Return Condensate to the Boiler

When steam transfers its heat in a manufacturing process, heat exchanger, or heating coil, it reverts to a liquid phase called condensate. An attractive method of improving your powerplant’s energy efficiency is to increase the condensate return to the boiler.

Returning hot condensate to the boiler makes sense for several reasons. As more condensate is returned, less makeup water is required, saving fuel, makeup water, and chemicals and treatment costs. Less condensate discharged into a sewer system reduces disposal costs. Return of high purity condensate also reduces energy losses due to boiler blowdown. Significant fuel savings occur as most returned condensate is relatively hot (130°F to 225°F), reducing the amount of cold makeup water (50°F to 60°F) that must be heated.

A simple calculation indicates that energy in the condensate can be more than 10% of the total steam energy content of a typical system. The graph shows the heat remaining in the condensate at various condensate temperatures, for a steam system operating at 100 psig, with makeup water at 55°F.

Example

Consider a steam system that returns an additional 10,000 lbs/hr of condensate at 180°F due to distribution modifications. Assume this system operates 8000 hours annually with an average boiler efficiency of 82%, and makeup water temperature of 55°F. The water and sewage costs for the plant are $0.002/gal and the water treatment cost is $0.002/gal. The fuel cost is $3.00 per Million Btu (MBtu). Assuming a 12% flash steam loss*, calculate the overall annual savings.

Annual Water, Sewage, and Chemicals Savings = (1 – Flash Steam Fraction) x (Condensate Load in lbs/hr) x Annual Operating Hours x (Total Water Costs in $/gal) ÷ (Water Density in lbs/gal)

Annual Fuel Savings = (1 – Flash Steam Fraction) x (Condensate Load in lbs/hr) x Annual Operating Hours x (Makeup Water Temperature rise in °F) x (Fuel Cost in $/Btu) ÷ Boiler Efficiency

Total Annual Savings Due to Return of an Additional 10,000 lbs/hr of Condensate = $33,760 + $32,195 = $65,955

* When saturated condensate is reduced to some lower pressure, some condensate flashes off to steam again. This amount is the flash steam loss.
The Office of Industrial Technologies (OIT), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. OIT is part of the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy.

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