Conserving Water Helps Reduce Energy Bills

Over 45% of all the fuel burned by U.S. manufacturers is consumed to make hot water and raise steam, costing U.S. manufacturers approximately $18 billion annually. Many manufacturing facilities that discharge hot water or steam are losing millions of dollars each year in unnecessary energy costs. The U.S. Department of Energy estimates that the average industrial facility can realize savings of 20% of their overall fuel bill just by conserving water and applying simple improvements to their steam systems. If steam system improvements were adopted industry-wide, the benefits would be $4.0 billion in fuel cost reductions and 32 million metric tons of emission reductions.

"[Energy] either goes into the atmosphere in the form of heat through vents or stacks, or it leaves in water," says Nathan Carpenter, Manager of Energy at Boise Cascade Corporation in Boise, Idaho. "You can manage it by reducing or recovering stack heat, or reducing water consumption and the heat in the [effluent] water."

AT A GLANCE

Reducing water consumption reduces energy cost by

- reducing the heat content of vapor and liquid effluents
- minimizing energy "leaking" out of system via steam and hot water leaks

Pinch analysis conserves water use by

- matching hot effluents to cool effluents
- avoiding "blind alley" improvement efforts that backfire

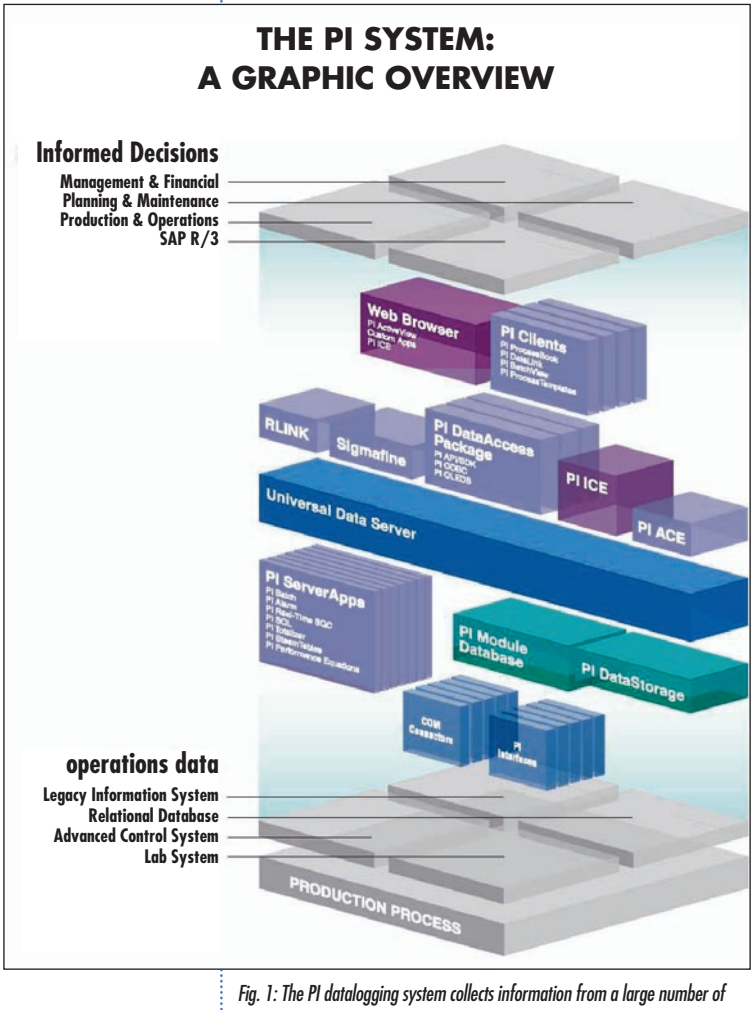

Fig. 1: The PI datalogging system collects information from a large number of sensors stationed througout the facility, and organizes it in a database where it will be useable for next-level analysis software. OSI Software, San Leandro, Calif.

Ready, Aim, Fire

Common sense and experience say that its better to start conservation programs by analyzing your current operation to identify the big energy wasters before planning energy-conservation projects. One of the most sophisticated techniques Boise has found for identifying energy wasters is pinch analysis.

Pinch analysis is an optimization concept developed by Dr. Linnhoff March at Linnhoff March Energy Services in Northwich, Cheshire, UK. The technique categorizes process flows into two areas: hot streams that need to be cooled down; and cold streams that need to be warmed up. The procedure models the mill like a heat exchanger to optimally

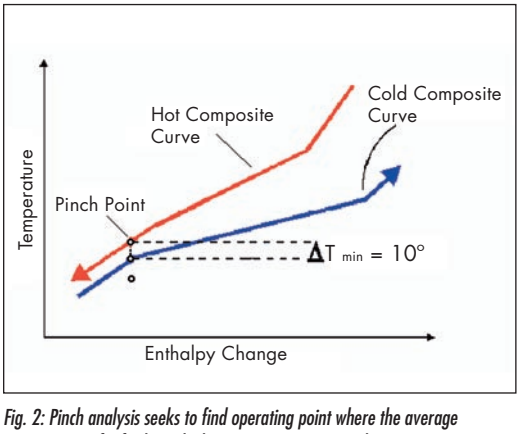

Fig. 2: Pinch analysis seeks to find operating point where the average temperature of a facility's discharges is as near to its inlet temperature as possible. Linnhoff March Energy Services, Northwich, Cheshire, UK.

Table 1: Results from 58 Pinch studies completed by American Process between 1995 - 2002

Mill Type	No of mills	Theoretical Energy Reduction	Practical Energy Reduction
Chemical Pulp Only	15	22%	15%
Chemical Pulp with integrated paper/paperboard	21	26%	17%
Newsprint with integrated paper	6	41%	28%
Other & combined chemical/mechanical integrated	16	24%	17%

transfer the heat by matching a cold stream that needs heating before discharge with a hot stream that needs cooling by an equal amount, so that they offset each other. In this way, one can "pinch" down to find the limiting factor that determines the minimal energy consumption. The model, of course, looks at both physical constraints and capital constraints. The pinch point means that optimal point-that point that provides the most savings from energy-conservation investment.

Attempting to conserve energy below the pinch point leads to "throwing good money after bad," as the old saying goes. The projects cost more than they save. Often the added cost appears as increased operating costs in areas not directly affected by the project. They therefore don't show up in more conventional analysis.

Pinch analysis starts with measuring the actual process flows through the facility. Boise collects data with a PI data logging system (shown in Fig. 1) from OSI Software of San Leandro, Calif., and a mass and energy balance program set up specifically for the pulp paper industry called WinGEMS from Pacific Simulation of Moscow, Idaho. WinGEMS provides a graphical representation of standard processes as shown in Fig. 2.

"On top of that, you superimpose the pinch technology optimization software," says Carpenter.

Boise uses O-Pinch software from American Process in Atlanta, Ga.

Results Perceived

Over the years, companies may build, add, reconfigure, or modernize an existing facility in hopes of achieving better optimization of their industrial process, but sometimes they do not get the results they expect.

"We realized that over the years we were doing things that we thought were energy-efficiency projects," Carpenter recalls, "but we weren't seeing the kind of progress in energy efficiency that we expected."

Pinch analysis, told them that they were not taking a large enough view of the mill. "We were doing things in small areas that by themselves made that small unit operation more efficient, but made us less efficient elsewhere," Carpenter says.

Perhaps the perfect analogy would be a tree. The optimal path leads straight up the trunk to the very top branch. Without a holistic picture of the tree, one might have branched off lower down the trunk and ended out on a limb. The pinch analysis helps give the whole picture of the plant operation to see what is needed to get back on the main trunk.

"A lot of times," says Carpenter, "you don't really need to buy a lot of new equipment. Maybe you just need to reconfigure the process that you have today. If you can do that economically, that's what you do."

Manufacturers have recognized that the whole system must be considered for improvements to best pursue reducing operating costs. Upstream inefficiencies will affect process heating and cost of producing steam; while downstream inefficiencies (leaks, bad traps, poor load control) can also affect process heating and have severe effects on the boiler and cost of producing steam.

Results Achieved

"We do a lot of boiling, frying, and baking in our plants," says Rob Schasel, Senior Group Manager of Energy and Utilities at Frito Lay in Plano, Tex. "If you reduce the amount of excess water in the process, ... every pound of water that you take out is a thousand BTUs you don't have to expend to boil it."

Frito Lay is targeting about a half a million dollars a year in energy savings from their own internal analysis. The company has implemented three of the projects, which are performing as anticipated.

"First and foremost, water in and of itself is a cost item," Schasel points out. "It's a cost as it comes in the door and it's a cost as it goes out the door. So every gallon you save, doubles up the cost savings. It's a gallon that you don't have to buy and it's a gallon you don't have to pay to dispose of."

Conservation isn't just about saving money, Schasel believes. It also involves protection of your ability to produce and your standing as a good corporate citizen.

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For More Information

Pacific Simulation
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OSI Software
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Linnhoff March
Energy Services
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