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 1.5” , Medium Expansion Ratio (200:1)

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[1]
- 0.25 yd^3 of mix → 50 yd^3 foam, enough for 100 yd^2 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 exposure[2]

Market Need

- Concrete contracting is a $67 billion industry in the US[3] - estimated 6 million yd^2 pavement poured during winter months[4]
- 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 2018[6]
- 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.

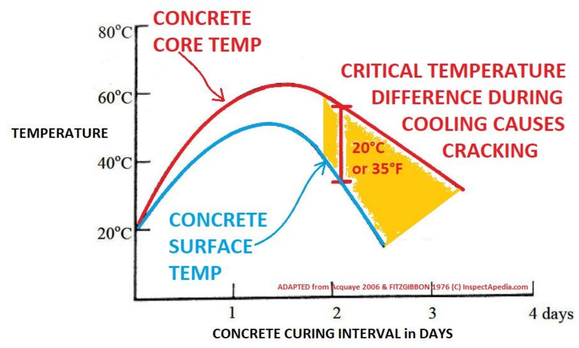

Figure 2 — Effect of Temperature Difference on Concrete Curing[7]
This figure shows that it is critical to keep concrete core and surface temperature similar.

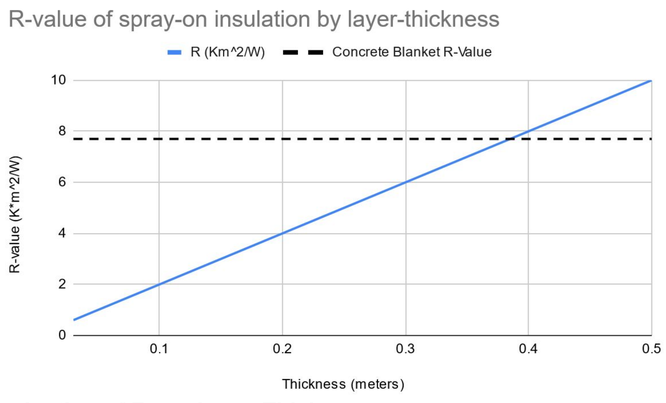

Figure 3 — Determination of Foam Layer Thickness
The intersection of the average R-value for concrete blankets and the linear relationship between R-value and length, R = L/K. Polyacrylamide conductivity is 0.05 W/(m*K).[8] Our product requires a thickness of **15 inches.**

References

[1] https://www.firefighternation.com/leadership/aspirating-foam-nozzles/#gref
[2] https://www.nature.com/articles/s41545-018-0016-8
[3] https://store.lunette.com/blogs/news/its-time-for-some-science-101-lunette-style
[4] Personal Communication, Michael Morris, President of Musselman & Hall Contractors (Ret.) and Cindy Allen, American Concrete Paving Association March 30th 2022
[5] https://www.powerblanket.com/blog/category/concrete-insulation-blankets/
[6] https://www.ibisworld.com/industry-statistics/market-size/concrete-contractors-united-states/
[7] https://inspectapedia.com/structure/Effect-of-Temperature-on-Concrete.php
[8] www.sciencedirect.com/science/article/pii/S1385894720319094
[9] https://www.sdapcd.org/content/sdapcd/permits.html
[10] Personal communication, Michael morris, President of Musselman & Hall Contractors (Ret.) March 10th 2022

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
  - Automated cone vessel to bag powder
- Foaming Application (Consumer)
  - 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[9]
- Business and sales license required to market product

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

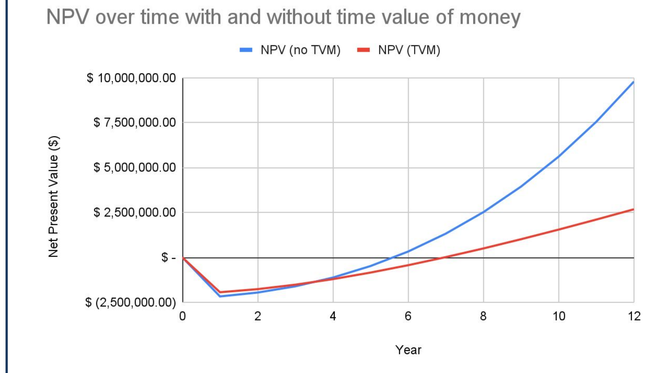

Figure 4 – Net Present Value
Evolution of net present value over time with and without TVM