WHEN IT COMES TO MITIGATING HEAT TRANSFER - DRAGON JACKET DELIVERS

Heat loss on pipelines and tanks is a process inefficiency that results in significant wasted energy and huge costs. Our analysis proves that Dragon Jacket Insulation can reduce annual heat loss by more than half, when compared to Fiberglas, and that larger pipe diameters represent the greatest opportunity for savings.

THE TEST

MATERIALS

- 2-Inch and 1-Inch Dragon Jacket Insulation
- 2-Inch Saturated and Unsaturated Fiberglas
- 6-Inch Schedule 40 Steel Pipe – 1 Foot Length

TESTING ENVIRONMENT

- Internal Pipe Surface Temperature: 175°F

ASSUMPTIONS

- Pipe Surface Temperature = Temperature Inside of Insulation

Insulation geometry was created in SolidWorks and then imported to SimScale for the heat transfer analysis. The profile (pictured), was extruded to a 12-inch length. Note: For the 1-inch thick insulation study, the wall thickness was changed to 1 inch.

After importing into SimScale, a constant temperature boundary condition was applied to the inside surface of the insulation at a magnitude of 175°F. A simple heat transfer analysis was then run prior to post-processing of the results.

For simplicity, the study measured the average heat flux across the outside surface.

Test Setup

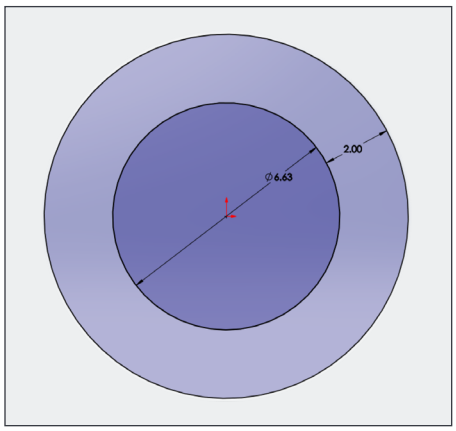

Figure 1: 2-inch insulation profile in SolidWorks

STUDY #1 – 2-INCH DRAGON JACKET INSULATION

THERMOPHYSICAL PROPERTIES

- Density: 2.1 lb /ft^3
- Thermal Conductivity: 0.022 W/m-K
- Specific Heat: 1,400 J/kg-K

The heat flux magnitudes varied, with the largest magnitude occurring on the inside face of the insulation. This was an expected result since this is where the largest temperature differential occurs. The key metric, however, was the heat flux on the outside surface of the insulation since this was heat loss from the system.

STUDY #2 – 2-INCH FIBERGLAS INSULATION

The same geometry profile from Study #1 was repeated in Study #2. The thermophysical properties were altered to be consistent with Fiberglas insulation.

THERMOPHYSICAL PROPERTIES

- Density: 24 kg/m^3
- Thermal Conductivity: 0.072 W/m-K
- Specific Heat: 700 J/kg-K

STUDY #3 – SATURATED 2-INCH FIBERGLAS INSULATION

The results of a study conducted in 2017 found that the exchange of air for water in the insulation causes a noteworthy increase in the thermal conductivity of the insulation. How significantly depends on the volume of water absorbed by the insulating material.

- 1% Volume, 30% Correction Factor
- 2% Volume, 48% Correction Factor
- 3% Volume, 61% Correction Factor
- 4% Volume, 71% Correction Factor

With Fiberglas insulation, water saturation is a common occurrence because the protective cladding often sustains damage, exposing the Fiberglas to the elements. For this study, a 3% water volume was implemented by multiplying the original k-value of the Fiberglas insulation by 1.61. This is reflected in the thermophysical properties used for this study.

THERMOPHYSICAL PROPERTIES

- Density: 24 kg/m^3
- Thermal Conductivity: 0.115 W/m-K
- Specific Heat: 700 J/kg-K

Fiberglas Insulation
Thermal Conductivity (W/(mK))

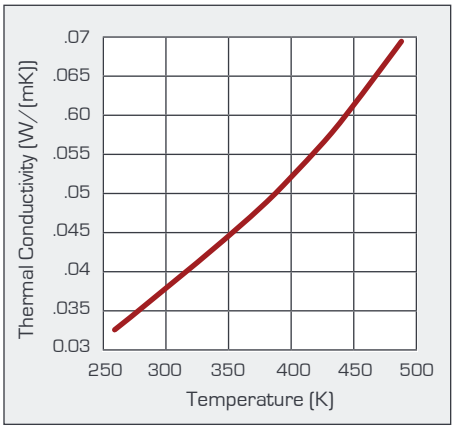

Figure 2: Chart used to obtain thermal conductivity of Fiberglas at the pipe surface temperature

DRAGON JACKET INSULATION

DRAGON JACKET INSULATION

WHEN IT COMES TO MITIGATING HEAT TRANSFER - DRAGON JACKET DELIVERS

STUDY #4 – 1-INCH DRAGON JACKET INSULATION

In this study, the thermophysical properties remain unchanged from the original 2-inch studies; the only change is in wall thickness, which was reduced to 1 inch.

THERMOPHYSICAL PROPERTIES

- Density: 2.1 lb /ft^3
- Thermal Conductivity: 0.022 W/m-K
- Specific Heat: 1,400 J/kg-K

SIMULATION ANALYSIS

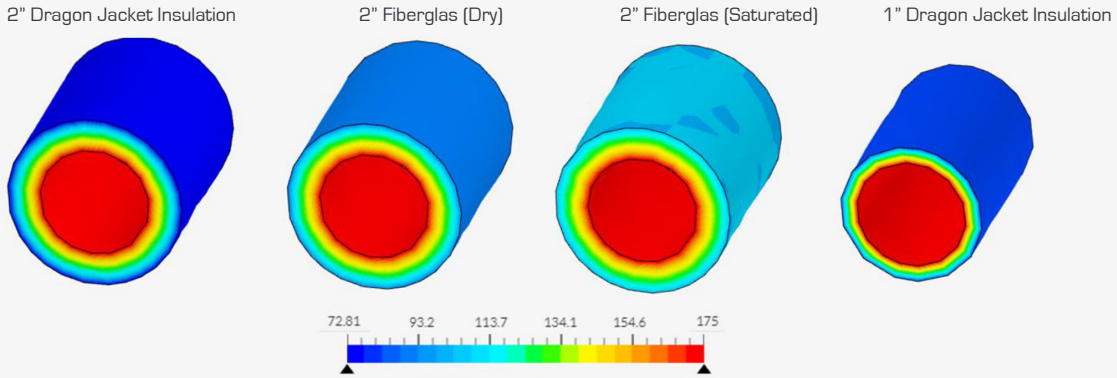

Figure 3: Simulation layout showing inside surface temperature of 175°F for all four insulation types

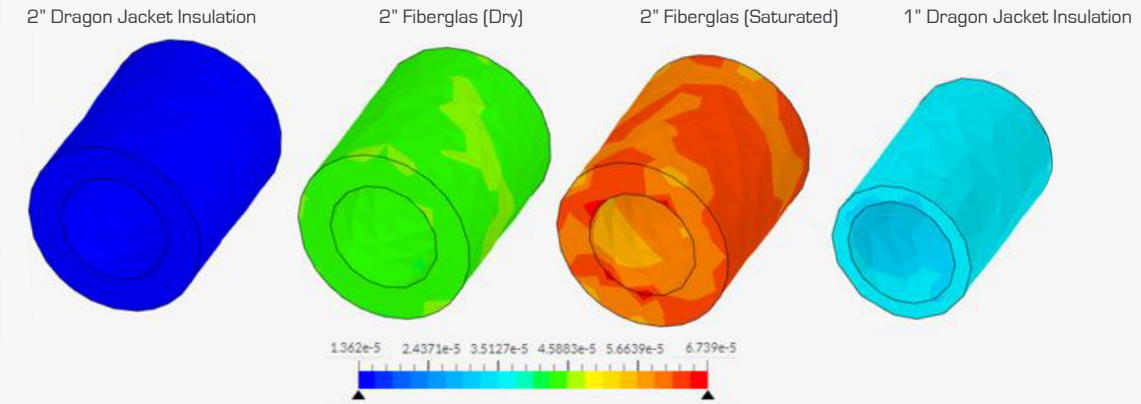

Figure 4: Resulting surface heat flux magnitude for the four insulation types

RESULTS

Heat loss was present in all insulation, but with damage and moisture penetration, heat loss and resulting energy costs increased significantly.

	Dragon Jacket	Fiberglas	Saturated Fiberglas	Dragon Jacket (1 in.)
Surface Heat Flux (Btu/s-in^2)	0.000014	0.000044	0.000056	0.000036
Yearly Heat Loss (MMBtu/yr/ft)	0.18	0.56	0.71	0.45
Cost of Heat Loss ($/ft/yr)	$1.36	$4.28	$5.51	$3.50

Table 1; Summarized study results

Note: Table references average surface heat flux values. The cost of heat loss (USD per foot per year) is calculated assuming natural gas as a fuel, which was estimated at $7/MMBtu.