Evaporative Cooling Pad Cleaning System for Poultry Housing
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Capstone Group J

PROBLEM STATEMENT
Livestock farmers depend on the use of evaporative cooling in an enclosed environment to prevent livestock from overheating during warm months. The evaporative cooling method is cost-effective and efficient, especially when properly maintained. A popular evaporative cooling device is evaporative pads, as shown in Figure 1. A problem that farmers encounter with evaporative cooling pads is that no standard method of cleaning is in place for maintaining them. Over time, calcium deposits from the farmer’s water supply, dirt, spider webs, and other media clog the evaporative cooling method is kept cost effective and efficient, especially when properly maintained. A popular evaporative cooling device is evaporative pads, as shown in Figure 1. A problem that farmers encounter with evaporative cooling pads is that no standard method of cleaning is in place for maintaining them. Over time, calcium deposits from the farmer’s water supply, dirt, spider webs, and other media clog the pads shown in Figure 2. Most farmers attempt cleaning the pads with a pressure washer, which is very time consuming, requiring roughly 4 hours per house. As shown in Figure 6, the flumes in an evaporative pad are overlaid in two different angles. When these flumes are not cleaned at the proper angles, there is still an excessive amount of deposits remaining inside the flumes.

DESIGN OBJECTIVE
- Design a mobile evaporative pad cleaning system to be transported by truck and utility trailer, based on the use of non-compressed air, that can be offered as a commercial service for livestock farmers to clean evaporative cooling pads.

ANALYTICAL RESULTS

Figure 3: Air Nozzle Experiments

From experimentation, the application of high velocity fluid was determined to be the best way to remove debris from the pad flutes. Air was found to be the less cumbersome fluid, since it does not hurt the structure of the pad and it is a virtually infinite resource. To combat the extreme demands of a high-pressure system, two air knives are used for low pressure, high-velocity air delivery of 120 cfm over a wide area of 18” x 128” (chosen for measuring simplicity). The value of 128 fps is close to the “115 fps that was found to be ideal in experiments. To generate the airflow, two low pressure blowers are employed to deliver 120 cfm at less than 1 psi. Calibration, spider webs and other hard surface debris cannot be removed by high-velocity air, so a rotary brush is used to physically remove them.

Figure 1: 1/8” Utility Trailer, based on the use of non-compressed air, that can be offered as a commercial service for livestock farmers to clean evaporative cooling pads.

DESIGN OVERVIEW
Generator
A large, diesel generator will power both blowers. The Generator is depicted in the figure at right as a large red cube.

Stage 1: Rotary Brush
(Above)
The brush is a 6-inch diameter, medium-stiff, rotary brush. The brush is powered by a small 1 horsepower electric motor. This motor is powered by the generator which is also used to power both blowers. The purpose of the brush is to knock off spider webs, exterior dirt, and calcium deposit.

Stage 2: Air Knives
(Figure 3)
This system utilizes two air knives, each set at an angle matching the flute angles of the pad itself. Each knife is powered by its own high velocity, low pressure blower. Each blower generates 120 cfm @ 5 inches of H2O. The cleanout velocity of the air knife is dictated by the site and how small the opening is set at. Based on calculations in Chart 1, the air knives will be set at 1/8” which will produce 128 fps of air.

Figure 4: Cleaned flutes before and after sufficient cleaning

Stage 3: Air knives are carried over brush and air knives at 1 fps and sufficiently cleaned in one pass.

Stage 4: Another airknife, at the end of the conveyor, will remove and stack cleaned pads for replacement in house.

Stage 5: One crewmember begins to place pads on conveyor line.

Stage 6: Pads are carried under brush and air knives at 1 fps and sufficiently cleaned in one pass.

Stage 7: Subsequent pads are added when 2/3 of previous pad is through roller brush.

Stage 8: Remove pads from housing and take them to trailer.

Stage 9: Park trailer near or between houses.

OPERATIONAL PROCEDURES

COST ESTIMATE

Table 1: Summary of Projected Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuts, Bolts, and Washers</td>
<td>$205</td>
</tr>
<tr>
<td>Hose, Hose Clamps, and Fittings</td>
<td>$258</td>
</tr>
<tr>
<td>Blowers and Air Knives</td>
<td>$2,033</td>
</tr>
<tr>
<td>Generator</td>
<td>$5,125</td>
</tr>
<tr>
<td>18” Utility Trailer</td>
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<tr>
<td>Conveyor System</td>
<td>$3,010</td>
</tr>
</tbody>
</table>

TOTAL COSTS = $20,723.00

* Manufacturing/Contingency and Engineering Design percentages are based on perceived industry norms

REFERENCES

ACKNOWLEDGEMENTS
- Dr. Jeremiah Davis, P.E.: Auburn University Biosystems Engineering
- Dr. Mark Dougherty, P.E: Auburn University Biosystems Engineering
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- Auburn University National Poultry Technology Center