In the Public Eye (and on the Bottom Line)

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Owners and operators of chemical process plants are increasingly embracing the energy-saving technology and efficiency-enhancing systems that architects and engineers have been developing over more than a decade. And as a result, the owners and operators are saving hundreds of thousands of dollars annually.

Today's soaring energy prices have made more efficient plants not only worthwhile, but also key to protecting operating profits.

Not only that, chemical companies large and small today want to incorporate sustainable, green process design into their business plans — to save money on energy and to meet contemporary expectations of what makes good corporate citizens.

Energy economics and public image, then, have combined to motivate owners and operators to design energy efficiency into new process plants and to seek out energy-saving retrofits for existing process plants.

Energy-Efficient Plant Design Principles

In the design of a new process plant building or a major expansion of an existing plant, energy simulation or modeling software applications can be used to evaluate the energy balance use among various process systems, and reduce energy needs and costs.

One simulation task employs equations that balance the mass and energy entering the plant with the mass and energy exiting the plant. A key part of analyzing a complex model involves identifying energy wasted in energy-consuming processes.

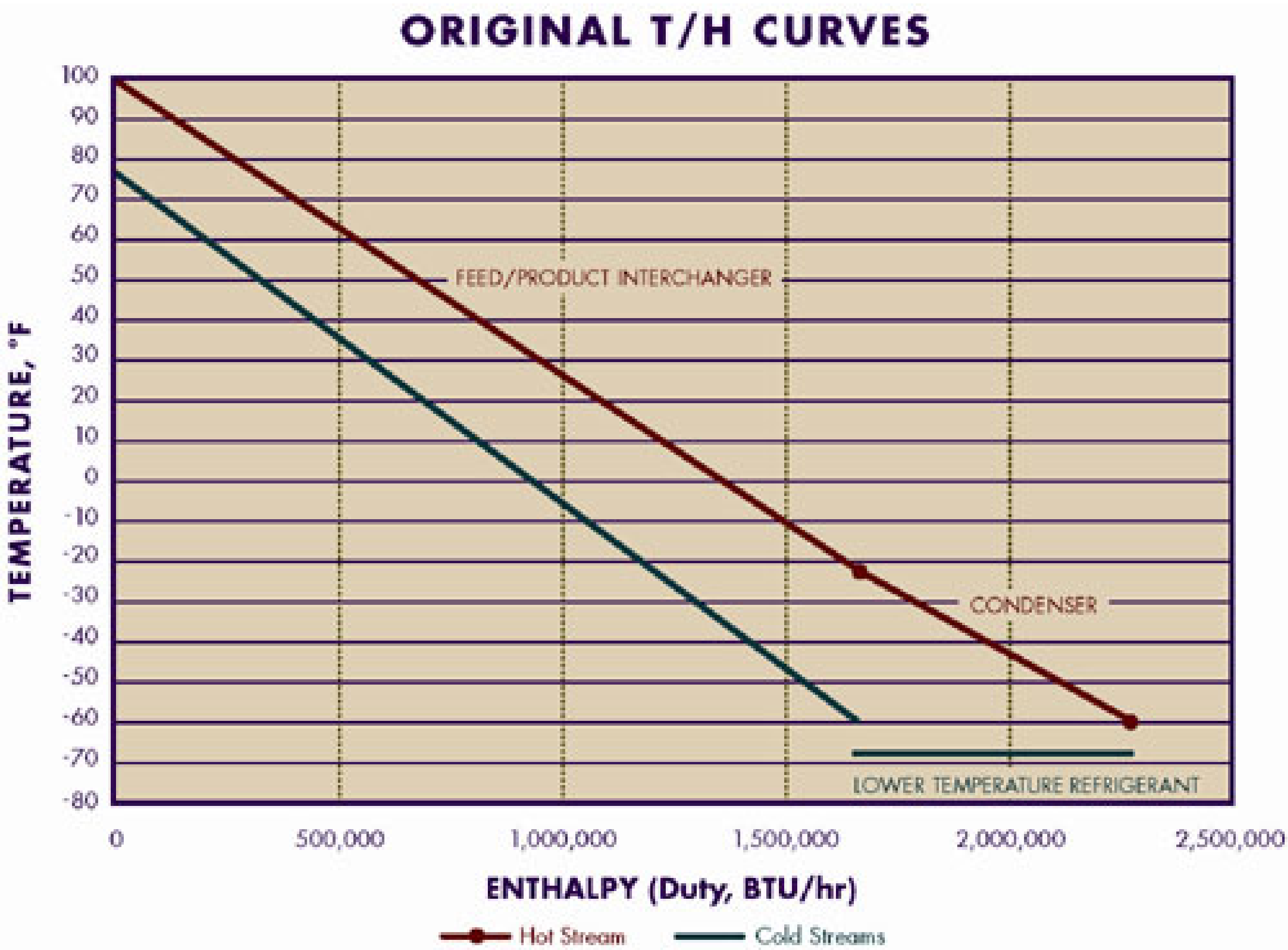
Another simulation task prioritizes the processes that require stepping down steam pressures. Many plants, for instance, use high-pressure steam for a small portion of the necessary heat-transfer applications, while most of the applications require low-pressure steam.

A conventional plant system produces all steam at high pressure and steps down the pressure for low-pressure needs. A more efficient approach would produce steam at both high and low pressures, with high-pressure production limited to the few applications for which it is needed. The low-pressure steam, used for most applications, would cost much less to produce. Similarly, compressed air analysis can also be conducted.

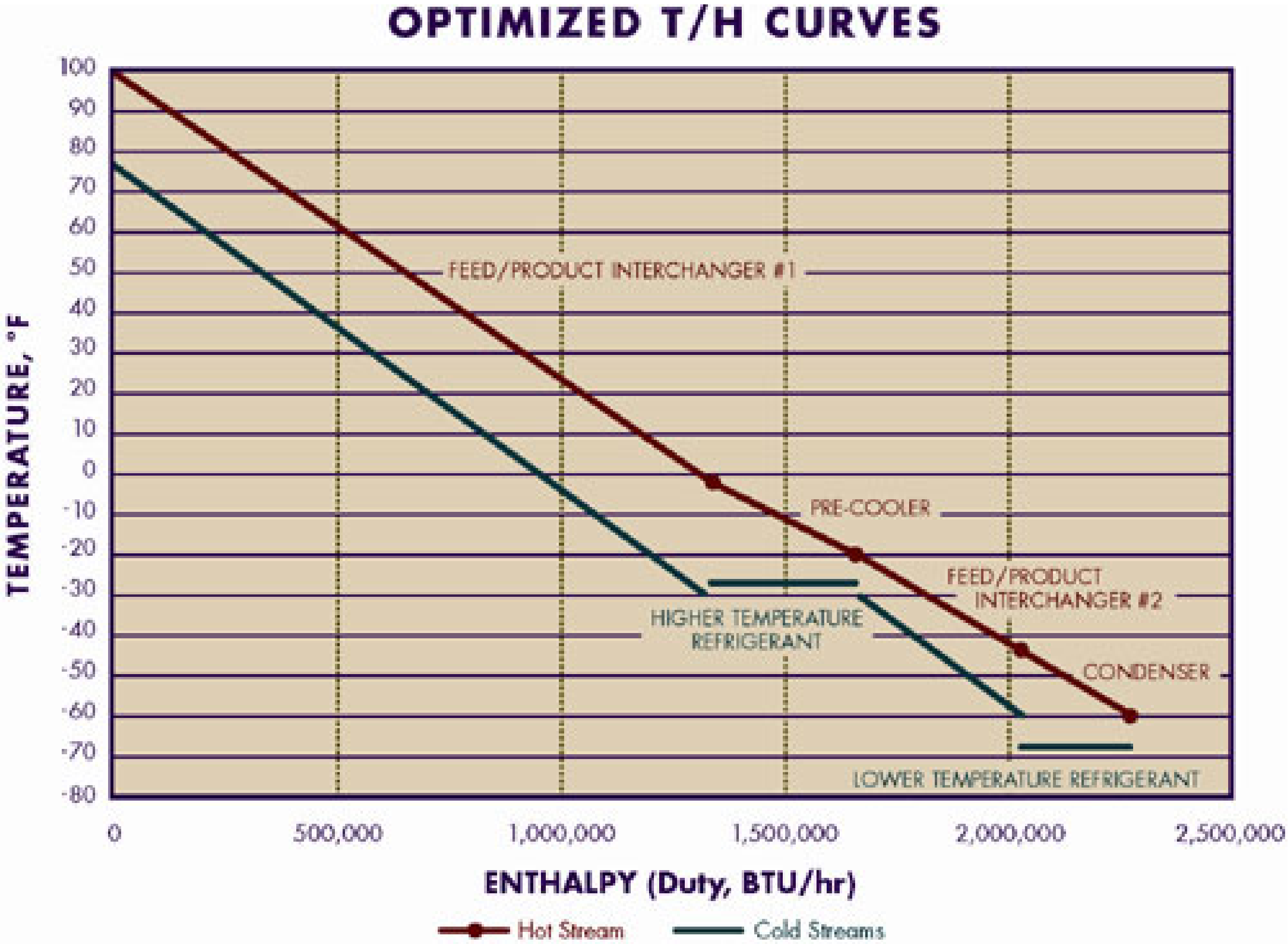
Reducing the energy wasted by plant processes does not, of course, eliminate all wasted energy. Plant systems continue to emit a certain amount of heat, which can be captured by energy-exchange technology and reused to reduce the energy required to operate HVAC systems.

For example, a technique called pinch analysis can maximize energy recovery from process streams entering and exiting process equipment.

Pinch analysis can track multiple streams of energy, available in plant process streams, on a temperature-enthalpy diagram using “composite curves.” The curves locate the temperature pinch point that is the minimum temperature difference between the hot and cold streams. The analysis also identifies the minimum utility loads required and the optimum temperatures of the utilities.



How is this data useful? In one case, a chemical process employed two distinct levels of refrigeration at different points in the process, with the lower of the two refrigeration temperatures condensing liquid out of a gas stream. While the process already recovered cold energy from the gas with a feed/product interchanger, a pinch analysis discovered that cool energy from the higher temperature refrigeration system could be exchanged and used to cut the energy needs of the lower temperature system in half. In this particular process, the savings totaled $200,000 over 10 years.



Analyzing Energy Use in Existing Process Plants

Creating an energy-efficient retrofit plan for an existing plant is usually easier than designing a new facility. While the techniques are similar, it is nevertheless too expensive to completely redesign an entire facility. The sensible goal is to reduce or eliminate inefficiencies when upgrades make economic sense.

Opportunities typically appear at points that have undergone modifications over the years. Process plants usually come online with all systems and processes operating relatively efficiently. As new equipment comes online over the years, however, it alters the balance of the systems and creates inefficiencies. Similarly, process refinements can create energy inefficiencies.

Improving the efficiency of an existing plant begins with an energy audit that identifies building and process plant systems that are wasting energy. Energy models created by software applications can point toward remedies.

Engineers audit energy use by studying process flow diagrams (PFDs) that illustrate the paths taken by various streams through a process. The diagrams include vessels, points where heat exchanges occur and where utilities are used.

In addition, process simulations created with modeling applications can help to evaluate the energy balance inside a chemical plant. These applications calculate how molecules flow through a plant, react with other molecules, change form, change use or waste energy. With a proper analysis, such as pinch analysis, suggested opportunities result in reducing waste.

PFDs and simulations can identify sources of energy leaks and calculate the magnitude, and meters can measure the amount of energy being siphoned off. Process plants have meters that provide billing data for utility companies. However, this only provides information regarding total usage. Additional meters can be added at suspect points within the plant to measure and provide data on how much water is used to produce steam at a given point and how much water is wasted. Gas and electric meters located at the process plant can also provide more information about actual waste.

By evaluating metered data and comparing it to ideal usage rates, it becomes possible to prioritize inefficiencies. Using the data, the renovation plan can address the most serious inefficiencies that require immediate attention, as well as identify less serious issues that can be addressed as budget permits.

The Change Challenge

Change is never easy, and addressing energy inefficiencies in chemical plants is change. But there are no other good choices.

A plant owner, for instance, may decide that shutting down the plant to renovate would cost too much money. In the past, owners typically have approved renovations that pay for themselves in one or two years. Longer payback periods have usually been rejected. But rising energy costs must sooner or later outweigh concerns about shutting down for some period of time. As energy costs continue to rise, they will eventually threaten the plant’s economics. So it makes sense to shut down for a short period and renovate, albeit having to wait for the payback, knowing that the collective savings will help ensure the plant’s survival for years to come.

Given the essential need to control energy costs today, especially with the upward trend in costs, longer payback periods are becoming a more acceptable goal. Owners are realizing that new systems will eventually pay for themselves and eventually produce savings on the bottom line. At the same time, a plant with a green energy-saving profile can help an owner build the company’s image in the public eye as a forward-thinking, environmentally responsible corporation.

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