

# Sow Cooling Pad

# Agricultural & Biological

ENGINEERING

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**Background**

- In 2015, a Senior Design team developed a sow cooling pad for use in farrowing facilities that would lower thermal discomfort in the sows crate to increase productivity.

**Problem Statement**

- Cooler used water from the farm, dumped exhaust water into the manure pit
- Wasteful/not realistic for large scale operations.

**Criteria**

- Close the system to improve efficiency in consumption, waste and operation management.
- Multiple Solutions for a closed system to cool and recirculate water
- Show cost analysis/decision matrix for solutions



**Barn Layout**

- 9,300 sow operation
- 240 crates/barn
- 60 crates/room
- 4 rooms/barn

**Maximum Water Flow**

- 144 gpm at full capacity
- 72 gpm average
- Two 89 gpm pumps to compensate

**Sow Heating Units Created**

- 460,000 btu/hr at max capacity
- 230,000 btu/hr average

**Geothermal Systems**

- 28 & 10 ton generators combined
- 42,000' of loop required
- 300 gallon recirculation tank

**Legacy Chiller**

- 35 ton chiller
- Air-Cooled
- 300 gallon recirculation tank

**Peltier Chips**

- 5/pad
- Independent pad operation
- Internal source to move water

**Economic Analysis**

|                    | Geothermal Vertical | Geothermal Horizontal | Legacy Chiller | Peltier Chips | Pit Cooled  | Piping PVC  | Piping Sch 40 Blk Steel |
|--------------------|---------------------|-----------------------|----------------|---------------|-------------|-------------|-------------------------|
| Barn Cost          |                     |                       |                |               |             |             |                         |
| Equipment          | \$25,000.00         | \$25,000.00           | \$65,900.00    | \$13,296.00   | \$25,679.61 | \$9,478.82  | \$22,371.62             |
| Install Generators | \$15,000.00         | \$15,000.00           | -              | -             | -           | -           | -                       |
| Loop               | \$2800/ton          | \$1300/ton            | -              | -             | -           | -           | -                       |
| Install Loop       | \$106,400.00        | \$49,400.00           | -              | -             | -           | -           | -                       |
| Install Pumps      | \$52,000.00         | \$52,000.00           | -              | -             | -           | -           | -                       |
| Isulation          | -                   | -                     | -              | -             | -           | \$5,449.14  | \$5,449.14              |
| Labor              | \$158,400.00        | \$101,400.00          | \$19,770.00    | \$3,988.80    | \$7,703.88  | \$4,478.39  | \$8,346.23              |
| 300 gl Recirc Tank | \$304.00            | \$304.00              | \$13,283.00    | -             | -           | -           | -                       |
| Total              | \$198,704.00        | \$141,704.00          | \$98,953.00    | \$17,284.80   | \$33,383.49 | \$19,406.35 | \$36,166.99             |



**Sustainability**

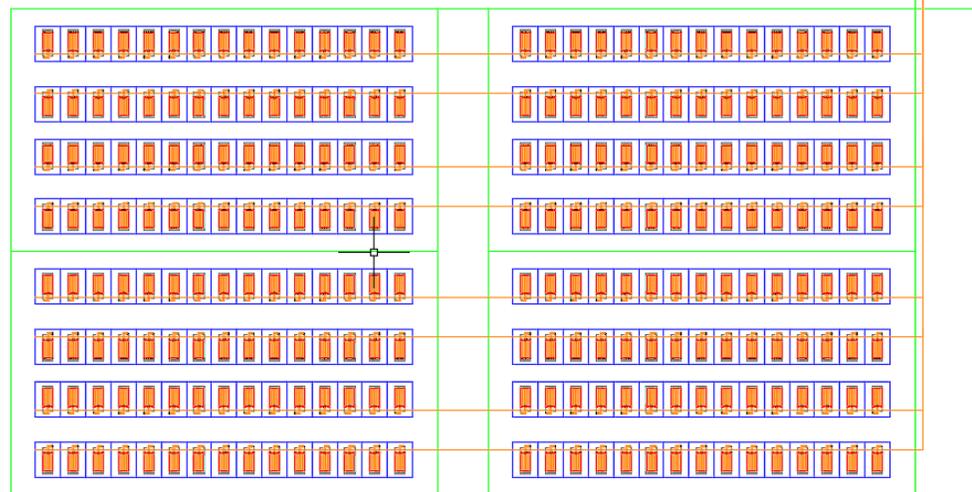
- Cooling pad Lifespan of 15 years
- Geothermal Generators 25-30 years
- Legacy Chiller 20-25 years
- Pit Piping lifespan 50+ years
- Peltier Chip lifespan 1 year
- 89 gpm pumps 10 years

**Impact**

- Gain of 2.5 pigs/pen/year climate dependent
- Gain of \$150-175/crate/year
- Improved estrus cycles
- Improved Daily Feed Intake (DFI)
- Improved Weaning Weight
- Improved sow health
- Lower gilt herd sizes

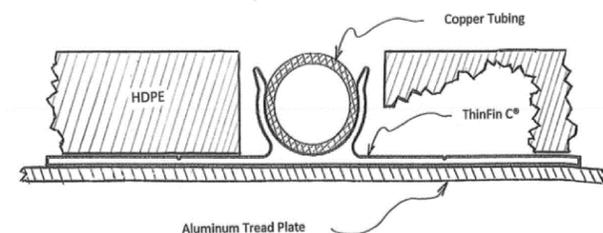
**Alternative Solutions/Evaluations**

| Solution              | Safety | Sustainability | Cost | Management | Viability | Score |
|-----------------------|--------|----------------|------|------------|-----------|-------|
| Vertical Geothermal   | 90     | 90             | 50   | 90         | 90        | 82    |
| Horizontal Geothermal | 90     | 90             | 80   | 90         | 90        | 88    |
| Legacy Chiller        | 90     | 85             | 85   | 90         | 90        | 88    |
| Pit cooled            | 10     | 80             | 90   | 20         | 10        | 42    |
| Peltier Chips         | 75     | 65             | 95   | 80         | 20        | 67    |



**Breakdown**

- Vertical - \$33.12/crate/year
- Horizontal - \$23.62/crate/year
- Legacy Chiller - \$20.62/crate/year
- Pit Cooled - \$2.31/crate/year
- Peltier Chip - \$72.02/crate/year



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