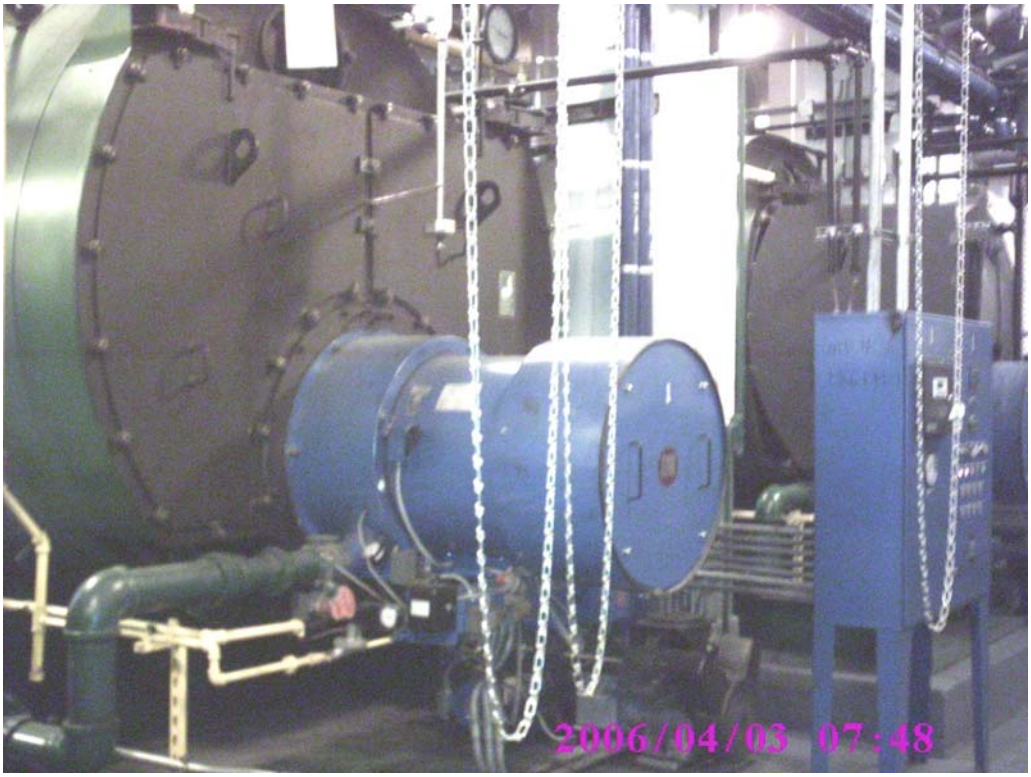
EMISSIONS AND FUEL ECONOMY BOILER TEST REPORT
New York City Housing Authority
FITCH FUEL CATALYST



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Dated: September 1, 2006

Executive Summary

Purpose:
A test program to measure the potential benefit of equipping NYCHA boiler with a permanent fuel treatment device (Fitch Fuel Catalyst) on plant emissions, maintenance, and fuel consumption was conducted during the 2005 - 2006 heating season.

Location:
The Penn-Wortman Houses at 875 Pennsylvania Ave. New York.
Three buildings complex - 360 dwelling units.

Boiler: Johnson PFTX-350-31LG15S 350 Ton duel fuel fired
Burner: Johnson FD68CA400LM

Dates: Baseline data collection – historic records
Fuel Catalyst installation November 28th 2005
Data collection 11/7/05 to 3/31/06

Results: Reduction in fuel consumption **5 percent.**
Reduction in emissions: CO 98 %, NOx 15%,
Increase efficiency: 1.2%

Other Comments: Boiler combustion chamber and heat exchanger surfaces showed marked reduction in soot. Carbon deposits were reduced by as much as 70%, which facilitates better heat transfer, efficiency and reduced maintenance.

Discussion:
New York City Housing Authority operates 2,276 apartment buildings with 1,428 boilers providing heat and hot water. 729 of these are dual fuel fired and consumed in excess of $80 million in diesel fuel oil in 2005. These 729 units are suitable for Fitch Fuel Catalyst retrofit.
Cost to retrofit 729 boilers @ $2,386 each - $1,740,000
Minimum annual savings to NYCHA - $4,000,000.
Savings over the 3-year catalyst service life - $12,000,000.

Recommendations:
Retrofitting the oil-fired boilers with Fitch Fuel Catalyst technology will have a positive impact on annual fuel budget and an above average return on investment of 5 months. Benefit will also accrue from reduced boiler cleaning and reduced atmospheric particulate and soot.
Funds should be appropriated to retrofit boilers system wide.

Personnel:
Rafael Valez - NYCHA NY. – Superintendent
Shawn Lundgren – NYCHA NY. - Chief
Kent Buckley – Analytical Combustion Systems, CT. - Testing agency
Mike Beatty – Analytical Combustion Systems, CT. – Testing agency
John Batey – Energy Research Center, Inc. Easton, CT- Data Analysis
Dr Konstantinos Koutelos - Green Power New York LLC, NY – Manufacturers representative
Chris Wright - Advanced Power Systems International, Inc. CT. - Manufacturer

Background:
Green Power New York LLC and Advanced Power Systems manufacturer of the Fitch Fuel Catalyst introduced the product to the New York City Housing Authority; Frank Roman, Carl Haffner, Tom Walsh, Shawn Lungren, William Steinmann and Mahesh Shah and John Loli from DECAS.

New York City Housing Authority personnel elected to conduct an evaluation of the fuel savings and emissions effect of the Fitch Fuel Catalyst on an in service diesel fired boiler. A successful evaluation to result in procurement of units for their boilers.

Several pieces of Housing Authority grounds maintenance equipment were also equipped with Fitch Fuel Catalyst units during the boiler evaluation period. The results from these tests were positive. These reports are available separately.

Fitch Fuel Catalyst Technology:
Advanced Power Systems International, Inc. (APSI) the manufacturer describes the product in literature as follows:

"The Fitch Fuel Catalyst is a polymetalic alloy housed in a canister and connected into a fuel system between the fuel tank and the burner. Its purpose is to reformulate fuel prior to combustion. It performs its function at the temperatures experienced by the equipment in normal service and has a service life of approximately 3 years in this application

The Fitch Fuel Catalyst is not a fuel additive. It is a special alloy that does not dissolve in fuel. The fuel is reformulated by the alloy catalyst to a state where it is capable of a more complete combustion. As a result, a boiler converts the chemical energy in the fuel to heat energy in a more efficient manner. The boiler efficiency is increased and the toxic exhaust emissions are decreased."

Purpose:
Evaluate the effect of Fitch Fuel Catalyst on fuel economy, and emission of NOx, and CO. Also to monitor carbon buildup and burner efficiency.

Boiler type: Johnson PFTX-350-31LG15S 350 Ton duel fuel
Burner Type: Johnson FD68CA400LM

Fitch Fuel Catalyst - Model FHD7.5-28-1.5 supplied by APSI and installed by Housing authority mechanics on site.

Location:
Penn-Wortman Houses at 875 Pennsylvania Ave. New York. The facility consists of three buildings with 360 dwelling units and two – 350 ton dual fuel fired boilers.

Test Equipment: Enerac 3000 (operated by ACS-NY) and on site fuel record keeping and NOAA provided degree-day charts.

Test Personnel:
Chris Wright - Advanced Power Systems International, Inc. Lakeville CT.
Rafael Valez - NYCHA NY NY
Shawn Lundgren – NYCHA NY NY
Kent Buckley – Analytical Combustion Systems – New Milford CT.
Mike Beatty – Analytical Combustion Systems – New Milford CT.

Test Procedure:
A single Fitch Fuel Catalyst unit sized large enough to service both boilers was selected. Both boilers are supplied from a common 20,000 gallon in ground fuel tank. The Fitch unit was installed in the supply line that services both boilers. The boilers operate on demand on an alternating fuel basis. The boilers were switched over to 100% oil fire on November 8th. On November 14th, ACS-NY recorded the 1st set of emissions and efficiency readings and to ensure the system was operating within specification. On November 28th the Fitch Fuel Catalyst was switched into the system. ACS-NY returned to take emissions and efficiency readings on December 12, January 2 and March 9th. All data was recorded and results are reported below. Fuel records were kept in daily logs by the on-site staff and the records were sent to Energy Research Center Inc for their analysis. (ERCI see appendix 1)

Test Results Discussions:
Marked improvement in CO and NOX emission were recorded, as well as improvement in efficiency. A dramatic reduction in carbon deposits on firing tubes as indicated in the images provide additional confirmation of the superior combustion that resulted from the installation of the Fitch Fuel Catalyst product.

Mike Beatty from ACS-NY reported, “The data indicate the boilers are running more efficiently and with lower emissions than before the Fitch Fuel Catalyst installation. In addition, the photographs of the tubes and tube sheets clearly indicate a significant carbon reduction”.

NOAA heating degree-day data for the time period in which the data were collected The Fitch Fuel Catalyst device was installed in December and fuel use data for January, February, and March were analyzed using Energy Tracking and Control. The results follow.

Graphs #1 show the results of this initial ETC analysis at the Penn Wortman Houses. The upper plot line (red) is the linear regression fit for the ETC fuel use factor for November prior to the installation of the Fitch device. A good data fit was obtained.

The second plot line (green) shows the fuel use profile for January 2005 after the Fitch catalyst was installed. Considerable scatter was observed for this period. The points shown represent the best fit. (Some data points not included). The data indicate a reduction in fuel use after December 2005. The measured savings was approximately 5 percent with an uncertainty of about 2 percent as indicated by the regression analysis. This uncertainty can be observed graphically by the scatter of points for the January data.

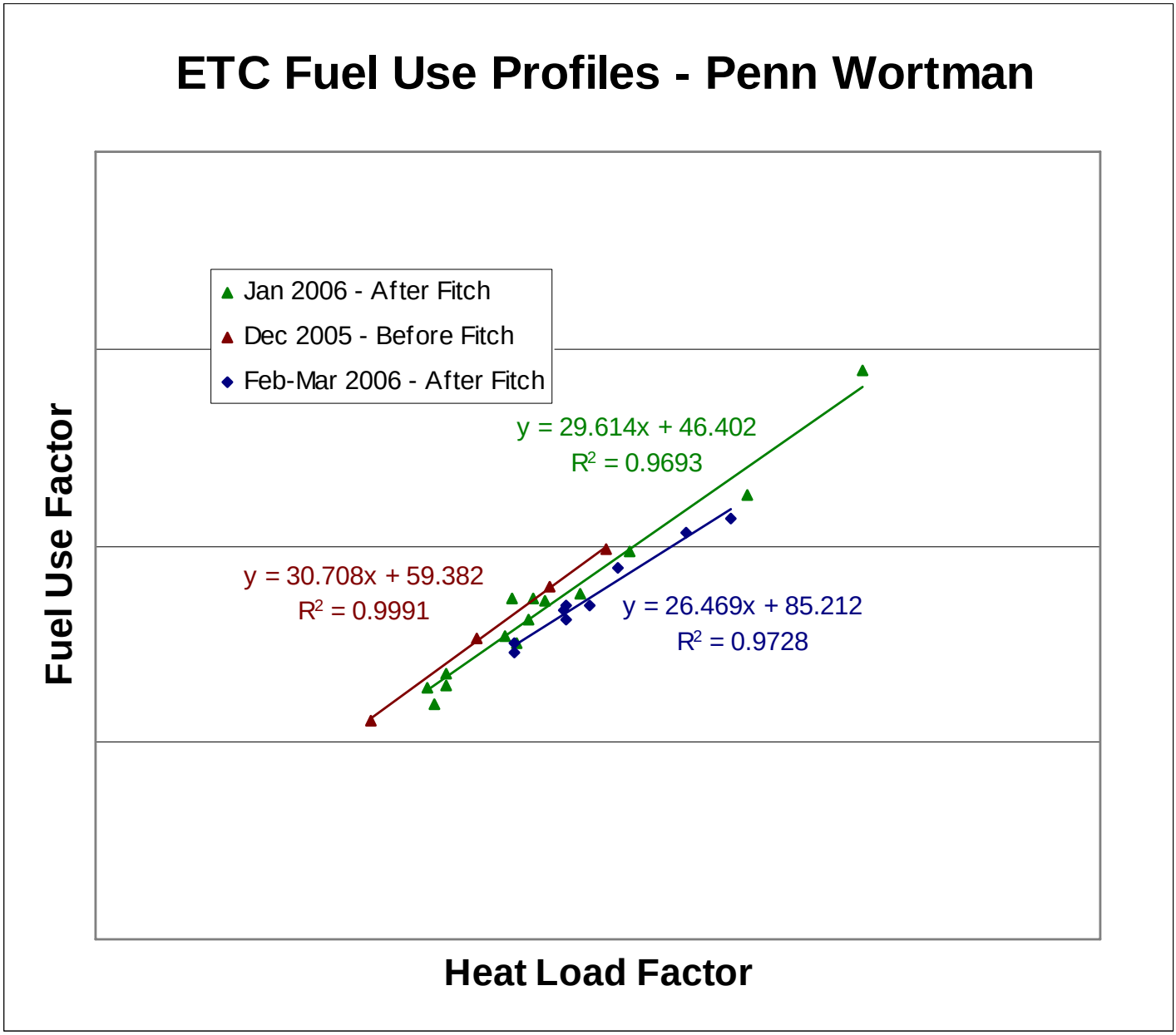
The third plot line (blue) is for the February and part of March 2006. The fuel use profile is below the January profile indicating lower fuel usage scatter was observed for this period and the points shown represent the best fit. (Some data points not included).

A net reduction in fuel usage on the order of 5 percent and perhaps higher was recorded with the Fitch Fuel Catalyst device installed.

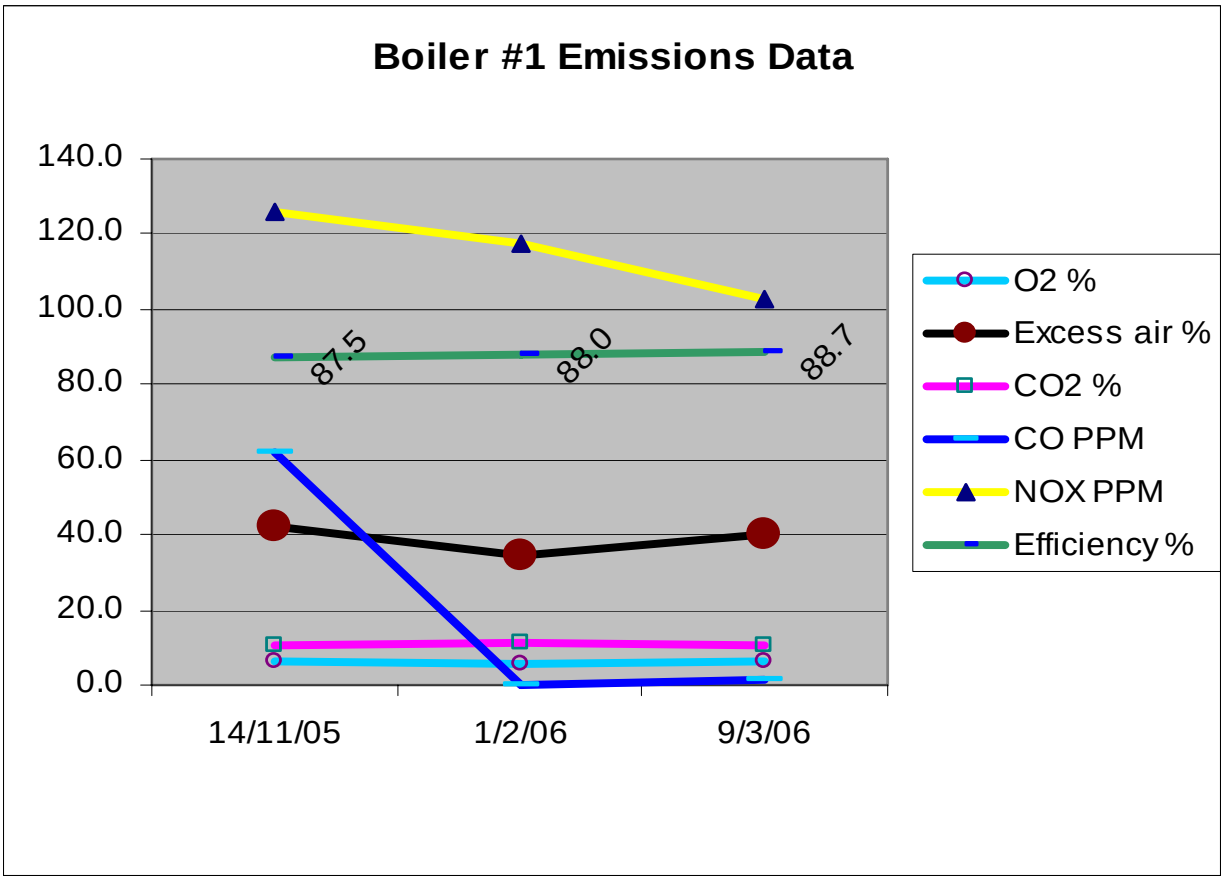
Graphs 2 & 3 show the emissions reductions and the improvement in efficiency for both boilers.

Photographs before and after installation of the Fitch Fuel Catalyst indicate the cleaning action resultant from the superior burn. Indications are that the boiler tubes and sheet were as much as 70% cleaner as reported by Ray Valez (NYCHA). In addition, the tubes were so clean that light could be seen shining in the tubes from the open back of the boiler.

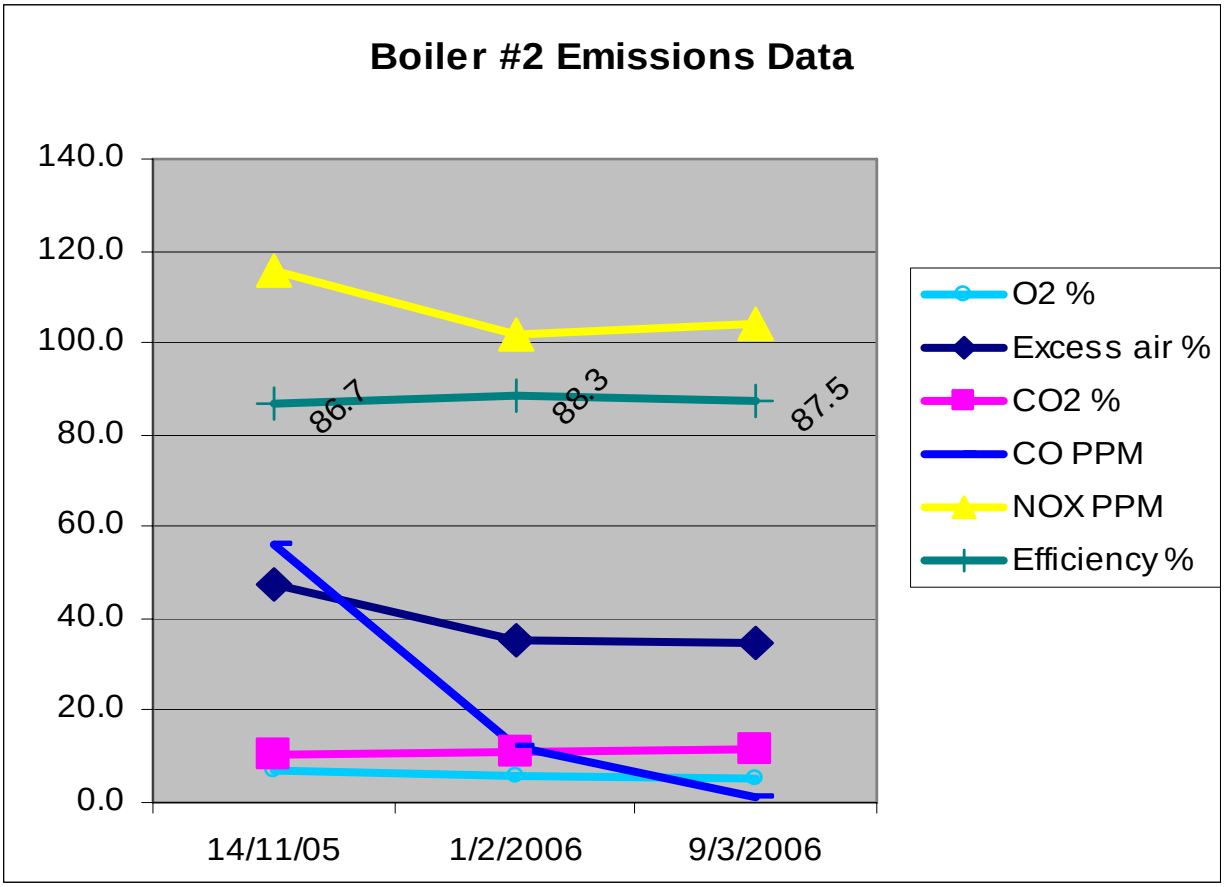
Graph 1


ETC Fuel Use Profiles - Penn Wortman
Jan 2006 - After Fitch
Dec 2005 - Before Fitch
Feb-Mar 2006 - After Fitch
y = 29.614x + 46.402
R2 = 0.9693
y = 30.708x + 59.382
R2 = 0.9991
y = 26.469x + 85.212
R2 = 0.9728
Fuel Use Factor
Heat Load Factor

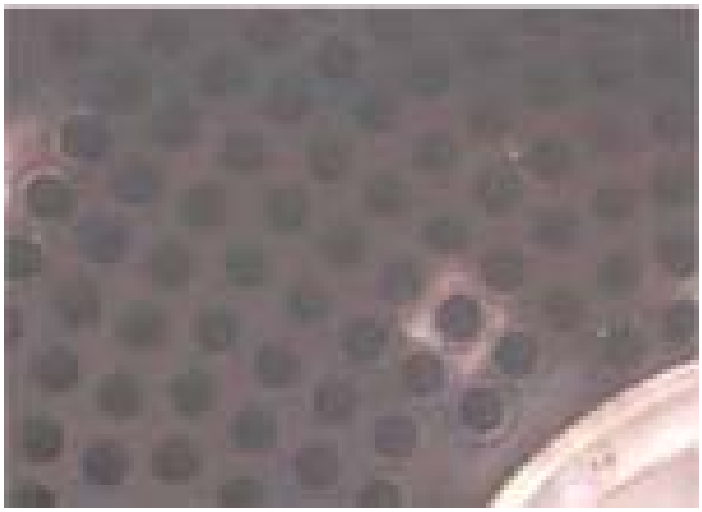
Graph 2



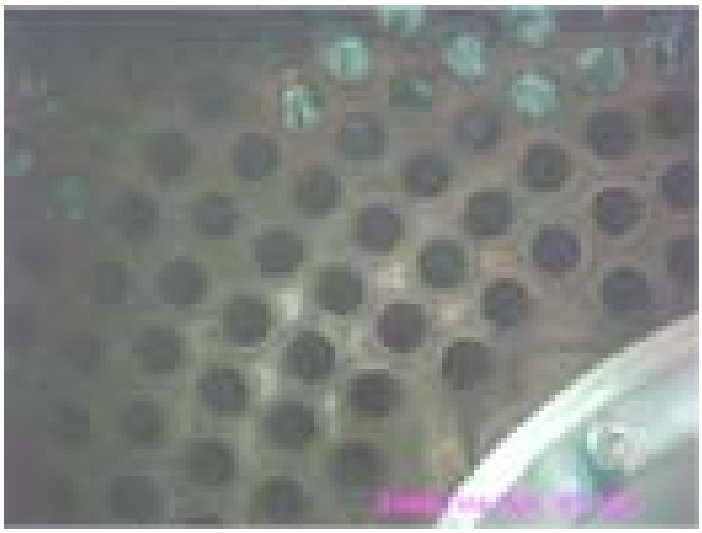
Graph 3



Boiler Front No Fitch

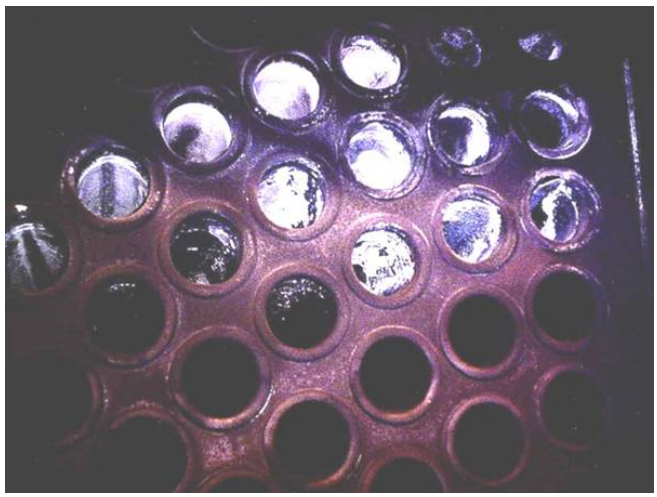


Boiler Front With Fitch

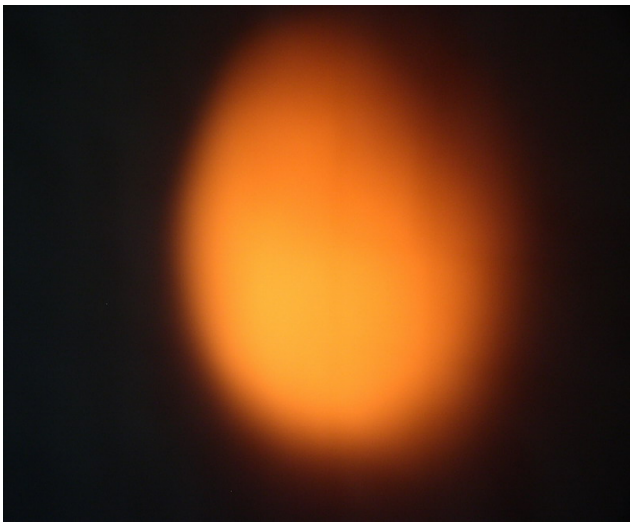


Note Boiler Tube & Sheet Cleanliness

Light shinning through from rear is apparent



Untreated flame **Fitch treated flame**



The improvement in combustion is readily apparent in the Fitch treated flame on the right when compared to the untreated flame on the left.

Conclusions:
These tests indicate that the Fitch device reduces fuel use by approximately 5 percent. Additionally carbon deposits were reduced by as much as 70%, which facilitates better heat transfer, efficiency and reduced maintenance. Emissions reductions as measured also indicate an overall improvement in combustion.

Fuel savings of 5 percent or higher can produce meaningful fuel cost reductions. Savings in maintenance will also be considerable. The Fitch Fuel Catalyst offers very attractive returns on investment. Use of the Fitch Fuel Catalyst is consistent with policies to reduce pollution, fuel costs and maintenance throughout the housing authority.

Additional Information

Energy Research Center, Inc:
Background and resume

Analytical Combustion Systems:
Comments

Customer References:
Mandarin Oriental Hotel - Manila
Grand Hyatt Hotel - Jakarta

ERC

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Energy Tracking and Control – John Batey PE.

A brief overview of the ETC method follows which describes how it is used to accurately measure energy savings in the field. Energy Tracking and Control relates fuel use to outdoor air temperature, with an accuracy of 99 to 99.5 percent - far superior to conventional tracking methods. The plots that follow compare the accuracy of the ETC and conventional K-Factor methods for tracking fuel use.

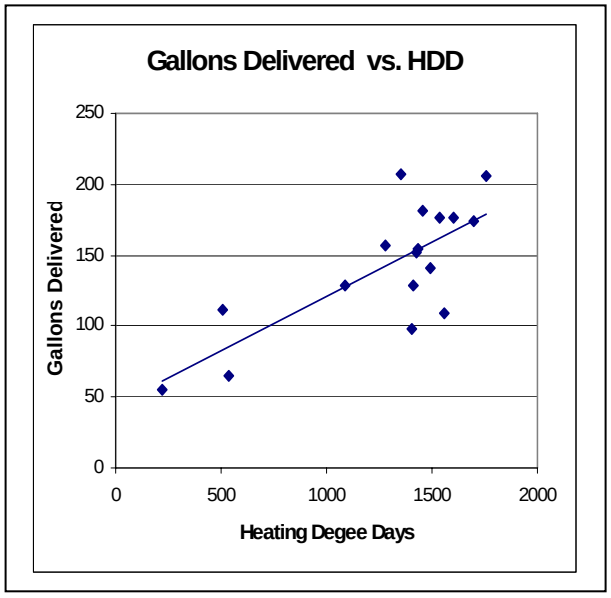


Figure 1a. Conventional Method

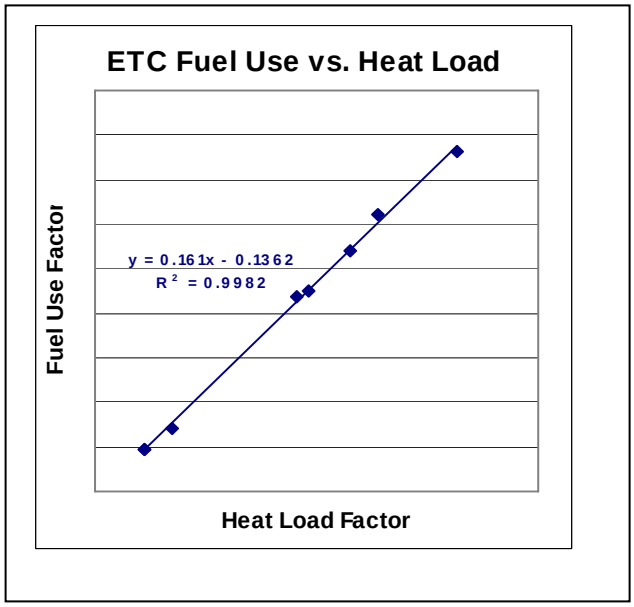


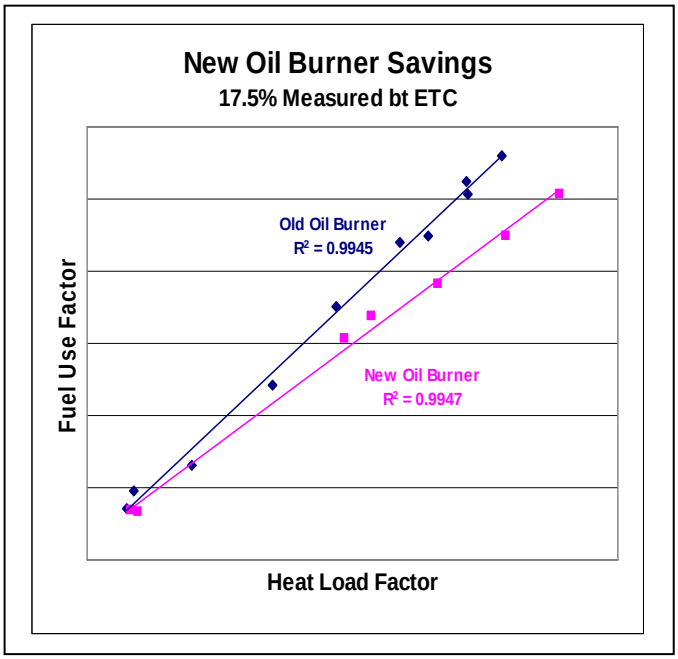
Figure 1b. New ETC Method

These plots demonstrate the superior accuracy with the ETC method. For example, at 1400 heating degree-days, the fuel use varies from 100 to 215 gallons for conventional methods. This is an error range of more than 50 percent. In contrast, the ETC plot on the right predicts fuel use with an uncertainty of ½ to 1 percent – or about 5 gallons.

An important new application for ETC is accurate measurement of fuel savings after energy efficiency improvements are installed in homes and buildings. This includes new burners, new boilers or furnaces, improved controls, and building upgrades such as thermal insulation.

Past fuel oil delivery or consumption records are collected. These are then compared to delivery data after the upgrade is installed. The ETC **fuel use factors** measure energy savings precisely. Actual cost savings

are then compared to the cost of the improvement so that payback periods and returns on investment can be easily determined and certified.



The Chart on the left shows a house in which a new high efficiency oil burner was installed. The actual fuel savings were measured by the ETC method.

The upper plot (blue) shows fuel use for the old burner before the upgrade. The lower plot shows the reduced fuel use by the new burner. Actual savings are determined by comparing these plots. In this case, the new burner reduced energy use by 17.5 percent a year. *The payback for the new burner is only 1.7 years based on recent oil prices*.

This cost savings calculation is only possible because of ETC's superior accuracy. No other tracking method has the precision needed to measure savings.

We are currently completing a demonstration study with the US Department of Energy's weatherization program that is accurately measuring fuel savings for a range of energy improvements including thermal insulation, weatherization, and new oil furnaces and boilers. ETC is an important new tool for accurately measuring energy savings in the field.

John Batey PE - Professional Experience:

Mr. Batey has extensive experience in evaluating gas and oil combustion equipment and HVAC systems, and efficiency improvement and air emissions regulations in residential, commercial, and institutional buildings as a research and applications engineer. This includes:

- Completed a combustion efficiency test program as part of a National Science Foundation Study on 100 residential heating units in 1971.
- Principal Engineer and Laboratory Manager at **Brookhaven National Laboratory** for five years, where he developed and operated a test facility for evaluating oil-fired space heating equipment for the U.S. Department of Energy. This work included; test program design and operation, data analysis, preparation of engineering reports, and technical presentations.
- Authored two training books: Advanced Oil Heat - A Guide to Improved Efficiency completed in 1994 for Brookhaven National Laboratory, and A Guide for Efficient Oil Heating in Homes in 1981, co-sponsored by the U.S. Department of Energy and the oil industry as part of a national energy conservation program. Advanced Oil Heat is now used for a national certification program for oil heat service technicians.