



Harris Group Inc.

Corn Ethanol Boiler Projects – Items to Consider

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Introduction

Not long ago, profiting from corn ethanol production was easy. Between plentiful feedstock, government incentives and inexpensive natural gas, it seemed the only requirement to assuring profit was to produce.

However, the costs of ethanol production have increased dramatically. Just producing ethanol is no longer sufficient to guarantee a profit. As more facilities come on line a competitive market has developed and it is becoming increasingly necessary to be a low-cost producer. The costs of feedstock, feedstock transport and distribution are driven by market forces and trending upward. The cost of energy, while lower today than a year ago, has seen record heights in recent years, and today's lower cost certainly will not last; however, the owner can control the source and consumption and thereby the cost of that energy.

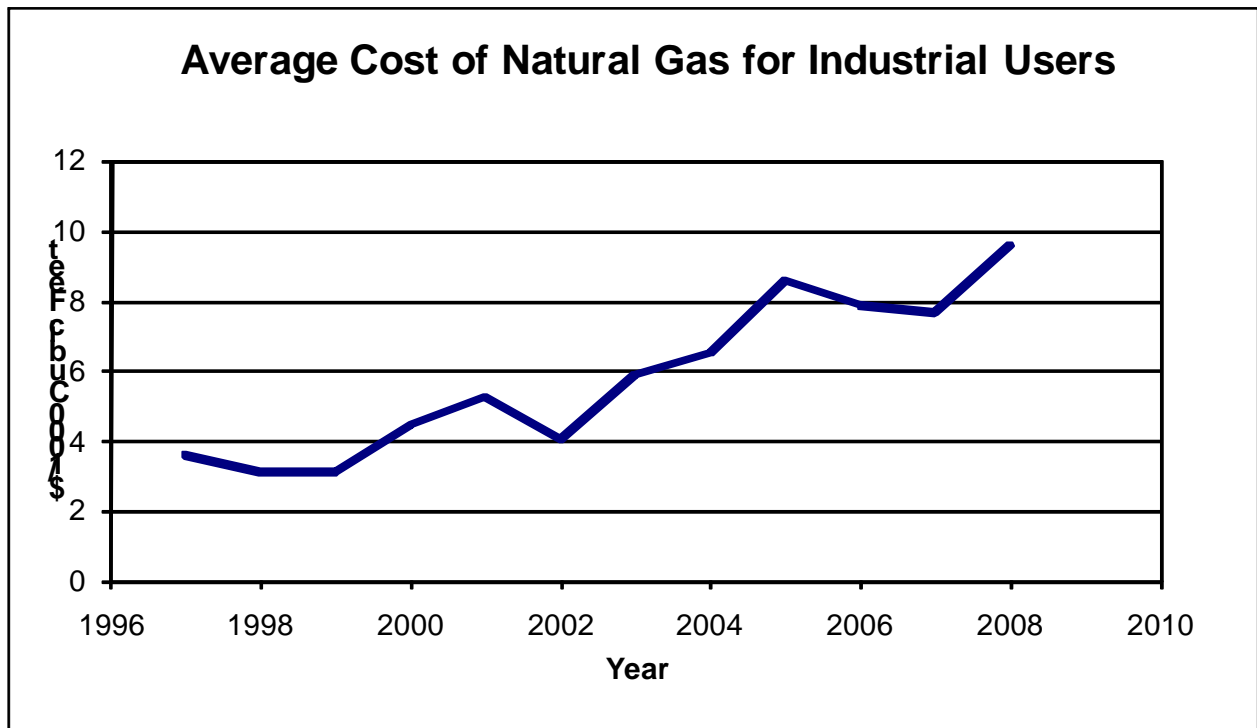
Boiler Considerations

A major cost associated with operating an ethanol production facility is in the energy required to operate a boiler and generate process steam, and the boiler may be a candidate for refurbishment or replacement for any of a host of reasons. Older boilers may not be efficient or may be undersized with respect to the process, especially if improvements in plant throughput have been made and systems de-bottlenecked. Component wear must be considered, and there may be need to upgrade emissions equipment. Economics may drive conversion to a different boiler fuel or to combined heat and power (CHP) systems.

In many cases, boiler rebuilds can be more cost effective than a new system because the basic system infrastructure is already in place. Also siting and/or permitting approvals may be easier to obtain. However, there are physical limitations to any capacity, efficiency or pressure increases sought with a boiler rebuild. Furthermore, downtime is required for a rebuild. This can extend from several weeks to several months, depending on the extent of the rebuild work. In order not to affect production, the

plant must have spare boiler capacity or bring in a rental boiler for the duration of the downtime.

Boiler replacement has an advantage, space permitting, of being tied-in with minimal downtime leaving the older boiler as a back-up, temporarily or indefinitely. Boiler replacement also allows for the ability to burn a wider variety of fuels than might be available from a boiler rebuild/conversion. Finally, boiler replacement provides the opportunity for a capacity increase which can be used to boost plant production and/or upgrade steam outlet conditions for power cogeneration opportunities, further reducing plant energy costs.



The average cost of natural gas has more than doubled in the last 10 years. This reflects price increases of more than 11% annually. In spite of a decline in 2009 due to the recession, the overall trend is expected to continue and emphasizes the need to critically evaluate all possible energy options and opportunities at your particular facility.

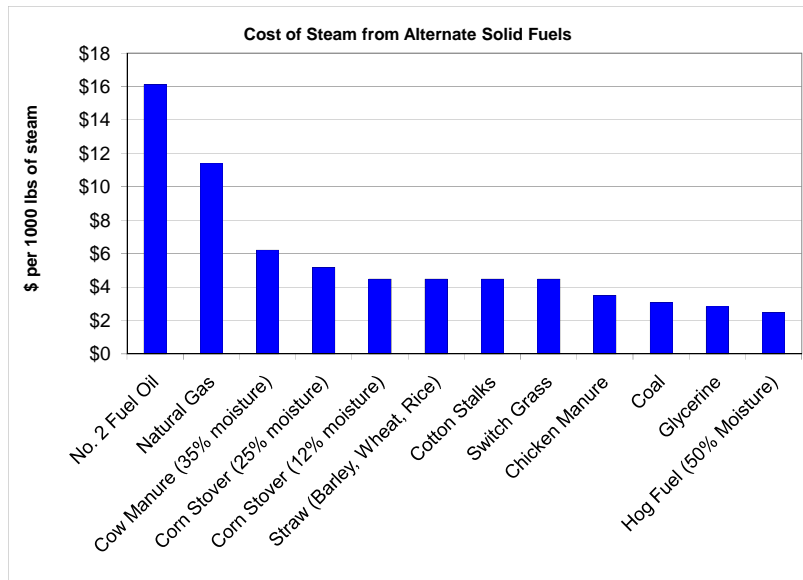
Selecting the Right Fuel(s)

There are a tremendous variety of fuels available for use in boilers. Normally there may be two or three that are right for your particular installation. Fuels normally considered include:

- Natural gas
- Oil

- Coal
- By-product and waste fuels including forest and agriculture residues

As indicated in the following table, the cost per BTU of various non-mainstream fuels can be substantially less than traditional fossil fuels such as natural gas and oil. These alternate fuels (with the exception of coal) are collectively referred to as “biomass” and are gaining in popularity because of this higher fuel value per unit cost.



The implications of selecting biomass as a fuel will be discussed in another paper because balancing the benefit of low cost fuel against the overall reliability of biomass combustion is a complex issue. In general, however, consideration should be given to the following items when it comes to fuel selection:

- Cost
- Local availability
- Transportation costs
- Storage and handling requirements
- Overall system reliability

Boiler Complex Footprint

Over the last 30 years, ever-increasing fuel costs and tighter emission regulations have resulted in more efficient and cleaner boiler systems, but these systems require a significantly larger footprint. Factors influencing equipment sizes include:

- Larger furnace size to increase heat absorption and enhance burning
- Additional combustion ductwork and air ports for more efficient burning
- New back-end equipment for increased efficiency
- Larger, more efficient emission control equipment

Emission Control Equipment

Increased air emission control regulations have affected all phases of a boiler project, from siting the unit to operational compliance. Limits are placed on particulate and gaseous products of combustion discharged from the stack. These discharges are handled in different and varied means or equipment depending on the amount, size and type of emission:

- Particulate control equipment
 - Stack dispersion
 - Mechanical cyclone collectors
 - Wet scrubbers
 - Electrostatic precipitators
 - Baghouses
- SO_x control equipment
 - Burning low sulfur fuels
 - Stack dispersion
 - Wet desulfurization systems
 - Dry desulfurization systems
- NO_x control equipment
 - Low NO_x burners
 - Flue gas recirculation
 - Catalytic converters

Back-end Heat Traps

Heat traps at the boiler outlet reduce the flue gas temperature to the stack, increasing the boiler steaming efficiency. The most common backend heat traps are the economizer and the tubular air heater. The economizer heats the feedwater being pumped to the steam drum, reducing the amount of fuel required. The air heater heats the furnace combustion air improving the combustion conditions in the furnace. These devices can be used separately or in combination on a particular boiler system. When used separately, the economizer is usually simpler and more economical.

Summary

There are several reasons for considering boiler refurbishment or replacement:

- To improve boiler efficiencies
- To increase production capacity
- To upgrade boiler emissions equipment
- To replace worn components
- To convert from one fuel to another because of economics or product change
- To upgrade steam outlet conditions for power generation

So far, we have touched on all of these topics except the last two. As already discussed, burning biomass will be discussed in a future paper.

Combined heat and power generation (CHP) will be the focus of the next paper, where there is the potential to meet all the electrical energy needs of a corn ethanol facility paying only to generate steam.

About the Author:

Paul Schoen is a senior process engineer with more than 25 years of chemical process and project engineering experience with both operating companies and technology providers. He has executed all phases of chemical processing projects from concept through design, specification, procurement, fabrication, installation, start-up and production in greenfield, expansion and retrofit applications worldwide. His background includes pharmaceutical and chemical R&D activities from bench to pilot scale through production campaigns in support of clinical trials and the process optimization of manufacturing facilities. Contact Paul at paul.schoen@harrisgroup.com or 206-494-9561.

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