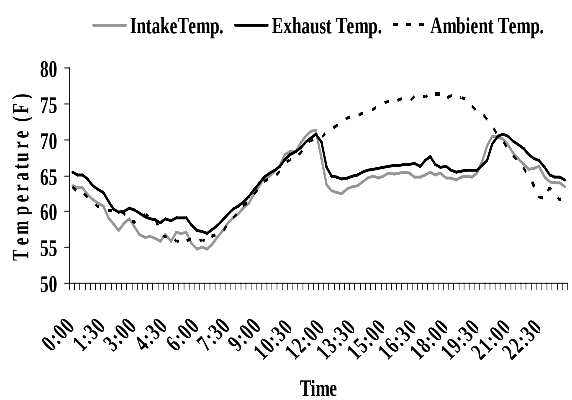

Figure 6. Typical Cool Summer Day Temperatures (July 4, 2006).

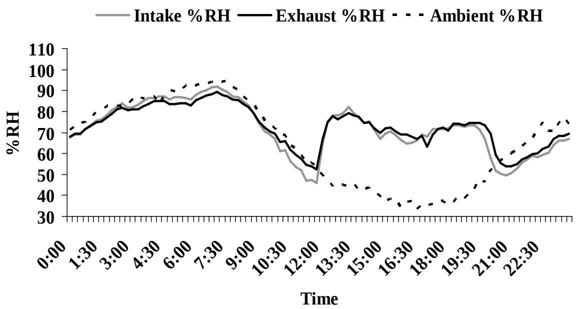

Figure 7. Typical Cool Summer Day Relative Humidity (July 4, 2006).

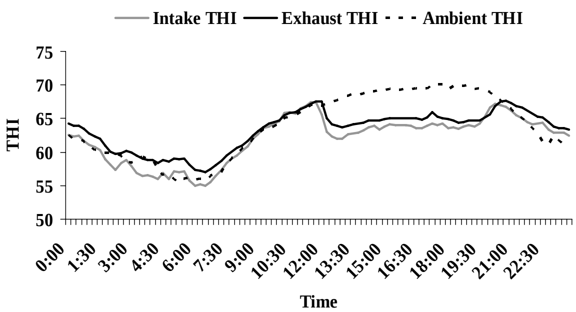

Figure 8. Typical Cool Summer Day THI (July 4, 2006).

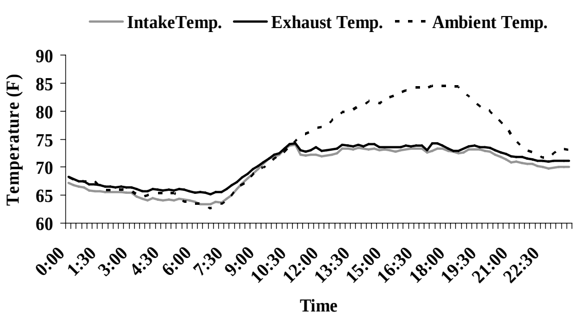

Figure 9. Typical Low Humidity Day Temperatures (July 26, 2006).

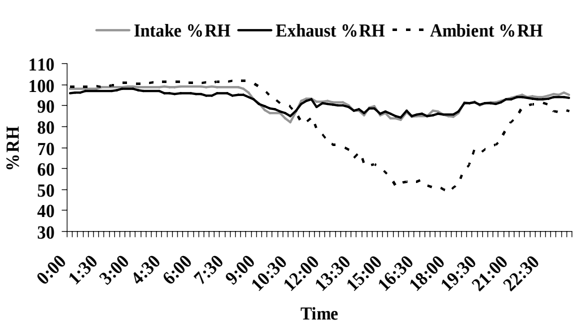

Figure 10. Typical Low Humidity Day Relative Humidity (July 26, 2006).

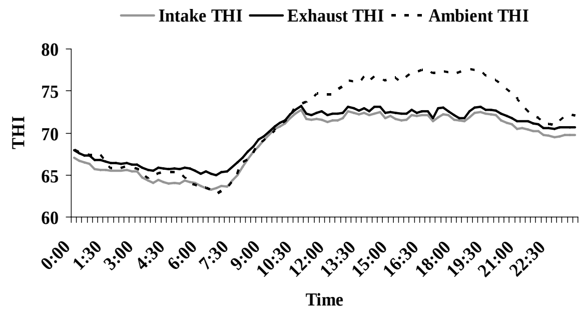

Figure 11. Typical Low Humidity Day THI (July 26, 2006).

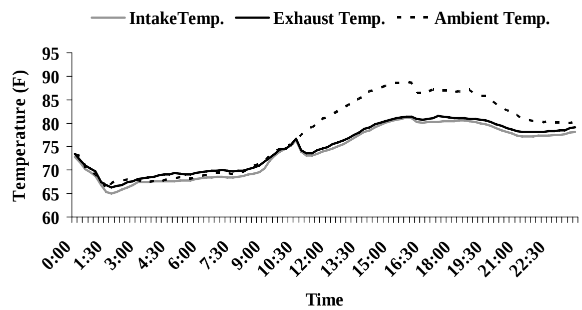

Figure 12. Typical Very Humid Day Temperatures (July 29, 2006).

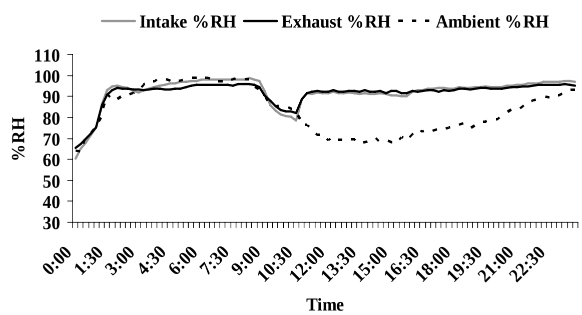

Figure 13. Typical Very Humid Day Relative Humidity (July 29, 2006).

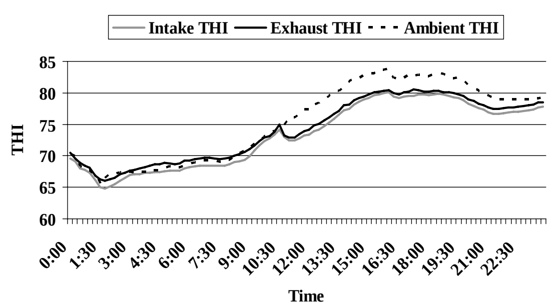

Figure 14. Typical Very Humid Day THI (July 29, 2006).