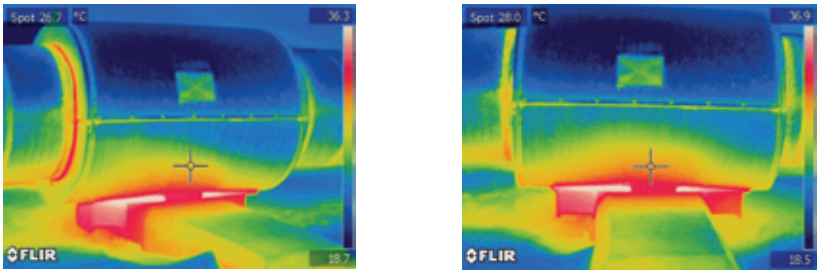
IMPORTANCE OF THERMALLY ISOLATED PIPE SUPPORTS TO A HEAT MANAGEMENT SYSTEM

To optimize a Heat Management System for critical services, like molten sulphur, a homogenous thermal profile is critical for good performance. First, this requires a high-integrity and consistent insulation system. Secondly, it is imperative that any additional metal appurtenances in contact with the pipe wall are eliminated or minimized. Any additional metal contact represents a location for unwanted heat loss, and is commonly known as a "heat sink". These heat loss points create cold spots on the pipeline which can lead to material flow restriction and/or blockage at that point.Heat sinks can be pipe flanges, valves, instruments or pipe supports and anchors. The heat tracing system is compromised when there is metal-to-metal contact between the pipe wall and structural pipe support, (pipe rack or sleeper foundation). This can be avoided by the proper design and implementation of "thermally isolated" pipe supports and anchors.

The infrared camera photos below depict what can happen when a pipe anchor support is not properly designed i.e., from a thermal point of view it is not "thermally isolated" from the pipeline.



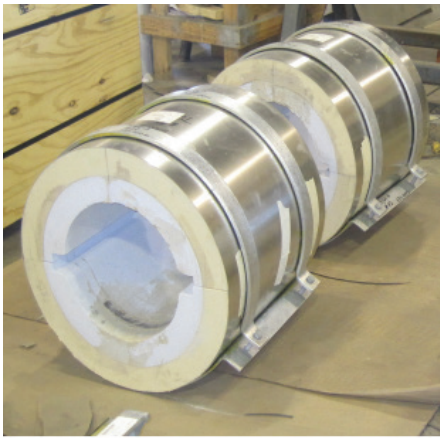
Thermal Images of a "Heat Sink" Anchor

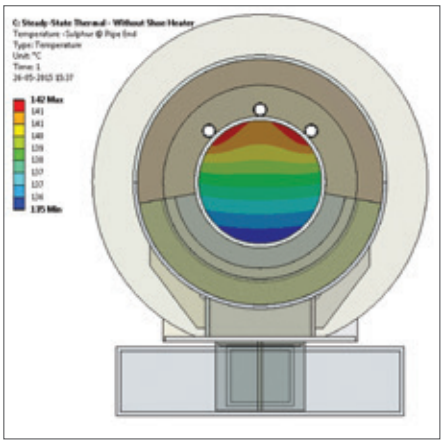
The reddish portions shown in the infrared thermal photographs are representative of high heat loss, relative to the surrounding area. In this particular pipe anchor, there was excessive heat loss through the base of the pipe anchor support. These types of "heat sinks" are detrimental to the pipeline heating performance and can cause solidification at localized cold spots on the line under certain conditions.

WHAT IS A THERMALLY ISOLATED PIPE SUPPORT?

A thermally isolated pipe support is designed not to include any metal-to-metal contact with the pipe wall, as is found in conventional welded T-supports. This allows the piping thermal insulation system to continue across the support location without any change in the cross section or thermal properties. The design of such a support includes a curved supporting plate, or "cradle", rolled to the same exact diameter as the O.D. (outer diameter) of the insulated pipe. This vertical support occurs over approximately 120 degrees across the bottom of the insulated pipe. With the proper insulation system, the cradle support can carry ample vertical and lateral loads, while maintaining the thermal envelope.

Thermally Isolated Pipe "Cradle" Supports

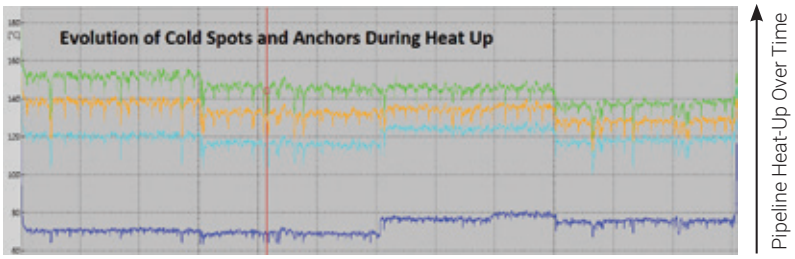




An engineered slide plate assembly of Teflon and polished stainless steel allows the pipe to move easily in a controlled manner when pipe growth occurs from heat-up and cool down of the line. One half of the assembly is shop welded to the underside of the pipe cradle support and the other half is welded to the pipe sleeper beam in the field to create a slide plate.

Similarly, there are pipe anchor points that require a "thermally isolated" engineering design. Because anchors must transfer significant axial loads from the pipeline to the sleeper beam support, the design is quite different and complex. Load-transferring carbon steel lugs are welded to the pipe wall, and axial loads are transferred through a series of high density inserts within the thermal insulation cross section. These inserts prevent metal to metal contact, but provide the desired level of mechanical strength and thermal insulating characteristics to "thermally isolate" the pipe anchor from the pipeline wall.

Proper anchor thermal design can be verified by various methods, including Finite Element Analysis modelling, as shown in the middle figure on the left. A poorly performing anchor design can cause significant heat sinks on a sulphur pipeline and result in plugging at localized areas during stagnant conditions, when material remains in the cold spot caused by the anchor. The temperature profile graph below (Temperature vs. Length) depicts this phenomenon during a heat-up phase of a pipeline full of product. As the pipeline and its contents warm, there are discernable lags in heat-up on the pipeline caused by the excessive heat loss at the pipeline anchors. This creates uneven heating along the pipeline, and can lead to disastrous effects if excessive pressure builds in certain sections of the line.



Thermally "Lagging" Pipe Anchor Supports during a Heat-up Event

PROPER PIPE SUPPORT DESIGN

Properly designed thermally isolated pipe supports and anchors are critical to the ideal performance of a high-temperature pipeline. The design of these pipe supports is dependent on many factors, including:

- Pipe stress analysis – vertical, lateral and axial loadings
- Expected axial and lateral pipe movement
- Mechanical (load bearing) properties of pipe insulation
- Factor of Safety requirement
- Width of the sleeper support beam

When selecting the pipe support and anchor types it is also important to ensure that the pipe insulation cross-section contains adequate mechanical strength (i.e., compressive strength) to support the maximum pipe loadings. For example, a combination of Expanded Perlite and Polyurethane Foam (PUF) insulation generally possess enough compressive strength to sufficiently transfer pipe loads through the insulation system to the steel pipe cradle base. Softer, flexible insulations exhibit much lower compressive strengths, and under the anticipated pipe loadings significant deformation of the insulation thickness could occur. This compromises the thermal insulation's integrity and may also cause pipeline alignment issues.

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