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LIGHT COMMERCIAL AND RESIDENTIAL OIL HEATING SYSTEMS WITH AND WITHOUT FPC-1 FUEL PERFORMANCE CATALYST

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ABSTRACT

The operational costs of light commercial and residential oil heating systems have increased over 50% in the past two years, primarily as a result of distillate fuel oil price increases. By utilizing FPC-1 in fuel oil, a net average savings of 5 - 12% can be realized in these heating systems.

This average net savings is made up of a combustion efficiency increase of 1 - 4%, and a maintenance efficiency increase of 4 - 8%. The evaluation conducted in this report was primarily designed to determine the effects of FPC-1 when added to #2 heating oil in a ratio of 1600 parts oil to 1 part FPC-1 However, studies also include; 1) the effect of FPC-1 on sulfuric acid formation due to sulfur content in oil at different FPC-1 concentrations, 2) the cleanability of heat exchanger and burner systems when using FPC-1 and finally, 3) operational characteristics found in the typical on-off home heating systems.

This report will show conclusively that FPC-1 is found to be effective in improving the overall efficiency and maintenance of oil-fired light commercial and residential heating systems.

INTRODUCTION

The typical oil-fired heating system, is under attack because of its inability, resulting from age, to achieve and maintain maximum efficiency. It is generally recommended to obtain maximum efficiency from an oil-fired heating system that the burner be replaced with more efficient contemporary models. Or that the old oil furnace be scrapped in favor of natural gas units, heat pumps or electric heat. FPC-1 Fuel Performance Catalyst, when added to the fuel oil, can improve and subsequently maintain high furnace efficiency. The use of FPC-1 can increase fuel efficiency in the existing burner system without substantial cost for major overhauls or modifications.

State-of-the-art estimates indicate that the average furnace system is only 66% efficient. Burner replacements can increase overall efficiency up to 80%. This test documents that furnaces as old as 25 years old, can achieve an efficiency of 75-77%, with FPC-1 treated No. 2 oil and this efficiency can be easily maintained.

The testing program was designed to evaluate FPC-1 and its effect on residential and light commercial oil-fired furnaces. However, this program was expanded to encompass the following:

1) To determine the acid dewpoint and rate of acid buildup in light furnaces.

2) To evaluate, under ASTM D-2156 and D-2157 test procedures, FPC-1's effect on smoke, and real-life adjustments.

3) To verify the effects of FPC-1 at the following mixing ratios: 1600/1, 800/1, and 400/1.

4) To verify the ability of FPC-1 to clean furnace heat exchanger surfaces over a given period of time.

5) To evaluate the effects of on/off operation on furnace efficiency and maintenance, using FPC-1.

6) To evaluate the effects of FPC-1 on existing sludge formations in older burner assemblies.

7) To determine the changes in operation of a furnace after removal of FPC-1 treated fuel.

METHODOLOGY

The test procedures to determine combustion efficiency are found in the ASTM D-2156 and D-2157 guidelines. ASTM D-2156 is the standard test method for smoke density in flue gases from burning distillate fuels, and involves a smoke spot test. ASTM D-2157 is the standard test method for the effect of air supply on smoke density in flue gases from burning distillate fuels, and, in conjunction with D-2156, monitors the efficiency of the burn of distillate fuels.

Additional procedures used in this test are not covered by any ASTM methods. These procedures relate to acid dewpoint and the rate of acid buildup within the furnaces. Although ASTM has no prescribed methods for determining these factors, the procedures are accepted by industry in general and the ASME. The procedures are recommended by Land Combustion, Inc. while using their Dewpoint Meter Model 200.

Utilizing the above procedures as a standard format, various tests were conducted. These tests include the following:

1) Changing FPC-1 mixing ratios from 1600/1, 800/1, and 400/1.

2) Visual inspection of furnace heat exchanger surfaces before and after FPC-1.

3) Visual inspection of burner assemblies, including nozzles and strainers, before and after using FPC-1 with emphasis on sludge and carbon deposits.

4) Operating furnaces through an on/off sequence, typical of home usage.

5) At the end of FPC-1 testing, untreated fuel was used again to determine any deterioration in efficiency.

With the furnaces running at normal burner output, the following data was recorded:

Oil Flow	Ambient Temperature, WB/DB
O_2	Furnace Outlet Temperatures
CO_2	Smoke Numbers
Combustibles	Rate of Acid Buildup
Stack Temperatures	Burner Damper Settings

Test equipment used was:

Land Model 200 Acid Dewpoint Meter
Bacharach Continuous 02 Analyzer - Model CA-1
Bacharach 02-C02 Analyzer - Model 10-5020
Neutronics Continuous 02 Analyzer
IMC Instruments Model 6100 Digital Thermometer
Bacharach Smoke Spot Tester - Model RCC-3

Tests were conducted on the following furnaces:

Unit No.	Manufacturer	Model #	Burner Manufacturer	Model	Oil Consumed
1	Carrier	58FH-106	Carrier	38M-105K401	.75 gph
2	Crane	OY 90E	Crane	MP-1192	.75 gph
3	Amer.Furnace	19-OC	Amer.Furnace	M 175-C	1.50 gph
4	Unknown	Unknown	Hallmark Oil Burner Baltimore, MD	Unknown	.85 gph

RESULTS

FPC-1 Fuel Performance Catalyst has shown itself to be effective in improving the combustion and maintenance efficiency of residential and light commercial heating systems. The table below shows various stages of furnace efficiencies.

Efficiency With FPC-1 (Date)

Unit#1	Unit#2	Unit#3	Unit#3A	Unit#4
75.2(11-25)	77.55(12-1)	74.9(12-3)	74.9(12-3)	75.3(12-1)

Efficiency Without FPC-1 (Date)

63.7(10-6)	75.20(10-22)	71.1(10-6)	67.5(11-4)	74.1(10-26)

Net Change

7.9	2.35	3.81	7.33	1.2

Percent Increase

12.4	3.1	5.1	10.8	1.6

Conditions Evaluated Per Unit

Unit #1 - Typical of current, popular design and manufacturer, Carrier Corporation, Model 58FH-106, rated at 100,000 BtuH input. Unit was run to evaluate a typical overall efficiency gain, based on the unit as received with usual adjustments, and then readjusted with FPC-1 and allowed to run. Unit improvement in performance is related to the combination of combustion and maintenance efficiency.

Unit #2 - Very old burner, but a current furnace. The manufacturer was Crane Corporation, Model OY90E, rated 100, BtuH input. This unit was run to evaluate 25+ year old systems. This unit was completely clean at the beginning of the test. Therefore, the efficiency increase is due only to combustion improvement.

Unit #3 & #3A - Light commercial-duty furnace, with an age of approximately 10 ten years. This type unit is still currently available, and is manufactured by American Furnace - Model 19-OC. Extensive testing for FPC-1's ability to clean up a dirty system was performed on this unit. The data above shows the efficiency gain from "as received" to "as cleaned", under #3. However, the unit was made dirty by smoking, as shown under #3A. Quick physical cleaning of sooty surfaces was performed.

Unit #4 - This unit is 25+ years old, but has the original burner, which is currently available. The furnace manufacturer is unknown, but the burner is a Hallmark Oil Burner from Baltimore, MD. This unit showed the least improvement in combustion efficiency. This system was used to demonstrate that as the concentration levels of FPC-1 were increased from 1600/1 to 400/1, the furnace efficiency did not change.

CONCLUSIONS

1) An overall efficiency of 5-12% is possible, using FPC-1.

2) At Smoke No.2 operating conditions, as recommended by ASTM, the use of FPC-1 will completely clean the heat exchanger surface of carbon soot. Without FPC-1 carbon will form and reduce the efficiency so that cleanings of a once-a-year minimum would be required.

3) Use of FPC-1 removed all sludge from burner strainers.

4) Although the rate of acid buildup was already low, due to the low sulfur fuel, using FPC-1 reduced this rate of acid buildup to '0'.

5) Without FPC-1 three units operating at No. 2 smoke had combustibles of 0.1, or 200 ppm. When FPC-1 was added to the fuel, combustibles were eliminated.