HeatCrete - A Spray-on Concrete Curing Insulator

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Problem
- Concrete curing is a sensitive process and moisture, temperature, contamination affect strength - heavy insulation blankets and electric heating tarps are used
- Current solutions are expensive and labor intensive with limited use and concrete strength is still compromised during winter seasons

Product Concept
Product: Compressed air foam system (CAFS) for dispensing insulation foam for concrete curing
- Rig components: stainless steel, 50-gallon tank, pump, hose, spray gun, stainless steel nozzle
  ■ Specifics: Fan-shape nozzle, 60 psi pressure, Width 0.25 yd
- Used as soil conditioning agent, flocculant agent
- Polyacrylamide hydrogel is too large to enter biological cell membrane, ensuring no harm from exposure

How it Works
- Receive product powder composed of potassium polyacrylamide hydrogel AND ammonium lauryl sulfate (ALS) combined in tank with water
- Combines with compressed air and discharged through aspirating foam nozzle
  0.25 yd³ of mix → 50 yd³ foam, enough for 100 yd² pour

Regulation
- EPA approval for run-off in environment required
  ○ Used as soil conditioning agent, flocculant agent
- Polyacrylamide hydrogel is too large to enter biological cell membrane, ensuring no harm from exposure²

Market Need
- Concrete contracting is a $67 billion industry in the US³ - estimated 6 million yd³ pavement poured during winter months
- Global cement & concrete market reached almost $440 billion in 2018 — expected to reach $650 billion by 2022 with CAGR of 10.4%⁵
- Concrete articles market is one of largest segments in the “other concrete products” market valued around $22.7 billion in 2018⁶
- No prior art similar to product composition and structure

Results

Figure 1 — Components of Spray-On Foam Rig
From left to right, the rig on the back of a standard pickup truck bed is shown, then the rig itself and the special nozzle attached to it.

Figure 2 — Effect of Temperature Difference on Concrete Curing⁷
This figure shows that it is critical to keep concrete core and surface temperature similar.

Figure 3 — Determination of Foam Layer Thickness
The intersection of the average R-value for concrete blankets and the linear relationship between R-value and length, R = L/K. Polyacrylamide conductivity is 0.05 W/(m*K).

Figure 4 — Net Present Value
Evolution of net present value over time with and without TVM

Financials
- Target customers: small-medium contractors.
  ○ Option to lease the spraying rig ($100 per day) or buy it outright ($4000), as well as 50 pounds of mix for $75.
  ○ Estimated labor savings of 15 manhours and $1000 for a 1000 square foot concrete pad ¹⁰
  ○ Savings in storage and transport over blankets.
- Estimated initial investment of about $2,500,000, with $700k capital costs and $90k development costs.
- Breakeven point of 7 years, payback period of 11 years

References
4. https://www.nature.com/articles/s41545-018-0016-8
5. Personal Communication, Michael Morris, President of Musselman & Hall Contractors (Ret.) March 10th 2022
8. [10] Personal communication, Michael Morris, President of Musselman & Hall Contractors (Ret.) March 10th 2022
9. [8] Personal Communication, Michael Morris, President of Musselman & Hall Contractors (Ret.) and Cindy Allen, American Concrete Paving Association March 30th 2022
10. [7] https://www.sdapcd.org/content/sdapcd/permits.html

Manufacturing
- Foaming Powder Material Balance
  ● Polyacrylamide and ammonium lauryl sulfate is mixed in 9:1 wt% ratio
    ○ Translates to 45 lbs polyacrylamide and 5 lbs ammonium lauryl sulfate per 50 lb bag
- Equipment
  ● Production
    ○ 5000 gallon steel mixer to mix foaming powder
  ● Foaming Application (Consumer)
    ○ Automated cone vessel to bag powder
  ● Foaming Application (Spray Gun)
    ○ 50 gallon drum to hold water and powder mix
      ■ Fits on back of standard, long-bed pickup truck
    ○ 1.5” diameter nozzle for aerated expansion
- Considerations
  ● Dry-mixing permits required due to air pollution
  ● Business and sales license required to market product