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# process HEATING

## Energy Calculations for Return Condensate

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Parameter	Value
Steam Temperature	212°F
Condensate Temperature	23°F
Boiler Efficiency	85%
Boiler Fuel Cost	\$15.30/MMBtu
Boiler Capacity	44,000 lbs/hr
Condensate Return Rate	90%
Energy Loss per Pound	157.33 BTU/lb
Total Energy Loss	6,230,268 BTU/hr
Cost of Energy Loss	\$95.32/hr
Annual Cost of Energy Loss	\$835,003.20/year

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Returning condensate to the boiler operation is great step toward improving energy efficiency. But how do you know if the costs are justified? An example can demonstrate the process. Table 1 shows the operating criteria for a typical operating steam system.

For the purposes of this example, assume no condensate returned to the boiler plant. In that case:

- $(h_c - h_m) = \text{Energy Loss per Pound}$

$$(180.33 - 23) = 157.33 \text{ BTU/lb Energy Loss per Pound}$$

- 44,000 lbs of steam = 44,000 lbs of condensate (90 percent Return) = 39,600 lb
- 39,600 lb x 157.33 (BTU/lb) = 6,230,268 BTU
- 6.230268 x \$15.30 = \$95.32 per hour
- \$95.32 x 8,760 (hours/year) = \$835,003.20 per year

The potential savings of \$835,003.20 per year is based on the amount of energy required to elevate the makeup water of energy content (sensible energy) to that energy level of condensate being returned in a gravity-designed condensate system. The calculation does not take into account the

savings from chemicals, water and sewer costs. It also does not consider the negative effect of bringing back the condensate at higher pressures, resulting in greater savings.

The above is calculated with no condensate being returned to the boiler, but most industrial plants are returning at least a small percentage of condensate. Each plant should evaluate the cost of failing to return condensate and set forth a roadmap for returning condensate.

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