Fitch Fuel Catalyst Combustion Performance Research Report

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EXECUTIVE SUMMARY

A research team from the School of Chemistry at the University of Connecticut has analyzed the Fitch Fuel Catalyst in live field installations and, in conjunction with prior research on the technology, confirmed:

- That a molecular reformulation of the fuel does take place when passing through the Fitch Fuel Catalyst;
- That this reformulation positively affects the combustion within the furnace, enabling a reduction in nozzle size of the furnace;
- That the average user in observed and historical instances[1] reveals 6.7% to 36.4% reductions, with an average of 18.8% across all installations; and,
- That residential installations tended to yield greater reductions, averaging 20.3%, versus commercial installations, which averaged 14.0%.

Based on these findings, it was recommended that a full-scale pilot across several hundred homes be pursued in order to better quantify average savings across a larger sample of installations.

Details of the research follow in the text of the report and in its appendices.

Overview

The Fitch Fuel Catalyst for heating oil furnace applications is a non-mechanical device which is installed in-line of the fuel line, between the heating oil filter/tank and the burner. The device constructively reformulates hydrocarbon fuels passing through the catalyst – through modification of molecular sequence and structure – at low temperatures and low pressure. Details of the Fitch Fuel Catalyst are contained in Appendix A.

The Suib Research Group at the University of Connecticut (UCONN) Department of Chemistry has previously reviewed certain aspects of the Fitch Fuel Catalyst product, including the general concept and chemical principles.[2] Our latest charge was to evaluate the performance of the Fitch Fuel Catalyst in combustion experiments, with a particular focus on the performance of the Fitch Fuel Catalyst in the home and commercial heating oil furnace application. In short, the goal of this research was to confirm whether the Fitch Fuel Catalyst product does indeed enhance the efficiency and combustion of heating oil, and to define a range of performance if it does.

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[1] Historical measurement data gathered by the installing technicians from prior installs, as provided by the company

[2] (a) Hu, B.; Yuan, J.; Kona, J.; Suib, S. L., prior results; (b) Ghosh, R.; Koerting, C.; Suib, S. L.; Best, M. Berlin, A., The effect of a metal alloy fuel catalyst on bacterial Growth, *Langmuir*, 2005, *21*, 10655-10661.

Towards this end, the UCONN team – lead by Dr. Steven L. Suib, UCONN Board of Trustees Distinguished Professor and head of the Suib Research Group, with support from researcher Jagadeswara Kona – undertook a number of activities, including:

1) Review of procedures and policies regarding the installation and maintenance of the Fitch Fuel Catalyst;
2) Review of installation and historical performance metric data collected from a number of Fitch Fuel Catalyst implementations currently in use;
3) Observation of live installations of the Fitch Fuel Catalyst and measurements of efficiency and fuel consumption at several different site profiles; and,
4) Interviews with customers who have installed and currently use the Fitch Fuel Catalyst product in their operations.

The research was initiated and completed in the June-July 2013 time period, and was based in/near Storrs, CT.

Our team found that the installation of the Fitch Fuel Catalyst reformulates the heating oil before it enters the burner, enabling it to burn more effectively in the burner. This more efficient combustion causes an increase in stack temperature in the furnace. Since this excess stack temperature is not needed, in order to reduce the stack temperature back down to its most efficient level, a smaller nozzle may be installed to match or exceed the original baseline efficiency. This smaller nozzle allows less fuel to be combusted and results in definitive, measurable savings in oil consumption.

Our analysis concludes that this increase in efficiency and decrease in fuel consumption is the only important measure of the efficacy of the Fitch fuel Catalyst. Such a decrease in fuel combustion will clearly create economic savings. It is important to note that additional fuel savings are likely due to the effect of the Fitch Fuel Catalyst on the fuel itself, but we are unable to fully predict or document this impact due to variability in fuel oil and combustion environments. Further research would be required to quantify these additional savings.

Below we summarize all of these studies and conclude in a separate section. Supporting data and documentation are included as Appendices to this report, as well as background on the team members supporting this study.

Relation of Use of Fitch Fuel Catalyst to Chemistry Occurring in the Fuel

In previous separate experiments,[3] it has been shown by the Suib Research Group that the Fitch Fuel Catalyst causes changes in fuel composition at the molecular level.

The inside of a Fitch Fuel Catalyst consists of a patented mixture of metallic alloys that, when exposed to fuels, causes a temporary catalytic conversion that can last for several days, depending on a number of

[3] The Suib Research Group at the University of Connecticut School of Chemistry has been evaluating this technology since 1999, with the support, in some instances, of the U.S. Department of Energy (DoE) and the U.S. Department of Defense (DoD).

environmental variables. Specifically, the Fitch Fuel Catalyst can extract hydrogen atoms from different fuel components, thereby changing the composition of the fuel. Oxygen is present when the catalyst is exposed to the fuel and oxygenated compounds that can burn more efficiently are produced. This may explain the enhanced combustion observed in the installations discussed above; further research is required to pinpoint a definitive explanation of the exact chemical conversion taking place.[4]

To be clear, prior research has confirmed that a chemical change does take place when fuel comes in contact with the Fitch Fuel Catalyst, and this effect is deemed to be beneficial to the combustion process.

This research was performed in August 2012 at the University of Connecticut Chemistry facilities in Storrs, CT. The research was lead by Dr. Suib as well. Summary of this research is shown in Appendix B.

Review of Fitch Fuel Catalyst Installation and Measurement Procedures

Key to validating the Fitch Fuel Catalyst performance was to validate the installation and measurement process that establishes the baseline and installed unit performance metrics that ultimately drive the performance claims of the product.

The research team was provided with a step-by-step installation process, documented in Appendix C, which was reviewed and studied by the research team. This process involved a series of measurements of key operational variables of the typical heating oil furnace environment. All measurements for the observed Fitch Fuel Catalyst installation process were completed using a C-127 Certified Digital Combustion Analyzer, manufactured by UEI Test Instruments.[5] This unit measures differential flue temperature, oxygen levels, flue and ambient carbon monoxide (CO), and differential pressure; it also calculates carbon dioxide levels, efficiency, excess air, and CO air free. These measurements are appropriate and sufficient to gauge performance of combustion related to the Fitch Fuel Catalyst. Information about the UEI C-127 unit is found in Appendix D.

The installation and maintenance of an oil-burning furnace is governed by standardized policies and procedures as adopted to support ASHRAE Standard 103.[6] Most HVAC[7] system installers in the U.S. are trained in these procedures as their baseline for their work on heating oil furnaces.

In general, the following process is used for installation of the Fitch Fuel Catalyst in a heating oil furnace application:

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[4] There are many variables in the combustion process that can affect combustion, and an extensive research effort would be required to identify and model these. Heating oil fuel in particular encounters many different exposures to bacteria, temperature, changing storage environments, etc. on the way to customers, and as a result, fuel can vary substantially as an input to this process. What is clear from this analysis is that while there are many variables in this equation, the overall system has been confirmed as effective, per this study.

[5] http://www.ueitest.com/products/combustion/c127

[6] ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers). For info on AFUE, see http://en.wikipedia.org/wiki/Annual_fuel_utilization_efficiency

[7] Heating, ventilation, and air conditioning

1. Take baseline measurement
2. Clean, tune, and optimize the burner
3. Take new baseline measurement quantifying results of clean and tune (with focus on lower stack temperature)
4. Install the catalyst and re-optimize the burner
5. Take new measurement to determine benefit in key operational variables – calculate resultant new nozzle size if supported
6. Install the reduced-size nozzle
7. Take final confirmational measurement

Thus, four measurements are made with the C-127 unit, while the heating unit is operational and burning fuel for heat to the system:

1. Before doing anything
2. After cleaning, tuning and optimizing the burner
3. After installing the Fitch Fuel Catalyst
4. After installing the reduced-sized nozzle

The goal of the completed installation process is to have maximized efficiency with as close to zero smoke as possible.

In reviewing the installation and measurement process, our analysis concludes that the process for measuring the key attributes and performance characteristics are in line with ASHRAE standards, and appropriate for this application. Further, the combustion analyzer equipment used as part of the Fitch Fuel Catalyst standard process is likewise appropriate. Finally, the key measurement variables tracked by the installer and used to calculate the reduced nozzle size is also confirmed as appropriate.

The research team concludes that any future installation process that follows the same procedure as reviewed and documented as part of this study should result in similar results to those referenced in this study.

A detailed summary of the installation process is shown in Appendix C.

Observation of Installation of Fitch Fuel Catalyst and Efficiency and Fuel Consumption Studies

In order to evaluate the performance of the Fitch Fuel Catalyst in combustion experiments, members of the research team visited and observed live installation of the Fitch Fuel Catalyst in four different facilities. The end-to-end installation (and measurement) process was observed and compared to the documented installation process. These installations were in residential and commercial facilities. Residential facilities are defined as the GPH < 5.0. Commercial facilities are defined as GPH 10.0 and above.

In all four of these different facilities, the fuel consumption was measured and observed to decrease when the Fitch fuel Catalyst was used. The % decrease in these four Facilities was between 9.1% and 20%. We observed no smoke in all four of the installations, suggesting that soot was not formed when the catalyst was used. Key indicators are summarized in Table 1.

Table 1: Summary of key indicators for observed installations

Facility	Nozzle Size	1 Baseline As Is Data	2 Baseline After Clean and tune	3 After FCC Installed	4 After FCC Installed w/Nozzle reduction
Timothy Edwards School	Nozzle size (GPH) Net Stack Temp	2.00 415.6	2.0 331.3	2,0 349.9	1.65 303.4
Wapping Community Center	Nozzle size (GPH) Net Stack Temp	2.50 399.2	2.5 372.4	2.5 406.5	2.00 387.2
Residential Home 1	Nozzle size (GPH) Net Stack Temp	1.1 381	1.1 381	1.1 391	1.0 360
Residential home 2	Nozzle size (GPH) Net Stack Temp	.75 568	.75 522	.75 539	.60 453

The research team concluded from these observations that the installation and measurement process was sound, and that the resulting efficiency and fuel consumption gains were within the expected range, based on research of prior historical data.

Detailed measurements regarding the new installations are included in Appendix E.

Interviews with Customers Who Use the Fitch Fuel Catalyst

Observations from the on-site installs and background research by the team were confirmed with interviews of current Fitch Fuel Catalyst customers. Ten customers and installation engineers were called that presently have the Fitch Fuel Catalyst operational on one or more burners. Every person praised the device and all mentioned significant fuel savings after installing and using the Fitch Fuel Catalyst. One engineer said he did 200 installations and there have been no negative comments and excellent evaluations regarding fuel savings.

These interviews were complemented by “deep dives” into multi-year data provided by some customer maintenance staff for several current commercial customers of the Fitch Fuel Catalyst. Members of the research team spoke with engineers who maintain large numbers of boilers for property management companies, and reviewed their data over multiple years tracking the performance of the boilers when outfitted with Fitch Fuel Catalyst units.[8]

[8] Note that commercial Fitch Fuel Catalyst units can vary substantially in size and can grow to full-sized floor-standing units for extremely large implementations, including aboard cruise liners and freight ships.

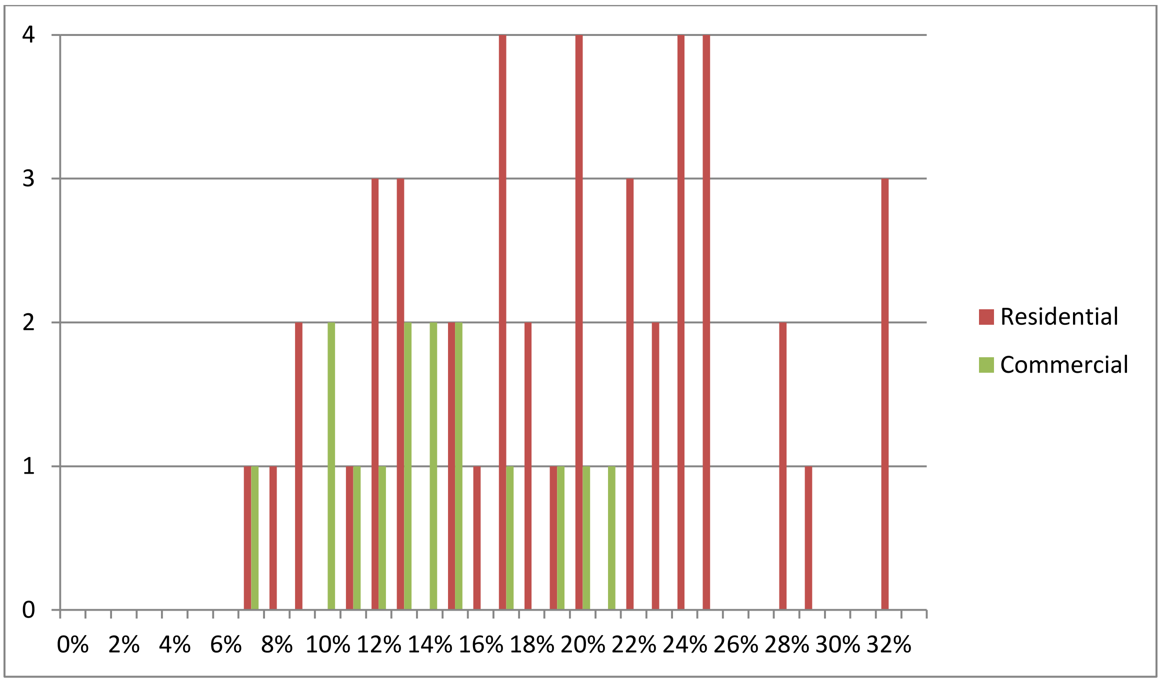
The research team noted that perhaps the biggest indirect indicator of fuel combustion savings from installation of the Fitch Fuel Catalyst is that all of the customers interviewed who are in a position to order successive units for other installations continue to purchase and use the Fitch Fuel Catalyst units.

Review of Historical Sample Data of the Fitch Fuel Catalyst

The installations observed by the research team all showed significant decrease in fuel consumption between 7.7% and 20%; note that we have only observed four installations.

To complement this on-site live research, the team evaluated a sample of historical installation data from Fitch's databases. Installation data sheets from a 62-record sample of different residential and commercial users of the Fitch Fuel Catalyst document decreases in fuel consumption ranging from 6.7% to 36.4%. A histogram of the distribution of the decrease in fuel consumption is given in Figure 1.[9]

Figure 1: Number of Instances in Sample Showing % Decrease in Fuel Consumption



The average decrease in fuel consumption for the 62 installations is 18.8%. These data clearly show a percentage decrease in fuel consumption when the Fitch Fuel Catalyst is used. When the data are broken out by residential versus commercial installations, there is a decided shift in the average, with commercial averaging 14.0% and residential 20.3% in gains.

Conclusions

The analyses by the University of Connecticut-based Suib Research Group suggest that the Fitch Fuel Catalyst, when installed in heating oil boilers, shows a measurable decrease in fuel consumption. Proper

[9] Data were rounded up from .5 and down from .4 to the next nearest whole value.

procedures need to be followed, such as cleaning the burner prior to installation of the catalyst; tuning the boiler to optimal efficiency is also necessary to achieve maximum impact. Further evaluation of the installation of the Fitch fuel Catalyst across a much broader base of data are warranted based on our observations to offer a complete view of the range of performance of the product.