

BY BOB EBERTS, ENGELHARD CORP.

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Winning The War Against Rising Natural Gas Prices

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Coriolis technology delivers accurate data, allows for accurate cost allocations

How many of us are happy with our gas bills? Rising natural gas prices in the U.S. and around the world are a growing concern.

Energy costs have risen astronomically in the past few years because of shortages in supply as well as increased demand. The increased demand was unexpected and the infrastructure of the gas market was unable to compensate.

To bring its own gas costs under control, Engelhard's McIntyre, Georgia facility uses Micro Motion® Coriolis technology to monitor gas usage and process efficiency.

A top ten gas consumer

As one of the top ten natural gas consumers in the state of Georgia, the McIntyre facility felt a tremendous impact from rising gas costs. Because they saw the price increase coming, steps were taken to keep costs down. The facility teamed up with sister plants in Attapulgus, Georgia, and Quincy, Florida, to buy natural gas, which gave them leverage for better prices in the marketplace. But because the McIntyre facility represents about 90 percent of the usage for that group of plants, category buying didn't result in great savings. Category buying has been very helpful to the smaller plants.

Engelhard's purchasing agency also purchased gas futures, projecting gas prices in the coming months and years and purchasing certain amounts of gas at the current rate to use at later dates.

Many of the McIntyre operations also use alternative fuels, such as diesel fuel. Over the 2000-2001 winter months, when cold weather caused higher gas consumption and gas prices skyrocketed, diesel fuel was sometimes more viable than natural gas.

While these actions saved Engelhard money, they were only temporary solutions. Anticipating that the cost of natural gas would continue to rise for several years, the McIntyre facility sought ways to limit its gas usage.

A Department of Energy report shows the December 2000 natural gas prices exceeded \$8.00 per thousand cubic feet at the well head (Figure 1).

The report also states, "The average well-head price of natural gas is projected to increase from \$2.08 per thousand cubic feet in 1999 to about \$3.30 per thousand cubic feet in 2000 and 2001, and then decline through 2004. The projected price reaches \$3.13 per thousand cubic feet in 2020, due to higher projected demand."

The decline projected by Mariner-Volpe in 2004 is expected to come about because of drilling more wells and installing more pipelines, which will bring the cost of gas down as the market becomes saturated. But once again, this is a temporary solution to what happened in 1999, when companies dropped out or reduced output because of oversupply, driving the prices up. The trend indicates much higher prices will prevail.

Because Mariner-Volpe's prices are well-head prices, transportation costs in pipelines, processing and purifying the gas and other associated costs are added before the McIntyre facility's end usage or burner tip price.

If, as the projection shows, the cost of gas is not likely to go down significantly, industry will have to find a way to cope with the additional expense. Engelhard decided their strategy would be to optimize the McIntyre facility's efficiency in using natural gas.

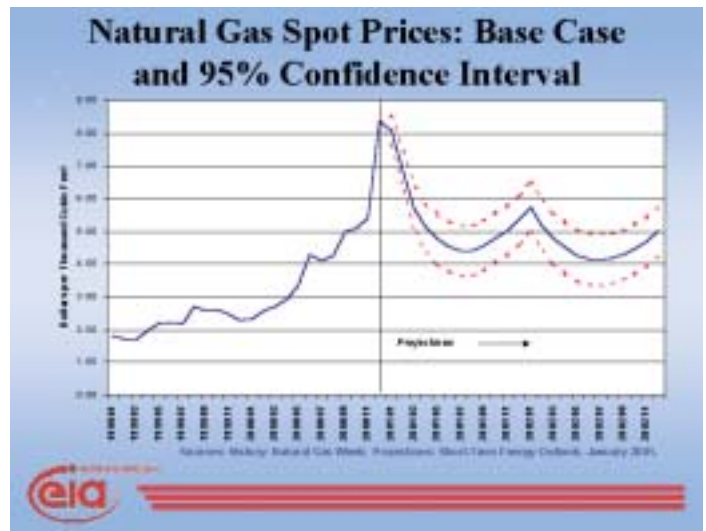


Figure 1. Price projections through 2002
 Source: Barbara Mariner-Volpe of the Energy Information Administration (www.eia.doe.gov), a part of the Department of Energy (DOE), "Natural Gas Market: Status and Outlook."



Allocating costs for accounting

The McIntyre facility uses natural gas in burners for drying operations and boilers for general process steam. The burners can range in size, according to the operation, from 6 million British thermal units (Btu) per hour to more than 90 million Btu per hour, which is equivalent to about 6,000 to 90,000 cubic feet per hour natural gas consumption. The boilers range in size from 12 to 20 million Btu per hour, using between 12,000 to 20,000 cubic feet of gas per hour. In the past, the accounting department budgeted for gas costs by calculating the percentage of the total gas consumption used in each process. The accountants would estimate whether each process was using more or less gas than anticipated by allocation only, but the figures did not reveal the actual gas usage or how efficiently each process was operating.

For example, if Process A was allocated 200 therms per operating hour, the accounting department might allocate 30 percent of the total plant's gas usage to that process. For a certain month, the total plant's gas usage was 100,000 therms, which



Burners used in drying operations require between 6,000 to 90,000 cu ft per hour natural gas.



The McIntyre Ga. facility's process steam boilers use as much as 20,000 cu ft per hour natural gas.

is read off of the utility meter coming into the plant. During that month, Process A operated 120 hours.

In this case, the accounting department's allocation would be 30 percent of 100,000 therms, or 30,000 therms, that were supposed to go into Process A. However, the process actually operated 120 hours and, at 200 therms per hour, used 24,000 therms for the month. The difference between the two usage rates is 30,000 divided by 24,000, or 125 percent of budget. This number is an efficiency or budgetary performance number used by the accounting department.

These cost allocations satisfy the accounting needs, but the system doesn't meet the needs of the engineering department. The allocation method tells nothing about how efficiently Process A is operating.

In the mid-1980s, the facility installed vortex meters to measure this flow on several applications. Such meters measure only volumetric flow, based on the velocity of the material flowing. That value must then be adjusted to account for the material's pressure and temperature.

Piping installation requirements for the vortex meter are stringent. To get an accurate reading, the vortex meter must have a fully developed turbulent flow within the meter, which requires a minimum of ten pipe diameters before and five pipe diameters after it.

For these reasons and others, these meters were difficult to maintain. Three different instruments were required to

Engelhard Corp. is a multinational organization. The McIntyre, Georgia, facility is part of the appearance and performance technologies group, which includes paper pigment additives, and specialty pigment additives in paints, paper and cosmetics.

get one corrected flow reading. All three instruments had to be maintained and accurately calibrated. Any significant error in any one of the variables would render the result meaningless.

As a result, the facility saw fluctuations in flow as high as ten percent. Because the vortex meter requires turbulent flow, reduced flow conditions sometimes affected accuracy. The gas usage values became “best guesses,” because the technology was inadequate.

Instrumentation improvements plantwide

During the past decade, the McIntyre facility has undergone numerous process instrumentation improvements. With gas prices on the rise, the facility’s management realized a need for updated technology to measure gas usage.

Coriolis technology had been used successfully in several slurry applications. Although the early Coriolis meters were large

and cumbersome, facility engineers decided to install modern meters on some gas applications to test their accuracy. Modern Coriolis meters have far fewer piping considerations and require less space than the vortex meters or the early Coriolis meters (Table 1.)

Benefits of Coriolis

The facility found that, like the Coriolis meters on slurry operations, the Coriolis meters on the new gas application required little maintenance. The main benefit of Coriolis technology is that it measures mass flow, meaning that pressure and temperature compensation is no longer required. That meant there were fewer instruments to maintain and calibrate.

The Coriolis meter reads pounds-per-minute directly and is significantly more accurate than the vortex meter. Their use in the natural gas applications took the guesswork out of gas consumption in individual processes. Engineers verify gas consumption through burner calculations and by measuring the amounts of non-combustibles and combustibles into and out of the system.

The accounting department can now budget by using measurements of the actual gas usage for a process instead of an estimated allocation number. Accountants are able to calculate an actual variable cost per product and see how the energy usage of each process for a specific product directly affects the bottom line. This system provides more accurate models, resulting in better management decisions and planning.

Engineers can now calculate thermal efficiencies of individual processes. They can perform a complete mass and energy balance and establish burner performance parameters. If a particular burner starts to consistently use more gas, maintenance will be alerted to look for problems (Table 2.)

The new meters also allow for the identification of weak links or “bad actors” in the system. The McIntyre facility has duplicate processes. If there are three systems performing the same function and one uses 10-15 percent more gas than the others do, engineers have a basis to investigate the cause. This can lead to improvement in energy usage and overall processing efficiency.

Vortex meter	Coriolis meter
Volumetric flow measurement	Mass flow measurement
Pressure and temperature compensation required	No compensation required
Fully developed turbulent flow required	Uses any flow regime
Piping requirements (straight pipe 10xD before, 5xD after)	Few installation restrictions
High maintenance	Low maintenance
Requires maintenance of auxiliary instruments	No auxiliary instruments required
Unreliable data, flow fluctuations to 10%	High accuracy
Outdated technology	Updated technology

Table 1. Comparison of vortex and Coriolis meters for meters for measuring natural gas usage.

Accounting benefits	Engineering benefits	Operations
Actual natural gas usage by process, not an allocation number	Thermal efficiency of operations	Ease of installation
Actual variable costs for products that directly affect bottom line	Burner performance	Low maintenance
More accurate accounting models	Identification of "bad actors"	High accuracy

Table 2. Summary of results from using Coriolis meters for natural gas measurement.

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Operation	Allocation method	Coriolis meters
Spray drying	71-80%	73-87%
Apron drying	>200%	23%

Table 3. Comparison of thermal efficiencies (%) for allocation method versus actual gas usage using Coriolis meters. The actual gas usage data has resulted in more than \$250,000 per year in re-allocated costs.

By determining actual gas usage, changes to the process can be made and the effects accurately measured.

Table 3 contains some examples of the contrast between the allocation method and actual cost figures based on Coriolis measurement for spray drying and apron drying. Using the allocation method, the thermal efficiency of the spray drying processes ranged from 71 to 80 percent. The measured gas usage showed a wider range, from 73 to 87 percent.

Also in Table 3, the allocation method shows the thermal efficiency for apron dryers at more than 200 percent, which points out a flaw in the calculations. Coriolis measurements show the actual efficiency is only 23 percent. These factors directly affect the profitability of products.

As a result of continuing operational and trending data obtained from the Coriolis meters, the facility has re-allocated more than a quarter of a million dollars in energy costs per year to the correct product line.

Re-allocation of gas usage costs is a continuing process. Engelhard projects continued upgrades as it strives for greater gas usage efficiency.

About the author

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