Insulate Steam Distribution and Condensate Return Lines

Uninsulated steam distribution and condensate return lines are a constant source of wasted energy. The table shows typical heat loss from uninsulated steam distribution lines. Insulation can typically reduce energy losses by 90% and help ensure proper steam pressure at plant equipment. Any surface over 120°F should be insulated, including boiler surfaces, steam and condensate return piping, and fittings.

Insulation frequently becomes damaged or is removed and never replaced during steam system repair. Damaged or wet insulation should be repaired or immediately replaced to avoid compromising the insulating value. Eliminate sources of moisture prior to insulation replacement. Causes of wet insulation include leaking valves, external pipe leaks, tube leaks, or leaks from adjacent equipment. After steam lines are insulated, changes in heat flows can influence other parts of the steam system.

Heat Loss Per 100 Feet of Uninsulated Steam Line

Distribution Line Diameter, inches	Heat Loss Per 100 Feet of Uninsulated Steam Line, MMBtu/yr			
	Steam Pressure, psig			
	15	150	300	600
1	140	285	375	495
2	235	480	630	840
4	415	850	1,120	1,500
8	740	1,540	2,030	2,725
12	1,055	2,200	2,910	3,920

Based on horizontal steel pipe, 75˚F ambient air, no wind velocity, and 8,760 operating hours per year.

Example

In a plant where the fuel cost is $8.00 per million Btu ($8.00/MMBtu), a survey of the steam system identified 1,120 feet (ft) of bare 1-inch-diameter steam line, and 175 feet of bare 2-inch line, both operating at 150 pounds per square inch gauge (psig). An additional 250 ft of bare 4-inch-diameter line operating at 15 psig was found. From the table, the quantity of heat lost per year is:

1-inch line:	1,120 ft x 285 MMBtu/yr per 100 ft	=	3,192 MMBtu/yr
2-inch line:	175 ft x 480 MMBtu/yr per 100 ft	=	840 MMBtu/yr
4-inch line:	250 ft x 415 MMBtu/yr per 100 ft	=	1,037 MMBtu/yr
	Total Heat Loss	=	5,069 MMBtu/yr

Given a boiler efficiency of 80%, the annual cost savings from installing 90% efficient insulation is:

(0.90 x $8.00/MMBtu x 5,069 MMBtu/yr)/0.80 = $45,620

Suggested Actions

Conduct a survey of your steam distribution and condensate return piping, install insulation, and start to save.

Insulation Optimization Software Available

The North American Insulation Manufacturers Association has developed a software package (3E Plus) that determines the optimum thickness for a wide variety of insulating materials. Outputs include the simple payback period, surface heat loss, and surface temperature for each specified insulation thickness. 3E Plus is available at no cost on AMO's website at *manufacturing.energy.gov*

Use Insulating Jackets

Removable insulating jackets are available for valves, flanges, steam traps, and other fittings. Remember that a 6-inch gate valve may have more than 6 square feet of surface area from which to radiate heat.

Install insulating jackets on steam traps according to steam trap manufacturer's directions to maintain proper trap operation.

For additional information on removable insulation, refer to the related steam tip sheet #17 Install Removable Insulation on Valves and Fittings in the publication library on the AMO website.

Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech.

Resources

U.S. Department of Energy—DOE's software, the *Steam System Assessment Tool and Steam System Scoping Tool*, can help you evaluate and identify steam system improvements. In addition, refer to *Improving Steam System Performance: A Sourcebook for Industry* for more information on steam system efficiency opportunities.

Visit the Advanced Manufacturing Office website at *manufacturing.energy.gov* to access these and many other industrial efficiency resources and information on training.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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