



Title: Industry Standard Practice for Outdoor Steam Pipe Insulation for Oil-fields in California

Introduction

This report addresses industry standard practice research related to the application of insulation for outdoor steam pipes used in onshore oil extraction in California. This work was performed on behalf of the California Public Utilities Commission (CPUC).

Actions Completed

The research performed includes the following activities:

- Identify key experts in this field that have been designing and/or applying steam pipe insulation both in California and elsewhere.
- Conduct structured interviews with experts identified above.
- Document the results of the survey.

Observations

The following summary of observations is based on eight complete interviews – six from engineering design firms, one from a pipe insulation manufacturer, and one from a major oil company.

- All engineering firms that were interviewed design outdoor steam piping systems for oil extraction with four of them having done so in California and the rest in other parts of the world such as Canada (specifically, Alberta tar sands), Middle East, Gulf of Mexico, and Texas.
- Without any exception all the experts that we interviewed indicated that insulating is the commonly used design practice for outdoor steam pipes. The level of insulation may be somewhat lower for companies that are cost-conscious (typically, smaller companies) – however, both major and minor companies, typically, insulate outdoor steam pipes.
- The main reasons cited by the interviewees for insulation include:
 - Energy conservation that leads to lower fuel consumption to create steam which in turns lowers overall costs for the owner/operator
 - Maintaining steam temperature to ensure the effectiveness of the operation
 - Ensuring safety of any human beings (or animals) that can potentially come in contact with the pipes and get injured
- The most commonly cited insulating material by the interviewees was mineral wool with an aluminum jacket. A few interviewees mentioned other material such as calcium silicate. The choice of the insulating material is dependent on the overall design, performance, and cost constraints as specified by the owner/operator of the equipment.

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- Thickness of insulation varies and can range from 1.5 inches at the lower end to 4 inches at the upper end. The exact thickness specification is developed using modeling tools that allow the designer to simultaneously account for various performance and cost parameters – such as length of pipe (i.e. distance from steam generator to well pad), cost of natural gas that is used for generating steam, temperature of steam needed, etc. In general – pipes with smaller diameters (e.g. <2 inches) including those moving hot fluids having relatively lower temperatures are likely to have insulation near the lower end of the range specified above.
- Most interviewees mentioned that design standards are applicable in the specification of the insulation. The standards mentioned included - ASME, ANSI, and ASTM.
- All interviewees indicated that any pipe for which temperature is above 140F is a hazard for people/animals and must be protected in some way. Insulation is the most common way of meeting the safety standards such as OSHA – however, one can also put wire cages around the pipes instead of insulation if safety is the only concern. One interviewee noted that – although it is relatively easy to install insulation on most of the piping, it can be difficult to design and install insulation on pipe joints, valves, etc.
- None of the interviewees except one was aware of any utility incentives that were being offered. The one interviewee who knew of the PG&E incentives did not attempt to take advantage of them as they involved too much hassle.

Results

- Insulation for outdoor steam pipes used for oil extraction is the standard practice with the most commonly used material being mineral wool with an aluminum jacket/sleeve. Based on the interviews – the industry standard practice is to install a minimum of 2 inches of mineral wool insulation with aluminum jacket.
- The existence of codes/standards about the design of insulation and the existence of safety practices that appear to rely, primarily, on insulation to protect against accidents further support the evidence that insulation is standard practice. Mineral wool insulation thicker than 1 inch is required, in most cases, in order to meet the basic OSHA standard of surface temperature of 140F or less.
- Insulation thicker than 2 inches may be required in order to meet the service demand (e.g. steam temperature for injection into oil wells) and this is, typically, established by using 3E Plus, ASTM or equivalent industry standard software.
- Therefore, projects proposing insulation thickness in excess of 2 inches should qualify for incentives. The IOUs should submit insulation thickness plus jacket sleeving calculations using 3E Plus, ASTM or equivalent industry standard software to demonstrate that the proposed thickness results in exterior jacket sleeving surface temperature of 140 F or less as required by OSHA. Savings should be determined as a reduction in fuel usage from using

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insulating material that exceeds the baseline. The baseline is characterized based on industry standard practice research, which finds that 2 inches of mineral wool insulation with aluminum jacketing is the predominant case. Program eligible insulation material must have an equivalent thermal conductivity (k-value) less than that of the baseline: 2” jacketed mineral wool.

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