



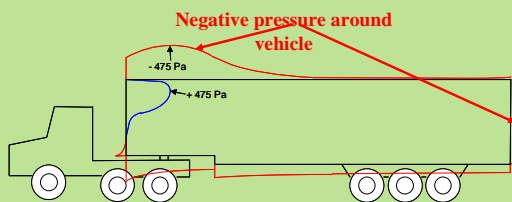
Conditions within Trailers Transporting Market Hogs in Western Canada

Trever Crowe Ph.D., P.Eng.

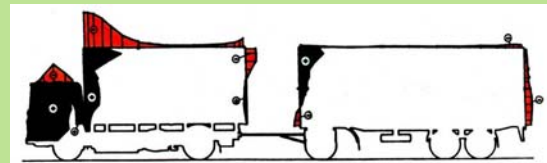
What affects conditions inside trucks?

- The pigs! – sources of heat and moisture
- Radiation – heat gain (sun, road, tractor)
- Air flow – removal of heat and moisture
 - Openings in the truck envelope
 - Locations
 - Are they open?
 - Porosity of gates
- What causes air to move?

Pressures external to the vehicle



- Air moves from higher pressure to lower pressures
- In an enclosed moving truck – from rear to front



Summary

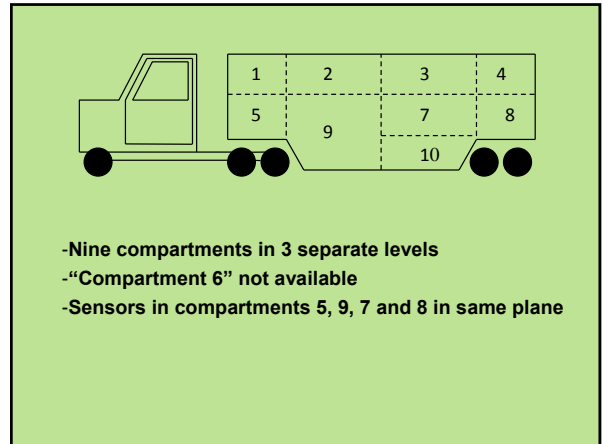
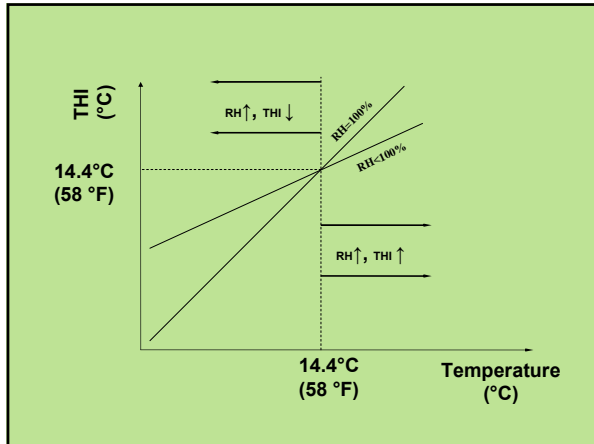
- No pressure gradient across vehicle = no cross flow
- Solid floors prohibit vertical flow
- Front-to-rear flow possible with solid sides, openings in front and rear
- Zero air flow when vehicle is stationary – heat and moisture accumulation

Why measure temperature and relative humidity?

- combination affects how animals (people) cope
- a “dry heat.” or “dry cold” actually matters
- described as a “temperature-humidity index”

According to NRC (1971):

$$THI (^{\circ}F) = [1.8 * T + 32] - [0.55 - (0.0055 * RH)] * [1.8 * T - 26]$$



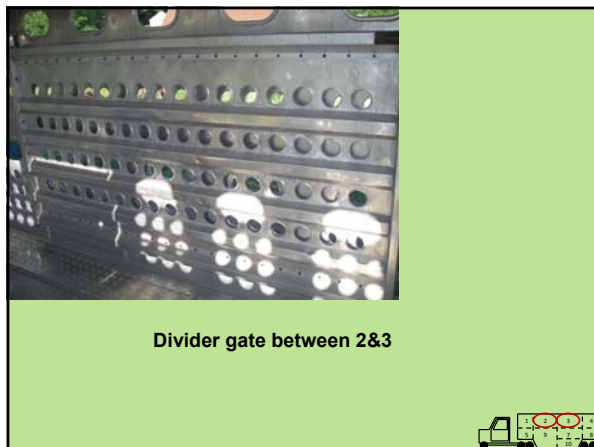
- Nine compartments in 3 separate levels
- “Compartment 6” not available
- Sensors in compartments 5, 9, 7 and 8 in same plane



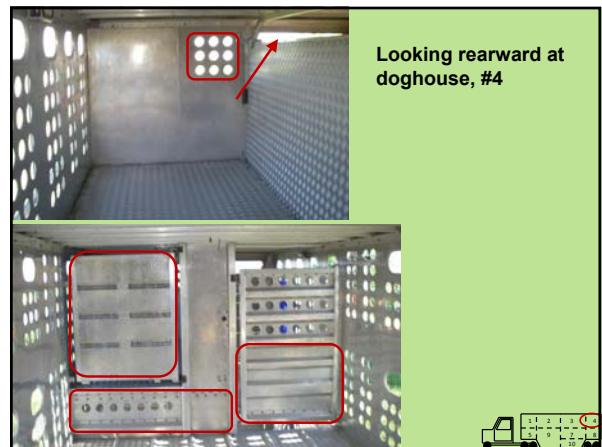
Looking forward, into compartment 1



Looking forward into #1 and #5



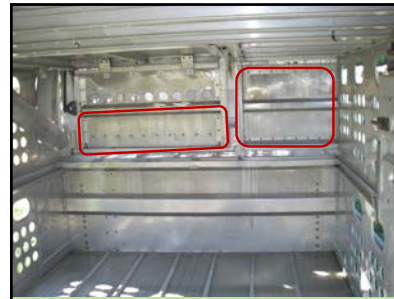
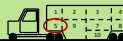
Divider gate between 2&3



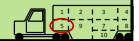
Looking rearward at doghouse, #4



Compartment 5 looking forward



Looking forward to #5, standing in #9



Looking rearward from #9,
gate between 9 and 7 closed



Rear wall/ramp of #10



Looking rearward into #8



Summary

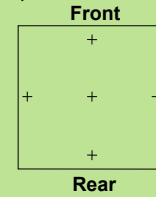
- Two sets of openings in front wall of #1
- Some solid gate between #1 and #2
- Solid gate between #3 and #4
- Opening in the rear wall of #4 and top of door
- Solid gates between #5 and #9/2
- High ceiling in #9 and portion of #8
- Low ceiling in #7 and #10
- Solid rear wall in #10



The Experiment

- Evening travel
 - zero solar radiation gain
 - relatively cool in summer
 - coldest possible conditions during winter
- Same truck
 - simplifies comparisons
 - Data were not adjusted based on ambient temperature
- Winter: 5 trips (-10, -12, -20, -28 and -13 C)
- Summer: 6 trips (10, 13, 10, 12.5, 14 and 15 C)

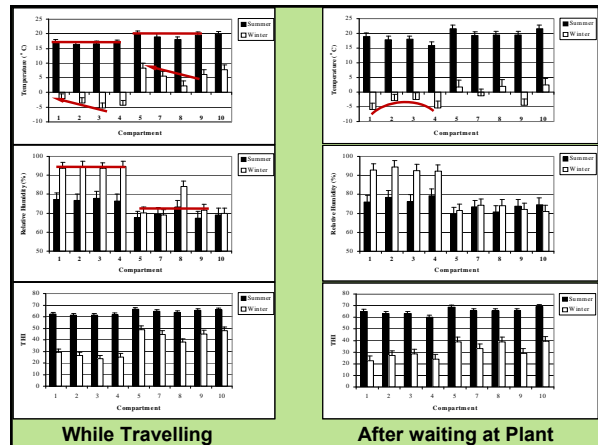
-Five (5) mini data loggers mounted inside each of 9 compartments (1 compartment with 4, 44 in total)



- Record temperature and relative humidity once each minute
- Sensors in compartment 9 at same level as those in compartments 5, 7 and 8
- Same trailer used for all trips – no differences due to trucks



Data loggers attached to ceiling of the truck



Summary

Winter

- Uniformly saturated conditions on the top deck, lower humidity levels on middle deck and compartment 10
- Temperatures colder at rear
- Compartments #5 and #10 consistently warmest

Summer

- Top deck cooler than rest of trailer
- Higher humidity levels on top deck
- Temperatures colder at rear
- Compartment #5 and #10 consistently warmest

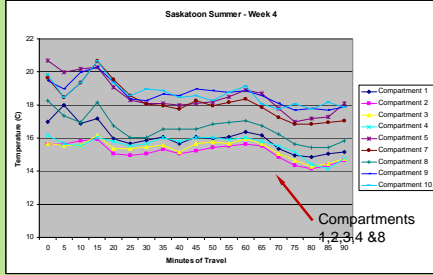


Conclusions

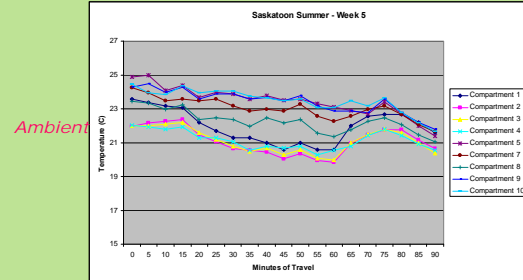
- Radiative heat loss from roof cools upper deck in both seasons
- Higher humidity in upper deck suggests less airflow
- General airflow from rear to front during winter, collecting heat in #1 and #5
- When stopped, center warms up while outside cools – “solid gates” may lead to isolating compartments 1 and 5 from 2 and 3



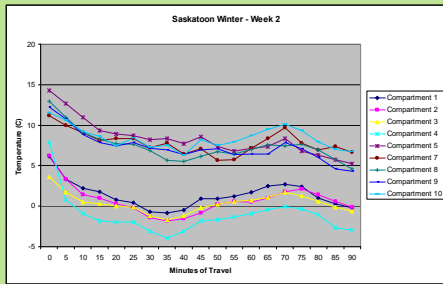
Truck Temperature: Cool Summer



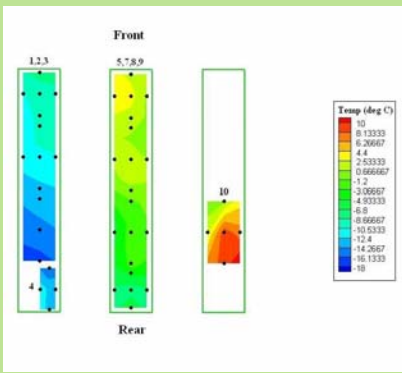
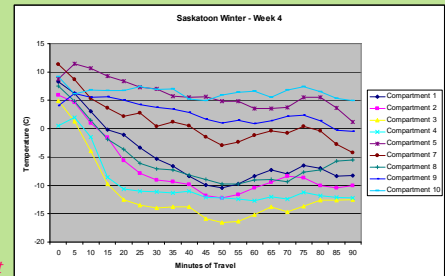
Truck Temperature: Hot Summer



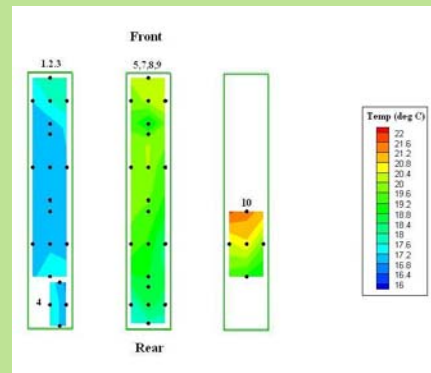
Truck Temperature: Warm Winter



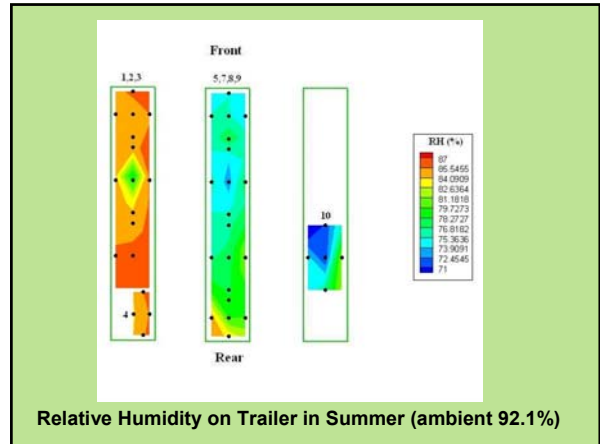
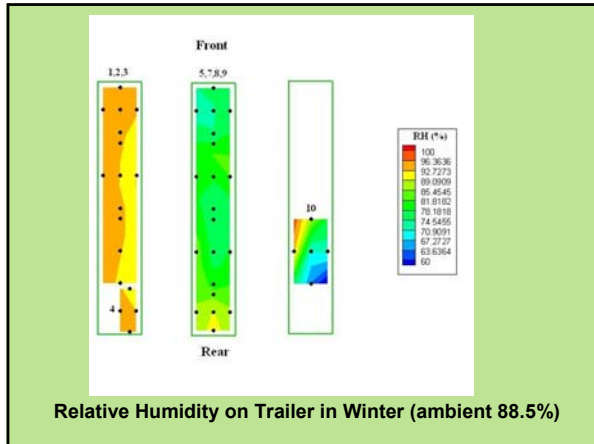
Truck Temperature: Winter Cold



Trailer Temperatures in Winter (ambient -28°C)



Trailer Temperatures in Summer (ambient 15.6°C)



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