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TIEEP

TEXAS INDUSTRIAL ENERGY EFFICIENCY PROGRAM

Newsletter Volume 2, Number 1, November 2020

Greetings from the Texas Industrial Energy Efficiency Program, and welcome to our Highlights Bulletin. As usual, this issue is packed with a mix of program information and energy efficiency tips. Read on for more details.

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Upcoming TIEEP Events

Thursday, March 4, 2021, 4:30-6:00 pm: TIEEP Virtual Spring Energy Forum, *Decarbonizing the Process Industries*, Cosponsored by STS-AIChE

Thursday, May 6, 2021, 4:30-6:00 pm: TIEEP Virtual Water Forum, *Topic TBA*, Cosponsored by STS-AIChE.

Dates & details subject to change

I hope you have been able to join us at some – or even all – of our events over the past few months. These include our Clean Energy and Efficiency sessions at the AIChE Virtual Spring Meeting, our Energy Forum at the AIChE Virtual Southwest Process Technology Conference, and the three "Houston – The Low-Carbon Energy Capital" webinars with UH Energy, the UH Bauer College of Business, and the Center for Houston's Future. If you missed any of these, don't despair. Just visit the TIEEP webpage (link below), where you can find materials from all of these events.

TIEEP Webpage

When you visit the TIEEP webpage, you will have a chance to meet our Advisory Council – virtually, anyway. The TIEEP Advisory Council members have their fingers on the pulse of the industry, and they help us to align our programming with current needs. The Council met on November 16. Two strong themes emerged from our discussion: i. decarbonizing of the process industries, and ii. the challenge of operating our plants efficiently at low rates. The first theme is related to last month's "Low-Energy Capital" webinars (see recap below), and it will also be the topic of the next TIEEP Energy Forum (scheduled for March 4, 2021). The second theme (energy efficiently at low operating rates) is the subject of "From the Casebook," at the end of this newsletter.

Program Recap: Houston – The Low-Carbon Energy Capital

Houston is often called “the energy capital of the world.” However, could it also become “the low-carbon energy capital of the world”? This is the question posed in a recently-completed six-month study by UH Energy, the UH Bauer College of Business, and the Center for Houston's Future.

[Low-Carbon Capital Summary Report and Webinars]

The study outlines opportunities and challenges as the region seeks to lead in four areas: carbon capture, utilization and storage; hydrogen; decarbonizing the electricity grid; and the circular economy/plastics recycling.

The task of decarbonizing may seem daunting, but the potential is huge. Houston already has a highly skilled energy workforce, along with the academic institutions that can prepare the workers of tomorrow. The region also has the initial infrastructure in place. This can provide the backbone for future developments, as illustrated for the case of hydrogen penetration in the figure below. Technology innovation and policy innovation pipelines, together with global partnerships, create the potential to make changes at scale and with urgency. The study identifies what’s feasible and lays out a pathway to decarbonize the region and maintain Houston’s role as the world’s energy leader during the energy transition.

From the Casebook: Low Rate Energy Efficiency

Many oil refineries and chemical plants are currently running at reduced throughputs due to the coronavirus-induced economic slowdown and the recent gyrations of oil prices. The impact on profitability and employment has become headline news. However, much less has been said about the impact on energy efficiency.

Energy intensity is the amount of energy used per unit of production:

$$\text{Energy Intensity} = \text{Energy Consumption/Production.}$$

Low energy intensity corresponds to high energy efficiency, and it is clear from this equation that this is achieved with low energy consumption and high production rates. There are many ramifications of this simple fact, and one of the most obvious is the adverse impact of cuts in production rate.

Chemical plants and oil refineries are designed to run at maximum efficiency at their nameplate capacity. As production falls in continuous processes, energy consumption does not go down proportionately. There are many reasons for this, and many are linked to control methods, equipment constraints, and leaks and losses.

Most flow control systems are inherently inefficient. Two common examples involving centrifugal pumps illustrate this point. In so-called "bypass control" (Figure 1), the flow rate to the downstream consumer is controlled by recycling fluid from the pump discharge either to the pump suction or to a feed drum ahead of the pump. When the flow required by the downstream consumer goes down, the recycle flow increases. However, the flow through the pump, and the pump's energy consumption, remain essentially constant. Energy consumption remains constant while production goes down, so energy intensity increases.

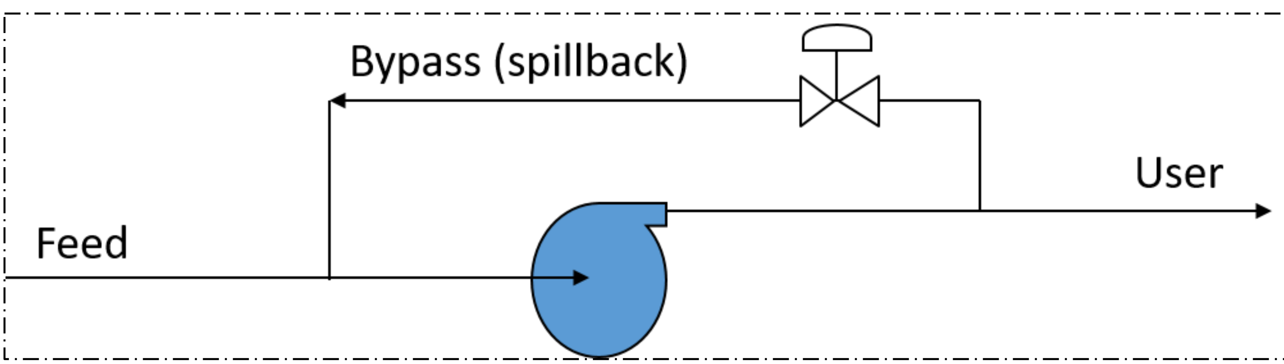

Figure 1: Bypass Control

In "throttle control" (Figure 2) the flow is adjusted by a valve in the pump discharge line. The valve closes to reduce the flow. This imposes a backpressure on the pump, which has to deliver a higher discharge pressure. This, in turn, demands more energy per unit of flow. In addition, both the pump and its driver (usually an electric motor) move away from their design points to new operating points, which are invariably less efficient. The result, once again, is an increase in energy intensity – although the increase is not usually as large as it would be with bypass control.

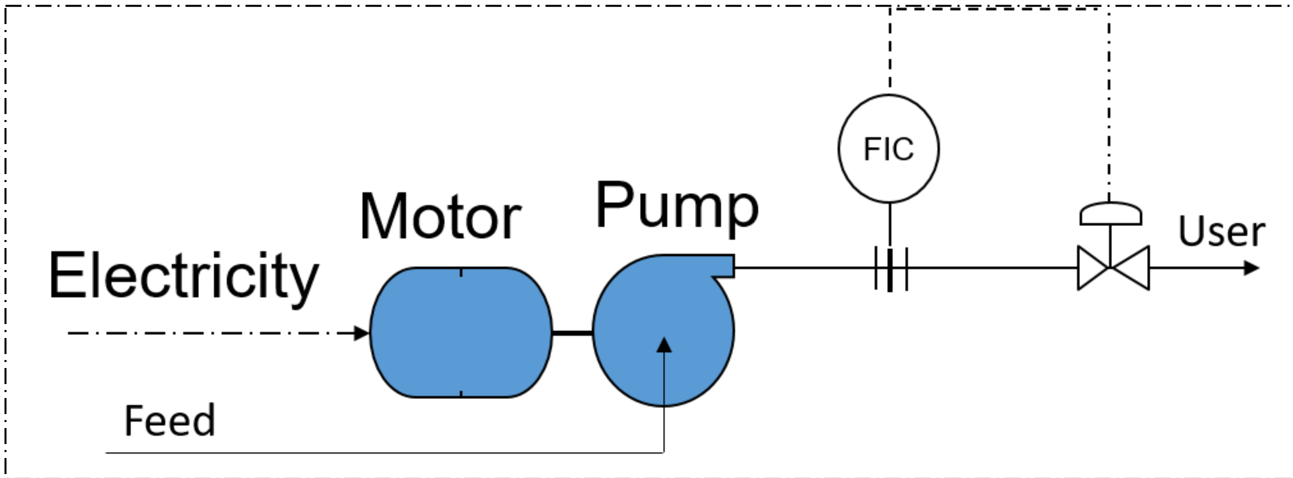

Figure 2: Throttle Control

In contrast to these examples, variable speed control can, in some cases, reduce energy intensity as flow rate goes down. However, this is generally much more expensive to implement.

Control systems can also cause energy intensity to increase as throughput drops is in distillation columns. The flows of reflux streams and stripping steam are often set based on nameplate throughput, and then held constant. Consequently, when feed rates drop, there is not a commensurate drop in energy consumption. This problem can be corrected by modifying flow control systems to maintain a constant reflux ratio or stripping steam ratio – or, better, to maintain constant product specifications using online chemical analysis.

It requires energy to overcome minimum turndown limits in distillation columns, boilers, furnaces, and other equipment, and minimum flow restrictions in piping. For example, as a distillation column reaches its turndown limit, it may be necessary to *increase* the reflux ratio to maintain liquid and vapor traffic, instead of reducing it, as discussed in the previous paragraph. When boilers reach their turndown limits, many sites either vent steam, or alternatively deliberately use steam inefficiently within their processes to avoid a visible vent. When a flow rate approaches the minimum limit in a pipe, it may be necessary to recycle fluids, which increases pumping costs.

Heat losses through piping and vessel walls, steam leaks, and condensate losses are insensitive to throughput, so they become a larger percentage of energy consumption as production falls, causing energy intensity to rise.

With the exception of some of the simpler control issues, it usually requires significant investment to resolve most of these problems. However, in some cases improvements can also be made through operating changes, especially where multiple pieces of equipment run in parallel. For example, it may be possible to shut down one process train in a multi-train plant, one or two pumps or fans in a large cooling water system, or one or two boilers in a large steam system. However:

- The operating changes must not compromise safety or reliability.
- System interactions should be considered. For example, shutting down a cooling water pump eliminates the energy use in that pump; but the reduction in flow may adversely affect the energy intensity of equipment that uses the cooling water (e.g., refrigeration units).

Adapted from: *Combat Low Rate, Low Efficiency*, Alan Rossiter, Chemical Processing, Vol. 82, No. 6, p. 12, June 2020.

In Closing…

Thank you for taking the time to read along with us. We hope you found the information useful, and that you'll join us in our upcoming events.

If you would like to ensure that you receive all program updates and notices of upcoming events, please subscribe on our webpage.

If you have any questions, or difficulties with registration, or to request removal from this distribution list, please contact Li Lopez, llopez37@Central.UH.EDU or 713-743-7904.