PURDUE UNIVERSITY | Agricultural and Biological Engineering

CAPSTONE/SENIOR DESIGN EXPERIENCE 2020

SB-5 Design of a Boar Cooling Pad

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1. Problem Statement:

The Purdue Hog Cooling Pad team has been developing a cooling pad for sows in farrowing crates. We have been working with the team to develop the current pad into a design for boars.

2. Background:

- Cooling pad uses water to help cool the hog
- Current pad (Figure 1) designed for farrowing crates
  - Second pad needed for boar stud
- Boars are picky and sensitive to heat stress
- Heat stress impacts semen production, morphology, and motility
- Temperatures above 88°F for 72 Hours results in 6 weeks of bad semen

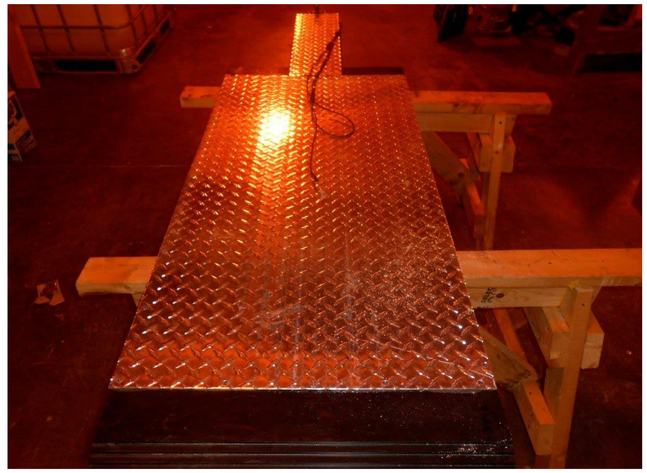

Figure 1: Sow cooling Pad

3. Factors:

Economic	Increased productivity Increased efficiency
Environmental	Decreased water usage Decreased electrical usage
Social	Animal Welfare

4. Constraints and Criteria:

Constraints

- Uses less than typical cool cell (<0.75 gpm/linear ft.)
- Low electrical demand
- Withstand weight of boar
- Serviceable by tools on farm

Criteria

- Recycles water
- Reliable
- Sized for easy moving and cleaning
- Easily serviceable
- Cost to make and price
- Manufacturability
- Animal welfare

5. Alternative Solutions:

- Cast pad
- Split pad
- Half pad
- Vertical pad
- Multi-crate pad (Figure 2)
- Slat pad

	Reliability and Performance	Cost	Serviceability	Installation	Total = 1
Scores	0.2	0.4	0.3	0.1	
Design 1	0.8	2.4	2.4	0.8	6.4
Design 2	1.4	2.4	2.1	0.7	6.6
Design 3	1.2	3.6	1.8	0.7	7.3
Design 4	2	1.2	0.9	0.2	4.3

Figure 2: Design Matrix

The design matrix, show in Figure 3, was used to determine the best solution.

6. Design of Solution:

There are five parts to the pad:

1. HDPE - strong base insulator
2. Copper pipe – holds the running water that cools the pad (Figure 4)
3. Temperature sensors – to easily see the pad is working properly
4. ThermoFin U® - creates more surface area for heat from the boar to the copper pipe
5. Diamond Plate Steel – strong protective covering

Several different parts were designed using AutoCAD. Pictured are the first drawings. As the project has progressed, it has changed and adapted. The model is adaptable for use as needed (Figure 5).

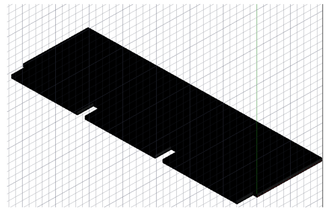

Figure 3: HDPE original design

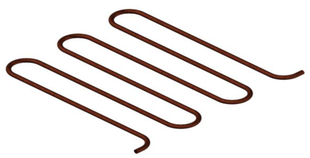

Figure 4: Copper Pipe

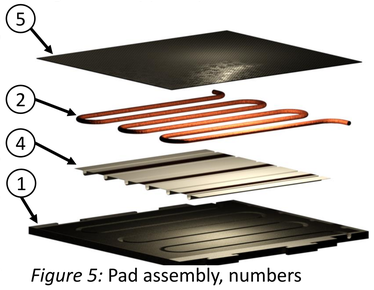

Figure 5: Pad assembly, numbers correspond to numbers located left. This does not include temperature sensors.

7. Deliverables

Final Design: The cooling pad will be able to be broken up into sections making easier to install and replace.

- Easy water connect and disconnect
- Temperature sensors throughout to show it is working
- Suggestions for quick shutoffs on each pad
- Small enough to keep defecation and urination from boar off the pad.

8. Implementation

The cooling pad is designed to be easily manufactured through injection molds and the bending of copper pipe. Once they are created there should be testing to determine efficiency of the pad, how it impacts the boars, and the impacts on the boar sperm. This can be done by running test trials at the Purdue boar stud and tracking the boar's respiration rates.

Figure 7: Crates at boar stud

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