



INDUSTRIAL TECHNOLOGIES PROGRAM

Aerogel-Based Insulation for Industrial Steam Distribution Systems

Aerogel Pipe Insulation Will Reduce Thermal Loss in Radial Geometries

Thermal loss through industrial steam distribution systems accounts for a large part of total U.S. energy consumption. Traditional pipe insulation employs mineral wool, fiberglass, calcium silicate, perlite, and various foams. Annular shrouds of these materials are tightly wrapped around steam pipes and clad with sheet metal. Aerogel-based pipe insulation functions similarly to conventional systems but with greatly improved performance.

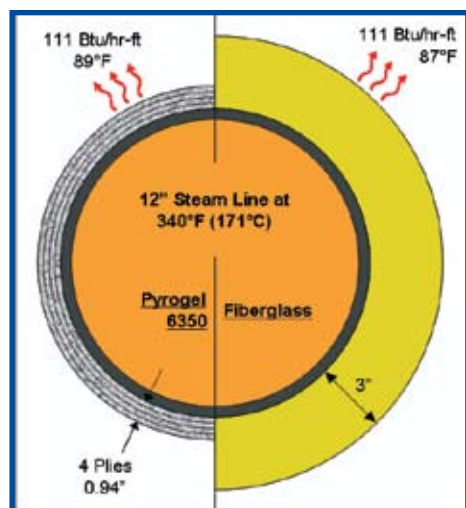
Aerogel has the lowest thermal conductivity of any known material. Recent processing developments allow this once boutique material to be manufactured cheaply in blanket form. The main attraction of aerogel insulation



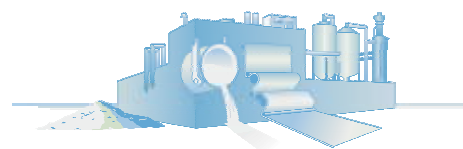
Aspen Aerogels manufactures inexpensive aerogel-based insulation in blanket form.

is that it significantly reduces the amount of material needed to achieve the same insulation value as bulkier traditional insulation. Aerogel is still more expensive to produce on a weight basis, but much less material is required, so the improved properties compensate for the difference in cost.

In this effort, insulation designs and installation protocols will be developed to allow for widespread adoption of aerogel-based pipe insulation by all industries that rely on steam distribution systems, with a focus on assemblies that are not currently cost-effectively addressed by aerogel insulation, such as large diameter, complex, and/or high-temperature pipe systems.



Less than 1 in. of aerogel-based insulation is equivalent to 3 in. of fiberglass. The aerogel-based insulation also requires 20% less cladding and binding.



Benefits for Our Industry and Our Nation

The primary benefits of aerogel-based pipe insulation are reduced energy usage and lower material costs achieved with a very low thermal conductivity and thickness, compared with conventional insulation materials.

Other benefits include lower installation costs derived from a novel one-step, on-site installation process; long term water resistance and corrosion protection due to the hydrophobicity of aerogel; and a reduction in hazardous emissions resulting from displaced energy consumption in both insulation manufacturing and reduced thermal losses. Projected across much of the 160,000 miles of US industrial steam pipes, this technology is estimated to produce energy savings of 127 trillion Btu per year by 2025, with resulting financial benefits of hundreds of millions of dollars.

Applications in Our Nation's Industry

The development of aerogel-based pipe insulation will immediately find applications across the entire industrial spectrum. Initially, cost barriers will limit the applicable pipe geometries and temperatures; this project will broaden those boundaries.

Project Description

The innovation addressed in this proposal is an aerogel-based pipe insulation (ABPI) system for industrial steam pipes.

Barriers

Major barriers to be overcome include:

- Lack of specific technical information about aerogel-based thermal insulation from the perspective of the end-user;
- Lack of experience working with aerogel-based thermal insulation in high-stress industrial environments; and
- A number of technical parameters currently limiting widespread deployment, including manufacturing cost and high-temperature durability.

Pathways

The objectives of the project will be achieved through (1) reviewing and clarifying end-user requirements of pipe insulation; (2) developing marketable straight-pipe insulation packages that embody integrated functionalities; (3) expanding the catalog of products through laboratory and field testing to respond to more complex geometries and harsher environments; and (4) reducing material cost through methods including aerogel aging, increasing throughput, and fiber reinforcement.

Progress and Milestones

- Develop consistent performance parameter benchmarks based on actual and desired characteristics of aerogel-based pipe insulation
- Identify a family of mature designs for straight-pipe insulation sheathing that reduce installation costs by 30 – 50%
- Complete five distinct in-service demonstrations of project progress
- Enhance high-temperature durability, focusing on lattice structures resistant to cyclic degradation in the 350° – 600°F range, low-cost fiber reinforcement above 390°F, and hydrophobic agents stable above 900°F
- Achieve material cost reduction in order to help meet a declared goal of a 25% decrease in 5-year cost of ownership of ABPI over high performance conventional insulation by 2015

Commercialization

A two-pronged commercialization plan has been developed to attract much of the pipe insulation market. The reduction of material costs and increased high-temperature durability of the product will open up much of the market currently out of reach.

The project partners are well-placed to support a rapid expansion of aerogel production to meet the newly opened market segment. Aspen Aerogels has made significant gains in achieving the necessary performance criteria of the material. Protherm and other pipe insulation vendors and installers will be carrying aerogel-based pipe insulation as a standard product by 2008, in time to support a growing manufacturing base. Specifically, industrial insulation installers will convert better than half of their new installs to this material system by 2015.

Project Partners

Aspen Aerogels
Northborough, MA
(Matthew Steinbroner: msteinbroner@
aerogel.com)

Protherm Services Group
Baton Rouge, LA

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy
Energy Efficiency
and Renewable Energy
Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

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