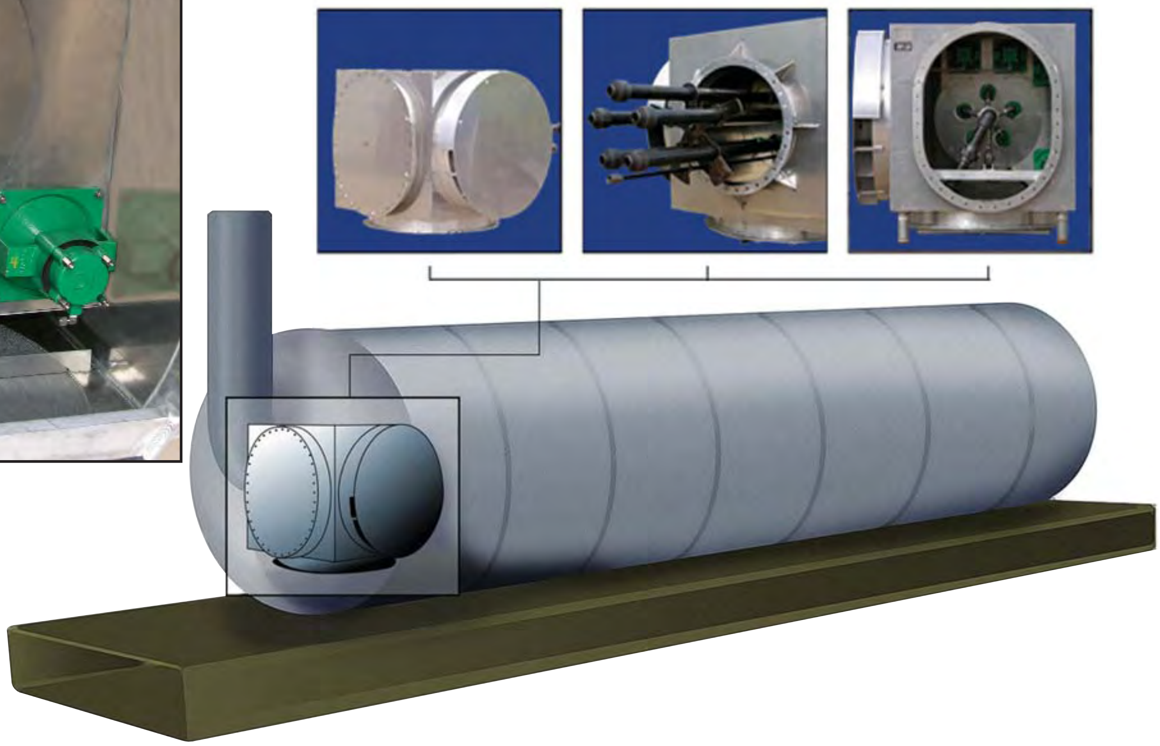
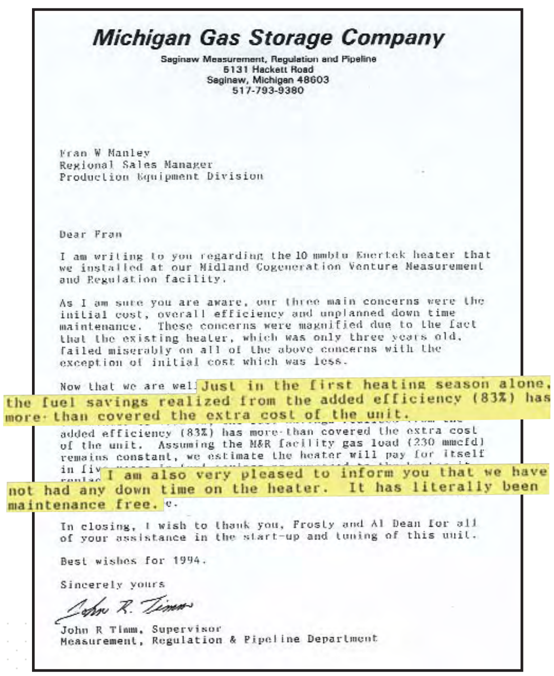
Engineered Concepts, LLC
Quantum Leap Technologies

Automatic Secondary Air Control System

[patent pending]

View of interior of Automatic Secondary Air Control System





Michigan Gas Storage Company

Saginaw Measurement, Regulation and Pipeline
5131 Hackett Road
Saginaw, Michigan 48603
517-793-9380

Fran W Manley
Regional Sales Manager
Production Equipment Division

Dear Fran

I am writing to you regarding the 10 mmbtu Enertek heater that we installed at our Midland Cogeneration Venture Measurement and Regulation facility.

As I am sure you are aware, our three main concerns were the initial cost, overall efficiency and unplanned down time maintenance. These concerns were magnified due to the fact that the existing heater, which was only three years old, failed miserably on all of the above concerns with the exception of initial cost which was less.

Now that we are wel[illegible]

Just in the first heating season alone, the fuel savings realized from the added efficiency (83%) has more than covered the extra cost of the unit.

added efficiency (83%) has more than covered the extra cost of the unit. Assuming the M&R facility gas load (230 mmcfd) remains constant, we estimate the heater will pay for itself in fiv[illegible]

I am also very pleased to inform you that we have not had any down time on the heater. It has literally been maintenance free.

In closing, I wish to thank you, Frosty and Al Dean for all of your assistance in the start-up and tuning of this unit.

Best wishes for 1994.

Sincerely yours

John R. Timm

John R Timm, Supervisor
Measurement, Regulation & Pipeline Department

83% efficiency and no downtime.

Reduce Your Fuel Costs and Emissions by 50%

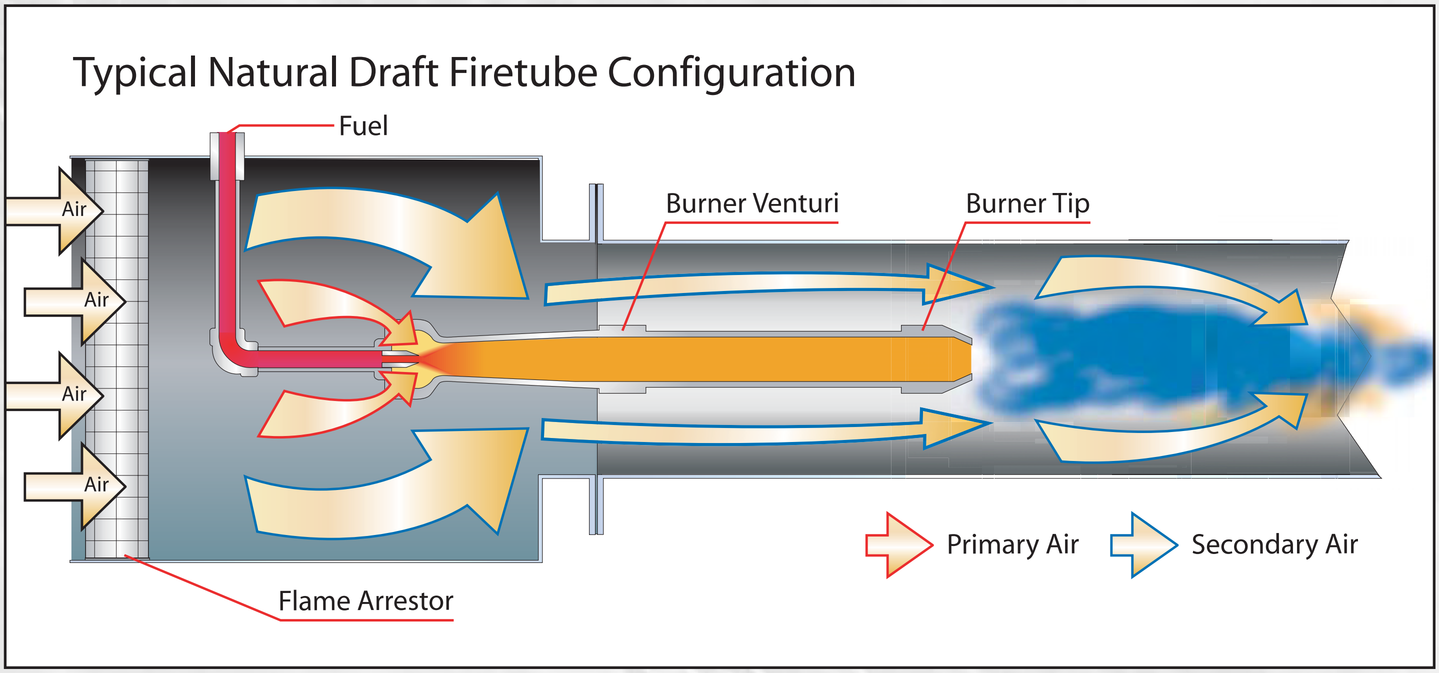
Imagine reporting a 50% reduction in fuel expenses and emissions from your natural gas fired processing equipment next year. How much would that be worth? Probably millions of dollars. It's possible with Engineered Concepts' Automatic Secondary Air Control (ASAC) System using efficient combustion technology to literally make money from air.

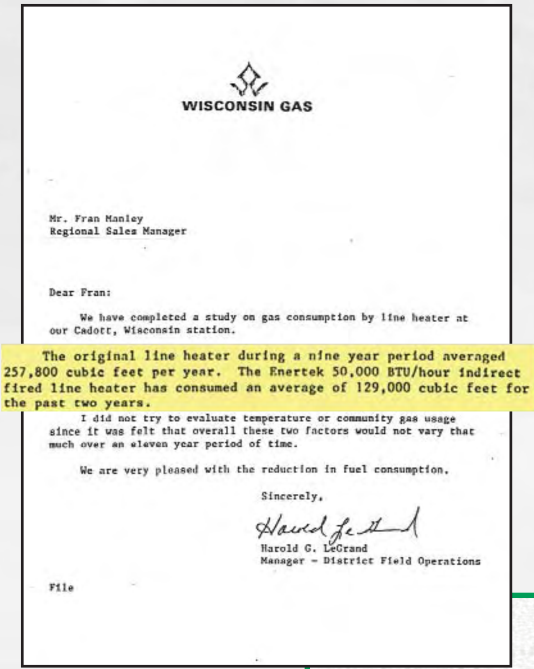
The ASAC System limits the secondary air surrounding the flame in the combustion chamber, resulting in a significant improvement in efficiency. Operations and field test efficiencies of the ASAC are generally reported as 75% or more. On that basis, it is not unreasonable to expect improvements in fuel consumption ranging from 30 to 75% depending on the combustion environment.

The ASAC also reduces carbon dioxide emissions and the chance of fire outages by providing more efficient and reliable burner operations.

Engineered Concepts' ASAC System is field proven and can be retrofitted to existing processing equipment or incorporated into new equipment packages.

Combustion Basics




WISCONSIN GAS

Mr. Fran Manley
Regional Sales Manager

Dear Fran:

We have completed a study on gas consumption by line heater at our Cadott, Wisconsin station.

The original line heater during a nine year period averaged 257,800 cubic feet per year. The Enertek 50,000 BTU/hour indirect fired line heater has consumed an average of 129,000 cubic feet for the past two years.

I did not try to evaluate temperature or community gas usage since it was felt that overall these two factors would not vary that much over an eleven year period of time.

We are very pleased with the reduction in fuel consumption.

Sincerely,

Harold G. LeGrand
Manager – District Field Operations

File

50% fuel savings

Engineered Concepts' Automatic Secondary Air Control (ASAC) System uses efficient combustion technology to literally make money from air.

The oil and gas production industry relies on natural draft firetubes to provide the heating requirements for heaters, glycol dehydrators, gas production units, oil treaters and other process equipment. Firetube heaters typically use low-pressure, partial pre-mix burners in which part of the air required for combustion, the primary air, is drawn into the burner and mixed with the fuel prior to reaching the flame at the burner tip. Secondary air is drawn through the firetube by stack draft and mixed with the fuel at the flame. Any secondary air not required for combustion is excess air.

The exact ratio of air (primary and secondary) required to provide the oxygen to burn a fuel is called the theoretical or stoichiometric air. Ideal combustion at this ratio would yield an exhaust gas with no oxygen or combustibles. In practice, some additional (excess) air must be added to compensate for inefficiencies in mixing and to ensure complete combustion.

Excess Air Decreases
Combustion Efficiency

Excess air wastes money from your operations by decreasing firetube combustion efficiency in two ways;

- The sensible heat used to warm the excess air to exhaust temperature is lost out the stack.
- Excess air lowers the flame temperature. Excess air of only 16.2% (3.4% excess oxygen) lowers the flame temperature about 260 degrees, thus reducing the temperature difference between the flame and the process so that less heat is transferred per unit area of firetube. Figure 1 illustrates the effect of excess air on overall efficiency.

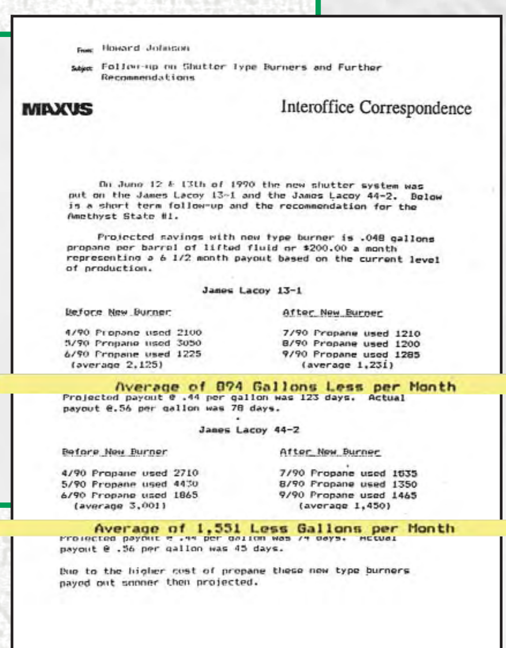
Typically, firetubes with uncontrolled secondary air operate with stack exhaust gas temperatures of 600 to 1100 degrees and excess air of 100 to 600 percent (11 to 18.2 % excess oxygen) depending on the process loads and the diameter of the firetube. This operating envelope covers efficiencies ranging from less than 10 to 60%, with large diameter firetubes tending to the low end of the efficiency range. The orange shaded area of **Figure 1** illustrates the typical efficiency range for natural draft firetubes with uncontrolled secondary air.

Field tests of large firetubes with uncontrolled secondary air have yielded combustion efficiencies ranging from 8 to 40% depending on operating mode and service.

Large Firetubes Are Prone To Low Combustion Efficiencies

Field performance tests have been conducted on various sizes and types of equipment to determine typical combustion efficiencies. Large diameter firetubes generally exhibit lower efficiencies than small diameter firetubes. This is because a large firetube has the ability to draw excess air - due to stack draft - in proportion to its crossectional area (a function of its diameter squared), whereas the ability to deliver energy from the firetube to the process is in proportion to the surface area (a function of the diameter). Therefore large firetubes are able to draw huge quantities of excess air and, if left uncontrolled, are prone to low efficiencies. Field tests of large firetubes yielded combustion efficiencies ranging from 8 to 40% depending on operating mode and service. Generally, an efficiency of 25 to 35% is normal for large diameter firetubes.

47.7% fuel savings



From: Howard Johnson

Subject: Follow-up on Shutter Type Burners and Further Recommendations

MAXUS Interoffice Correspondence

On June 12 & 13th of 1990 the new shutter system was put on the James Lacoy 13-1 and the James Lacoy 44-2. Below is a short term follow-up and the recommendation for the Amethyst State #1.

Projected savings with new type burner is .048 gallons propane per barrel of lifted fluid or $200.00 a month representing a 6 1/2 month payout based on the current level of production.

James Lacoy 13-1

Before New Burner	After New Burner
4/90 Propane used 2100	7/90 Propane used 1210
5/90 Propane used 3050	8/90 Propane used 1200
6/90 Propane used 1225	9/90 Propane used 1285
(average 2,125)	(average 1,231)

Average of 894 Gallons Less per Month

Projected payout @ .44 per gallon was 123 days. Actual payout @.56 per gallon was 78 days.

James Lacoy 44-2

Before New Burner	After New Burner
4/90 Propane used 2710	7/90 Propane used 1635
5/90 Propane used 4430	8/90 Propane used 1350
6/90 Propane used 1865	9/90 Propane used 1465
(average 3,001)	(average 1,450)

Average of 1,551 Less Gallons per Month

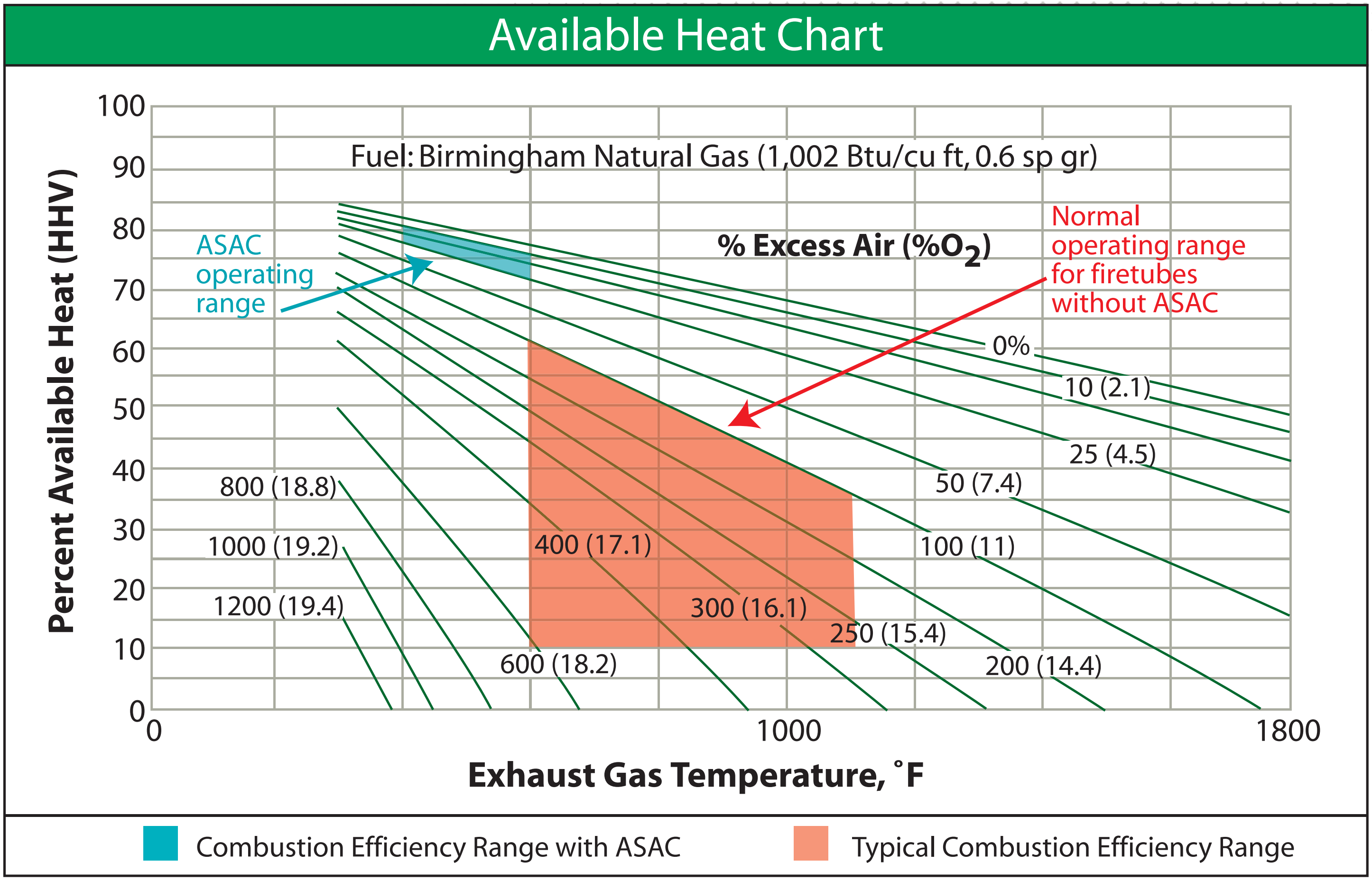
Projected payout @ .44 per gallon was 74 days. Actual payout @ .56 per gallon was 45 days.

Due to the higher cost of propane these new type burners payed out sooner then projected.

(Saved 2445 gallons per month of propane)

Off-On Firetube Operations Waste Valuable Heat

FIGURE 1



Source: Process Heat Tip Sheet #2, U.S. Department of Energy, DOE/GO-102002-1552

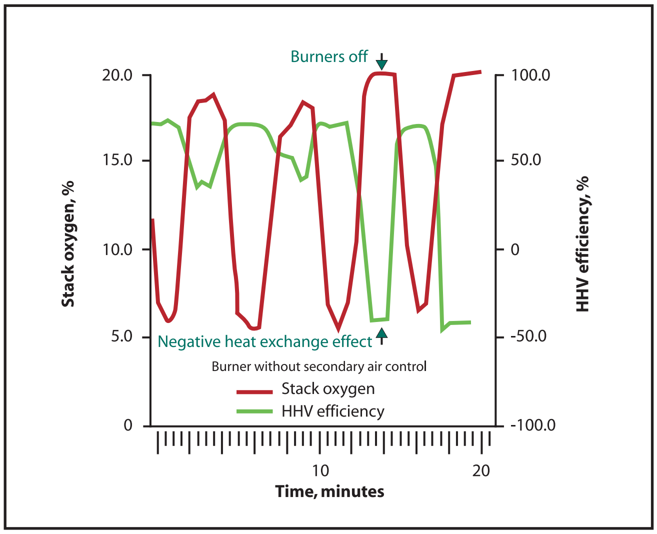
Controlling Excess Air Increases Combustion Efficiency

The temperature of the stack exhaust is indicative of the energy wasted by inefficient combustion. Obviously, any heat contained in the exhaust is not used in heating the process, and cooling the exhaust is a primary goal in attaining increased efficiency. The best way to cool the stack exhaust and to increase efficiency is by controlling the excess air in a narrow band of about 10 to 25% (2.1 to 4.5% excess oxygen). Reducing the excess air to this range will typically cool the exhaust gases to about 400 to 600 degrees and increase the overall efficiency to 75 to 80% (higher heating value basis) as illustrated by the blue region in **Figure 1**.

Off-On Firetube Operations Waste Valuable Heat

In addition to operating with uncontrolled secondary air, many firetubes operate in off-on (snap acting) mode. As shown in **Figure 2**, during the off cycle, the stack continues to draft ambient air into the firetube, thereby acting as a negative heat exchanger to the process. Large quantities of heat are lost from the process during the off cycle. Equipment designed with multiple firetubes suffer this negative effect if one or more of the firetubes is idle. Therefore, control of the flow of air into the combustion chamber while the firetube is idle is also an important objective in attaining the highest efficiency for a natural draft firetube.

FIGURE 2



Effect of off-on operations on firetube efficiency

Engineered Concepts'

Answer *to High Combustion Efficiency*

Precisely Control Excess Air

The **Automatic Secondary Air Control System** regulates the secondary air in direct proportion to the burner fuel pressure. It uses pressure from the burner fuel manifold to operate the air control valve to regulate the amount of secondary air flowing into the combustion chamber. The air control valve is adjustable to compensate for fuel composition and altitude, ensuring the correct proportion of excess air under all operating environments. Once adjusted, the ASAC maintains a constant fuel-to-air ratio across the full burner firing range by moving in response to changes in the burner fuel pressure. The system is designed to maintain the excess oxygen at 2% to 5% across the entire firing range of the burner as shown in **Figure 3**.

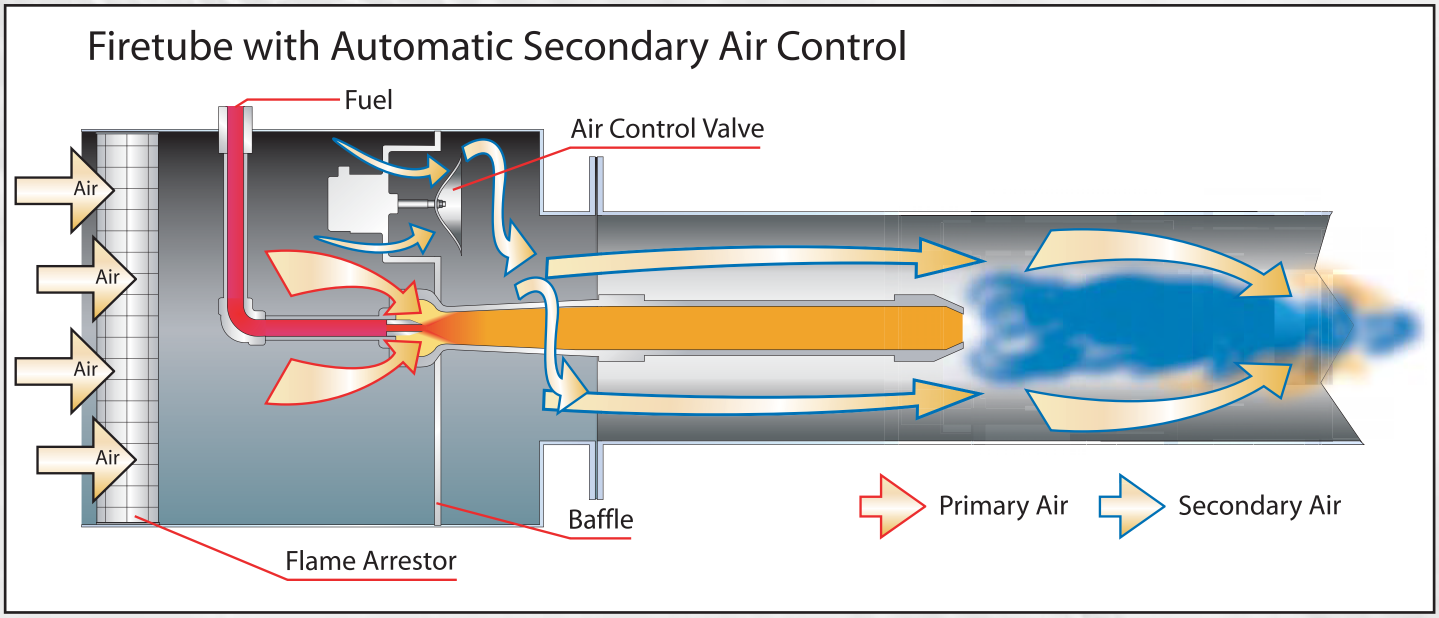
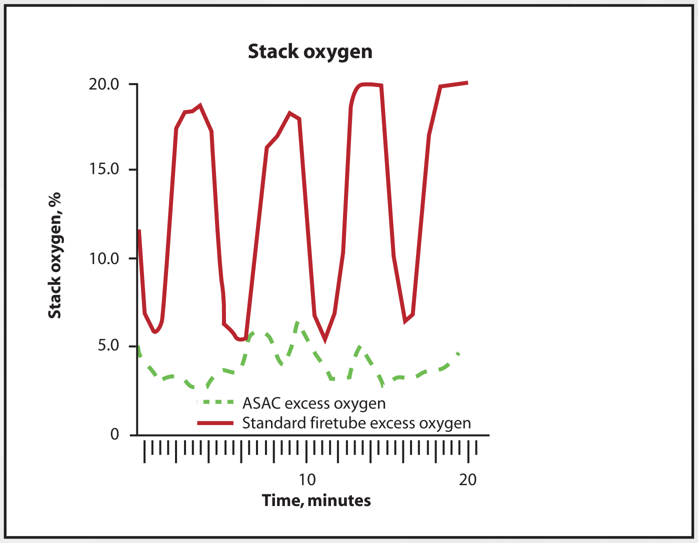
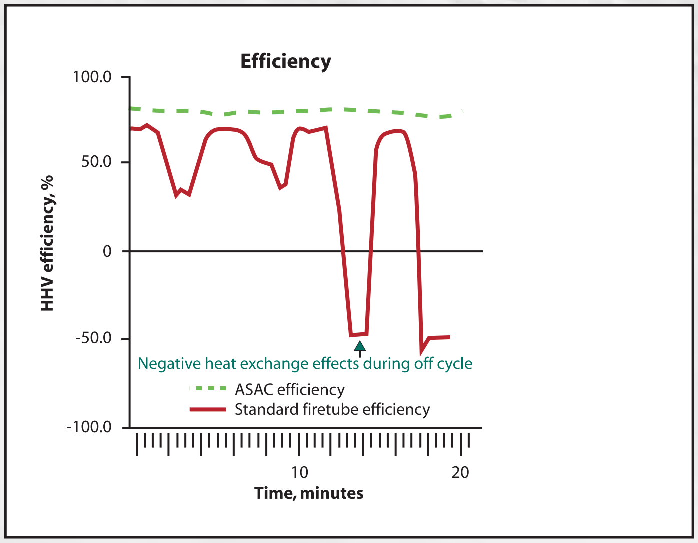


FIGURE 3



Stack oxygen contents comparison – ASAC vs. standard firetube

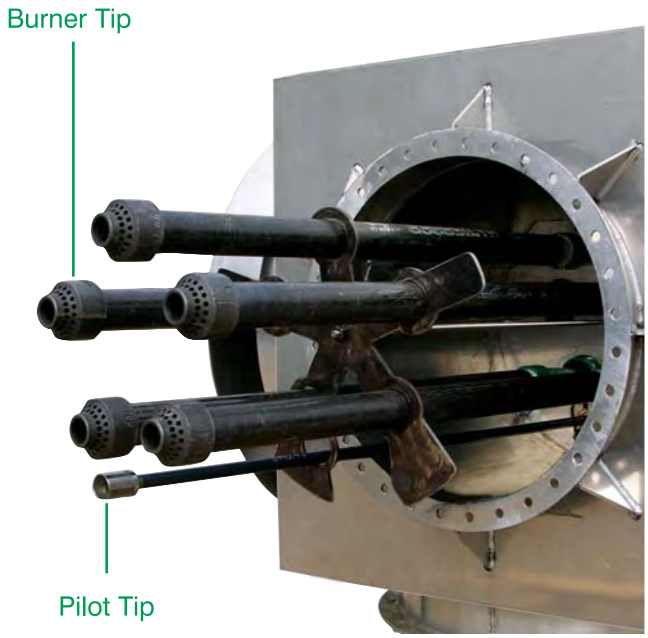
FIGURE 4

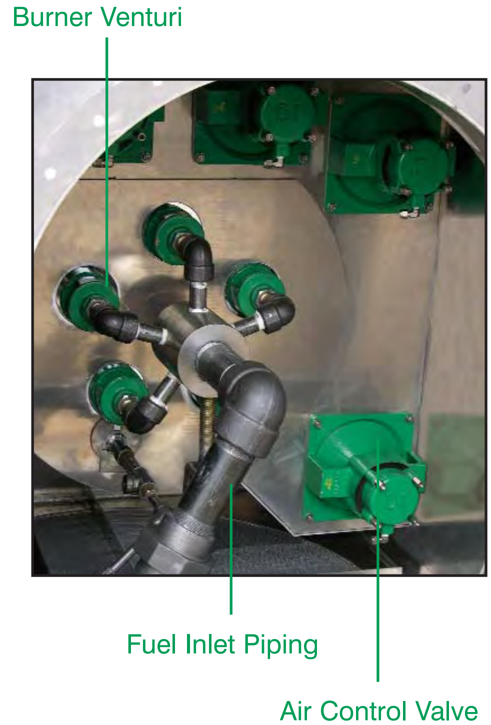


Efficiency comparison of ASAC vs. standard firetube

Eliminate Negative Heat Exchange Effects

Even when the firetube is idle, the ASAC System regulates the air flow through the firetube. This feature virtually eliminates the negative heat exchange effect associated with idle firetubes and allows use of multiple firetubes staged to accommodate the process load in the most efficient manner while still maintaining high overall combustion efficiency. **Figure 4** illustrates the improved efficiency gained by controlling excess oxygen and eliminating negative heat exchange effects.



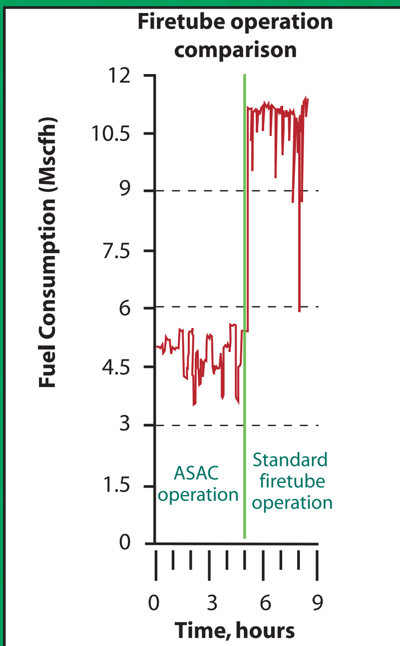


Application of the Automatic Secondary Air Control System is projected to save $253,162 of fuel per year and reduce carbon dioxide emissions by about 2940 tons per year.

The ASAC System is not limited to large process heating operations. Though small processes are usually more efficient than large processes, there is still room for significant savings. Even the smallest applications can attain savings of 30% or more beginning day one and continuing for the life of the unit.

ASAC (projected results based on actual field application)

	With Uncontrolled Secondary Air	With Automatic Secondary Air Control System
Process heat load, MM BTU per hour	4	4
Percent excess oxygen	15.3	2.2
Stack temperature, degrees F	810	595
Combustion efficiency, percent	36	75
Fuel consumed, MM BTU per hour	11.11	5.33
Carbon dioxide emissions, tons per year	5640	2700
Cost of fuel, dollars per MM BTU	5	5
Cost of fuel, dollars per year	$486,618	$233,456
Fuel and emissions reduction percentage		52



www.engineeredconcepts.com
1-800-814-9203

About Engineered Concepts

Engineered Concepts creates revenue-generating opportunities for the oil and gas industry by capturing emissions through application of innovative ideas for efficient, reliable equipment that attains the maximum environmental and economic impact.

Other Products from Engineered Concepts

The Quantum Leap Natural Gas Dehydration Technology (QLT) is the first TEG dehydration process verified through the EPA's Environmental Technology Verification Program to capture and convert virtually all hydrocarbon emissions to saleable product while also greatly reducing carbon dioxide emissions. QLT substantially reduces total operating expense and maintenance while improving operator safety and eliminating the odors associated with TEG dehydration.

The High Efficiency Recovery Option (HERO) has been documented to increase **total well revenues** by 10 to 15%. HERO ensures production of 100% of the produced hydrocarbons and eliminates all hydrocarbon emissions. The HERO stabilizes the liquids and returns all vapors to the gas stream. For maximum revenue and zero emissions, the HERO should be the operator's first option when selecting production equipment.

Engineered Concepts, LLC
Quantum Leap Technologies