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# Thermal Insulation Coating for Pipe Applications

Ismail AlAithan
*Virginia Commonwealth University*

Alhawraa Husain
*Virginia Commonwealth University*

Wejdan Reda
*Virginia Commonwealth University*

Katiana Slaton
*Virginia Commonwealth University*

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# Thermal Insulation Coating for Pipe Applications

**Team members:** Ismail AlAithan, Alhawraa Husain, Wejdan Reda, Katiana Slaton | **Faculty adviser:** Dr. Wei-Ning Wang | **Sponsor:** NNSB | **Sponsor adviser:** Tim Sherrange

## Problem as Presented by NNSB

The results of a recent insulation quantity review by E21/E26 to support the trade's installation process on Ford Class carriers (CVN 78), revealed that over 200,000 linear feet of insulation are required to insulate the non-nuclear piping systems alone. In select applications, the potential exists to replace traditional elastomeric and fiberglass insulations with Thermal Insulating Coating (TIC) products which are better insulators with longer life spans and reduced application time. Researching, testing, and implementing emerging thermal insulating products will position Newport News Shipbuilding (NNSB) as a leader in utilizing insulating technology that is crucial for future development of new processes that are cost-attractive and environmentally superior.

*Image 1: The aircraft carrier Gerald R. Ford (CVN-78) floats in the James River after being launched from dry dock at Newport News Shipbuilding, 11/17/2013*

## Goal of the Project

Tim Sherrange of NNSB tasked us with testing the anti-condensation abilities of the TIC Aerolon®, an aerogel-based insulation, using Federal test specifications for Coating Compound, Paint Antisweat. The main goal was to observe the anti-condensation abilities of the insulation and to initiate an analysis and comparison of the spray-applied aerogel insulation versus the hand-applied thick foam insulation that is currently used on ship pipes and ventilation. We plan to use computer simulation of the thermal properties of the insulated cylinders as well as a physical experimental setup.

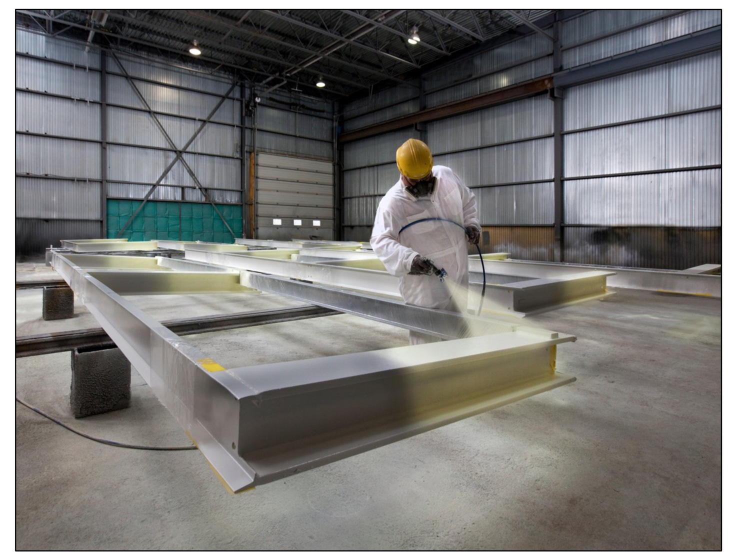

*Image 2: Photo of Aerolon® insulation application from Tnemec social media*

## What is Aerogel?

Aerogel is an ultra light synthetic material that has been derived from a gel. The liquid component of the gel is replaced with a gas, which results in a solid with a low density and thermal conductivity, making it ideal for insulation. Aerogels can be made using a fairly wide array of materials, although silica-based aerogel is the most common. The term "aerogel" doesn't refer to a set chemical formula, but rather to all materials that have a specific geometric structure.

The insulation we are testing is a TIC, a fluid-applied coating that uses aerogel particles in order to insulate. It is applied over a primer in as many layers as is desired, each about 50mils thick. It is then sealed with a topcoat. Because of the insulation is applied directly to the surface in question, there is little to no space left for moisture to build beneath the insulation, which prevents corrosion.

*Image 3: A piece of aerogel insulation protecting a flower from a torch*

## Procedure and Results

The VCU project team built an acrylic test chamber and NNSB provided three copper cylinders that were coated in 3 different thicknesses of Aerolon®. The federal specification calls for these 3 cylinders to be filled with ice cubes and water and maintained between 32°F and 38°F for the duration of a 3-8 hour test period. The specification also calls for the interior of the acrylic chamber to maintained at 68° ± 2°F with a relative humidity of 67% ± 2 percent. While the lab atmosphere fell within the appropriate temperature range we could not maintain the humidity within the required margin without equipment and/or chemicals that were far beyond the budget for the project, so this criterion was set aside for the time being.

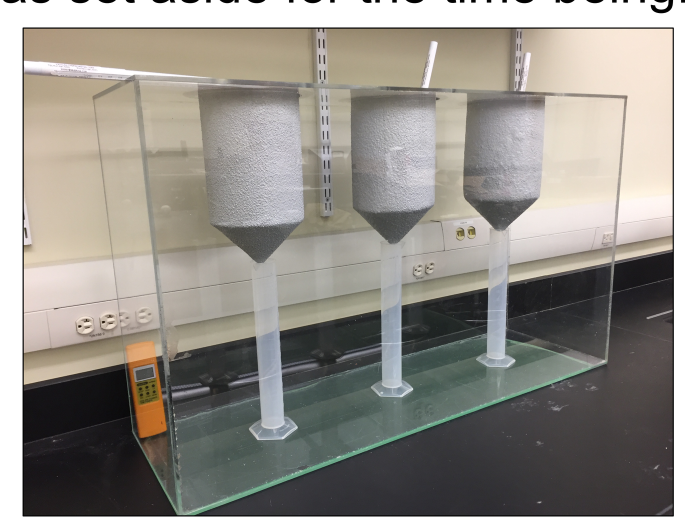

*Image 4: VCU photo of physical testing set-up*

In addition to physical testing, we opted to create a computer simulation of the insulated cylinders. This was especially important because we are unable to control the humidity of the chamber. The simulation also allowed us to observe the heat distribution inside the different thicknesses of the coating which could assist in an initial estimate of the thickness of insulation needed for different applications.

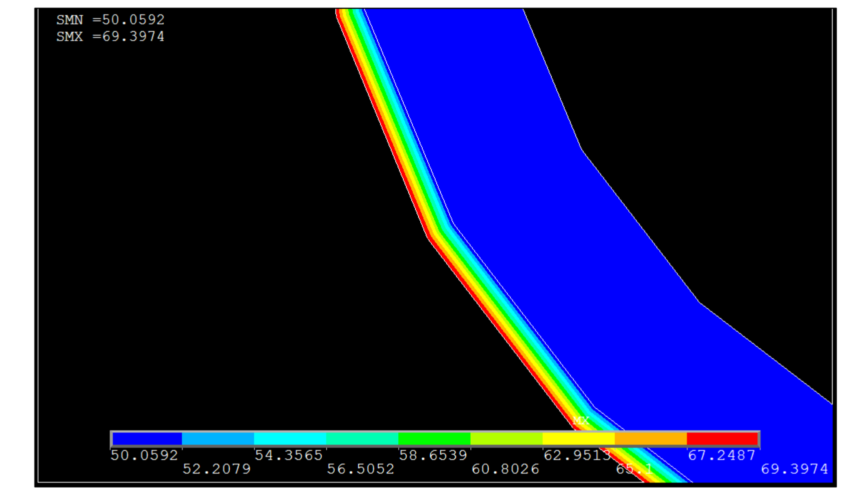


*Image 5: Initial computer simulation with $T_{ambient}$ of 80°F and $T_{internal}$ of 50°F*

Computer simulation of the insulated cylinders is well underway and physical experimentation has begun. While the quantity of data achieved at this point in time is not what we had originally hoped for we are optimistic about the future of the project.

## Problems Encountered

One difficulty that we encountered is timeline differences. As students of VCU we work on an academic calendar. Projects are measured in months, assignments in weeks, tasks in hours. It is a highly compressed timeline. When working on a project in conjunction with one or more industrial partners this compressed academic timeline differed greatly from the weeks, months, and years dedicated to projects in industry.

We also ran into financial limitations. Operating with a limited budget is realistic and expected but it can cause problems when attempting to deliver a high-quality project to a sponsor. The fact that our sponsor was willing to assist the project financially, allowed us to establish a physical test system for the project.

## Future of the Project

Despite timeline differences that set the project back farther than expected and financial limitations that prevented the level of control desired in physical testing Tim Sherrange has proposed to NNSB that the project be continued. At this time the proposal has not been confirmed.

VCU School of Engineering

*Image 1: Courtesy of http://www.dmitryshulgin.com/gerald-r-ford-class/*
*Image 2: Courtesy of https://twitter.com/TnemecCompany/status/824634534134116352*
*Image 3: Courtesy of https://simple.wikipedia.org/wiki/Aerogel*
*Image 4 & 5: Taken by VCU Capstone Team MNE519*