Introduction

In order to support and promote additional research efforts at the Charles C. Miller Poultry Research and Education Center, the efficiency of the transport of chicks from the hatchery to Auburn, AL has been investigated. Currently, large tractor trailer trucks traveling up to four hours from the hatcheries to the research farm are being used for transport. Availability of the tractor trailers is a growing issue and extremely inefficient due to the small load size of 6,000 chicks. The goal of this project is to design and construct a more efficient, smaller scale way of safely transporting the chicks from hatcheries to Auburn, AL to aid in research initiatives for the Poultry Science department.

During design, special attention will be given to the following constraints: the environment for the 6,000 chicks being transported will be climate controlled, including maintaining a temperature of 95°F and a relative humidity range from 50% to 70%; chicks will be transported 100/each tray in an industry standard sized tray; and $60,000 is the target budget.

Objectives

1. Design a climate controlled system, including heating and humidity control systems, that provide even airflow and ventilation across all trays and consistent temperature and humidity throughout trailer.
2. Design interior cargo mechanisms that allow trays to be locked during travel and then removed easily when needed for loading/unloading or other purposes;
3. Select a power system that provides sufficient and reliable power to systems, and design a housing for the generator to be protected from the elements;
4. Implement a system to wirelessly monitor environmental factors from inside the cab of the vehicle;
5. Ensure a waterproof interior that allows for washing and cleaning of unit to aid in disease prevention.

Design Overview

Mixing Room provides a chamber to homogenize the warm air and humidity and consists of:
- 3 heater system
- Humidifier
- Vent

Ventilation System ensures chicks are in an environment to prevent CO2 buildup and promote air exchange by using:
- 6 stir fans
- Intake fan
- Exhaust fan
- Duct system

Power and Controls are used to provide energy to the trailer and regulate air exchange rates within the trailer by using:
- Temperature and timer based controls
- Diesel generator
- Diesel storage tank

Flooring/Securing System allow chicks to be secure during transport while preventing discomforts from moving trays through the use of:
- Floor rails
- Back stop
- Shoring rails
- Ratchet strap tie down

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- Intake fan
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Heat Loss

The worst case scenario for heating was considered to be 23°F while traveling 70 mph. R-values were calculated by taking into consideration the layers of the cross section of the trailer, which was used to calculate the conductive heat loss. Then, the convective heat transfer was calculated, and the total heat loss of the trailer was 5037 BTU/hr.

Table 1: R-Values by trailer section.

<table>
<thead>
<tr>
<th>R-Value</th>
<th>Wall &amp; Door</th>
<th>Floor</th>
<th>Ceiling</th>
</tr>
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<tbody>
<tr>
<td>9.07</td>
<td>3.73</td>
<td></td>
<td>8.07</td>
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</tbody>
</table>

CO₂

To account for the CO₂ buildup produced by the chicks within the trailer, calculations were conducted using 86°F and 40% RH that yielded a total heat production of 9 W/kg. Using a x1.5 factor of safety with 6,000 chicks, it was possible to stay under 3,000 ppm CO₂ with a ventilation rate of 125 cfm.

Cost Analysis

A 6 x 12 ft. enclosed cargo trailer was retrofitted with power, heating, ventilation, monitoring, control, and securing systems to ensure safe transport of at least 6,000 hatchlings from hatcheries to the Auburn, AL research site. Fresh air and humidity is homogenized before air exchange, which will occur when temperatures fall out of the specified range safe for hatchlings. Lastly, the total cost of $23,179.82 which is significantly below the $60,000 budget.

Summary

A 6 x 12 ft. enclosed cargo trailer was retrofitted with power, heating, ventilation, monitoring, control, and securing systems to ensure safe transport of at least 6,000 hatchlings from hatcheries to the Auburn, AL research site. Fresh air and humidity is homogenized before air exchange, which will occur when temperatures fall out of the specified range safe for hatchlings. Lastly, the total cost of $23,179.82, which only uses 39% of the given budget.

Acknowledgements

Dr. Jeremiah Davis - Biosystems Engineering, Auburn University
Mr. Jon Davis - Biosystems Engineering, Auburn University