# Fuel Factor X -- Fuel Catalyst Evaluation
For
# Fuel Efficiency and Emissions Reductions
With
# G & H Dairy; Facility No. 3
Utilizing
# The Carbon Mass Balance Test Procedure

Final Report
June 2009

Prepared by:

Kim LeBaron
CMB Engineer

For

MyDailyChoice Inc.

# CONTENTS

## Appendices

# WHAT IS
# THE
# CARBON BALANCE TEST PROCEDURE?

## PREFACE

Fuel consumption measurements by reliable and accredited methods have been under constant review for many years. The weight of engineering evidence and scientific theory favors the carbon balance method by which carbon measured in the engine exhaust gas is related to the carbon content of the fuel consumed. This method has certainly proven to be the most suitable for field-testing where minimizing equipment down time is a factor.

The inquiries of accuracy and reliability to which we refer include discussions from international commonwealth and government agencies responsible for the test procedure discussed herein. This procedure enumerates the data required for fuel consumption measurements by the “carbon balance” or “exhaust gas analysis” method. The studies conducted show that the carbon balance has been found to be a more precise fuel consumption test method than the alternative volumetric-gravimetric methods.

The carbon balance test is a fundamental part of the Australian Standards **AS2077-1982**. Further, the carbon balance test procedure has proven to be an intricate part of the United States EPA, FTP and HFET Fuel Economy Tests. Also, Ford Motor Company characterized the carbon balance test procedure as being “at least as accurate as any other method of volumetric-gravimetric testing.” (**SAE Paper No. 750002 Bruce Simpson, Ford Motor Company**) Finally, the Carbon Balance procedure is incorporated in the Federal Register Voluntary Fuel Economy Labeling Program, Volume 39.

The following photographic report captures a few of the applicable steps necessary for conducting a reliable and accurate carbon balance test. As will be documented, every effort is made to insure that each test is consistent, repeatable, and precise. More importantly, it will be even clearer as to why the Carbon Balance Test has such a high degree of acceptance and reliability.

# EXECUTIVE SUMMARY

The Fuel Factor X fuel catalyst manufactured and marketed by MyDailyChoice Inc. has proven, in laboratory and field-testing, to reduce fuel consumption in the range 3% to 10% under comparable load conditions. It also has proven to significantly reduce carbon emissions.

Following discussions with Chris Robinson (Fuel Factor X Representative), Logan Checkets and John Gomez owner of G & H Dairy, it was determined that a fuel consumption analysis should be conducted utilizing a 2008 Case 215 tractor and 2007 New Holland skid loader. Varying engine types with dissimilar accumulated operating hours were evaluated in an attempt to determine the affects of Fuel Factor X fuel combustion catalyst on multiple engine types and emissions configurations.

G & H Dairy #3 is a large scale (2,500 milk cows) dairy operation that utilizes a significant amount of agricultural equipment. This location is one of several similar operations owned and operated by G & H Dairy.

A baseline test (untreated) was conducted on May 13, 2009 using the Carbon Mass Balance Test Procedure. After which, the pre-selected test equipment was treated by adding the Fuel Factor X fuel catalyst to the diesel fuel contained in a 500 gallon, dedicated, bulk fuel tank for the purposes of dosing the equipment being evaluated during the evaluation. On June 17, 2009, the test was then repeated (Fuel Factor X treated) following the same parameters. The results are contained within this report.

The data showed that the average improvement in fuel consumption, for both pieces of equipment tested, was 7.75%, during steady state testing, using the Carbon Mass Balance test procedure.

The treated engines also demonstrated a large percentage reduction in soot particulates, in the range 47%, and reductions in harmful exhaust related carbon fractions. Carbon dioxide reductions, based upon the measured reduction in fuel consumption, are also substantial.

# INTRODUCTION

Baseline (untreated) fuel efficiency tests were conducted on both pieces of equipment on May 13, 2009, employing the Carbon Mass Balance (CMB) test procedure. Fuel Factor X supplied sufficient product to correctly treat an isolated 500 gallon storage tank utilized for the purposes of this evaluation only. The agricultural equipment operators were then instructed as to the requirement for fuelling their equipment from the catalyst treated fuel tank. The test equipment was then operated on Fuel Factor X catalyst treated fuel for as close to 400 hrs of engine operation as possible. At the end of the engine-conditioning period (June

17, 2009), the engine tests were repeated, reproducing all engine parameters. The final results, along with the data sheets, are contained within this report.

# TEST METHOD

Carbon Mass Balance (CMB) is a procedure whereby the mass of carbon in the exhaust is calculated as a measure of the fuel being burned. The elements measured in this test include the exhaust gas composition, its temperature, and the gas flow rate calculated from the differential pressure and exhaust stack cross sectional area. The CMB is central to the both US-EPA (FTP and HFET) and Australian engineering standard tests (AS2077-1982), although in field-testing we are unable to employ a chassis dynamometer. However, in the case of a stationary equipment test, the engine can be loaded sufficiently to demonstrate fuel consumption trends and potential.

The Carbon Mass Balance formula and equations employed in calculating the carbon flow are a supplied, in part, by doctors' of Combustion Engineering at the university and scientific research facility level.

The Carbon Mass Balance test procedure follows a prescribed regimen, wherein every possible detail of engine operation is monitored to insure the accuracy of the test procedure. Cursory to performing the test, it is imperative to understand the quality of fuel utilized in the evaluation. As important, the quality of fuel must be consistent throughout the entirety of the process.

Fuel density and temperature tests are performed for both the baseline and treated segments of the evaluation to determine the energy content of the fuel. A .800 to .910 Precision Hydrometer, columnar flask and Raytek Minitemp are utilized to determine the fuel density for each prescribed segment of the evaluation.

Next, and essential to the Carbon Balance procedure, is test equipment that is mechanically sound and free from defect. Careful consideration and equipment screening is utilized to verify the mechanical stability of each piece of test equipment. Preliminary data is scrutinized to disqualify all equipment that may be mechanically suspect. Once the equipment selected process is complete, the Carbon Balance test takes only 10 to 20 minutes, per unit, to perform.

One likely candidate for testing, but not included, for the Carbon Mass Balance study was this John Deere tractor utilized extensively throughout the dairy. Once the decision is made to test a certain piece of equipment, pertinent engine criteria needs to be evaluated as the Carbon Balance procedure continues.

When the selection process is complete, engine RPM is increased and locked in position. This allows the engine fluids, block temperature, and exhaust stream gasses to stabilize. Data cannot be collected when there is irregular fluctuation in engine RPM and exhaust constituent levels. Therefore, all engine operating conditions must be stable and consistent.

A factory throttle position lock is utilized, as one method, to secure engine RPM. This provides a steady state condition in which consistent data can be collected. Should the engine RPM fluctuate erratically and uncontrollably, the test unit would be disqualified from further consideration.

Next, engine RPM and fluid temperatures are monitored throughout the Carbon Balance evaluation. As important, exhaust manifold temperatures are monitored to ensure that engine combustion is consistent in all cylinders. It is imperative that the engine achieve normal operating conditions before any testing begins.

Once engine fluid levels have reached normal operating conditions the Carbon Balance study may begin. The above photograph shows that the engine RPM is locked in place at 2000 r.p.m. It should be noted that any deviation in r.p.m., temperature, either fluid or exhaust, would cause this unit to be eliminated from the evaluation due to mechanical inconsistencies.

Once all of the mechanical criteria are met, data acquisition can commence; it is necessary to monitor the temperature and pressure of the exhaust stream. Carbon Balance data cannot be collected until the engine exhaust temperature has peaked. Exhaust temperature is monitored carefully for this reason.

Once the exhaust temperature has stabilized, the test unit has reached its peak operating temperature. Exhaust temperature is critical to the completion of a successful evaluation, since temperature changes identify changes in load and RPM. As previously discussed, RPM and load must remain constant during the Carbon Balance study.

When all temperatures are stabilized, and desired operating parameters are achieved; it is time to insert the emissions sampling probe into the exhaust tip of each piece of equipment utilized in the study group.  The probe has a non-dispersive head, which allows for random exhaust sampling throughout the cross section of the exhaust.

While the emission-sampling probe is in place, and data is being collected, exhaust temperature and pressure are monitored throughout the entirety of the Carbon Balance procedure.  This photograph shows the typical location of the exhaust emissions sampling probe.

While data is being collected, exhaust pressure is monitored, once again, as a tool to control load and RPM fluctuations.  Exhaust pressure is proportional to load.  Therefore, as one increases, or decreases, so in turn does the other.  The Carbon Balance test is unique in that all parameters that have a dramatic affect on fuel consumption, in a volumetric test, are controlled and monitored throughout the entire evaluation.  This ensures the accuracy of the data being collected.  Exhaust pressure is nothing more than an accumulation of combustion events that are distributed through the exhaust matrix.

The above photograph shows one method in which exhaust pressure can be monitored during the Carbon Balance test procedure. In this case, exhaust pressure is ascertained through the use of a Magnahelic gauge. This type of stringent regime further documents the inherent accuracy of the Carbon Balance test.

At the conclusion of the Carbon Balance test, a soot particulate test is performed to determine the engine exhaust particulate level. This valuable procedure helps to determine the soot particulate content in the exhaust stream. Soot particulates are the most obvious and compelling sign of pollution. Any attempt to reduce soot particulates places all industry in a favorable position with environmental policy and the general public.

The above photograph demonstrates a typical method in which soot particulate volume is monitored during the Carbon Balance test. This method is the Bacharach Smoke Spot test. It is extremely accurate, portable, and repeatable. It is a valuable tool in smoke spot testing when comparing baseline (untreated) exhaust to catalyst treated exhaust.

Finally, the data being recorded is collected through a non-dispersive, infrared analyzer. Equipment such as this is EPA approved and CFR 40 rated. This analyzer has a high degree of accuracy, and repeatability. It is central to the Carbon Balance procedure in that it identifies baseline carbon and oxygen levels, relative to their change with catalyst treated fuel, in the exhaust stream. The data accumulated is exact, as long as the criteria leading up to the accumulation of data is exact. For this reason, the Carbon Balance test is superior to any other test method utilized. It eliminates a multitude of variables that can adversely affect the outcome and reliability of any fuel consumption evaluation.

The above photograph identifies one type of analyzer used to perform the Carbon Balance test. The analyzer is calibrated with known reference gases before the baseline and treated test segments begin. The data collected from this analyzer is then computed and compared to the carbon contained within the raw diesel fuel. A fuel consumption performance factor is then calculated from the data. The baseline performance factor is compared with the catalyst treated performance factor. The difference between the two performance factors identifies the change in fuel consumption during the Carbon Balance test procedure.

Essential to performing the aforementioned test procedure is the method in which the task for dosing fuel is performed. It is critical to the success of the Carbon Mass Balance procedure to insure that the equipment evaluated be given meticulous care and consideration to advance the process of testing.

For the purpose of this evaluation, a dedicated 500 gallon fuel tank was utilized to insure the equipment being evaluated was regularly treated with the required concentration of the Fuel Factor X fuel catalyst.

# INSTRUMENTATION

Precision state of the art instrumentation was used to measure the concentrations of carbon containing gases in the exhaust stream, and other factors related to fuel consumption and engine performance. The instruments and their purpose are listed below:

> *Measurement of exhaust gas constituents HC, CO, $CO_2$ and $O_2$, by Horiba Mexa Series, four gas infrared analyser.*

**Note:** The Horiba MEXA emissions analyser is calibrated with the same reference gas for both the baseline and treated segments of the evaluation. In this case, a Scott specialty mother gas no. CYL#ALM018709 was utilized for calibration purposes.

> *Temperature measurement; by Fluke Model 52K/J digital thermometer.*
>
> *Exhaust differential pressure by Dwyer Magnahelic.*
>
> *Ambient pressure determination by use of Brunton ADC altimeter/barometer.*
>
> *The exhaust soot particulates are also measured during this test program.*
>
> *Exhaust gas sample evaluation of particulate by use of a Bacharach True Spot smoke meter.*
>
> **The Horiba infrared gas analyser was serviced and calibrated prior to each series of engine efficiency tests.**

# TEST RESULTS

## Fuel Efficiency

A summary of the CMB fuel efficiency results achieved, in this test program, is provided in the following tables and appendices. **See Table I, and Individual Carbon Mass Balance results, in Appendix II.**

Table I: provides the average test results for both pieces of equipment before and after Fuel Factor X fuel catalyst treatment **(see graph II, Appendix I)**.

## TABLE I

| Test Segment | Hours | Fuel Change |
|---|---|---|
| **Case Tractor** | | |
| Untreated | | |
| Treated | 415 | **- 7%** |
| **Skid Loader (New Holland)** | | |
| Untreated | | |
| Treated | 344 | **- 8.5%** |
| **Average (Absolute)** | | **- 7.75%** |

The computer printouts of the calculated CMB test results are located in **Appendix II.** The raw engine data sheets used to calculate the CMB are contained in **Appendix III**. The raw data sheets, and carbon balance sheets show and account for the environmental and ambient conditions during the evaluation.

## Soot Particulate Tests

Concurrent with CMB data extraction, soot particulate measurements were conducted. The results of these tests are summarized in **Table II**. Reductions in soot particulates are the most apparent and immediate. Laboratory testing indicates that carbon and solid particulate reductions occur before observed fuel reductions. Studies show that a minimum 300 to 400 hours, Fuel Factor X fuel catalyst treated engine operation, are necessary before the conditioning period is complete. Then, and only then, will fuel consumption improvements be maximized.

## Table II

| Fuel Type Density | Soot Particulates |
|---|---|
| **Case Tractor** | |
| Untreated | 2.91 mg/m$^3$ |
| Treated | 1.74 mg/m$^3$ |
| | - 40% |
| **Skid Loader** | |
| Untreated | 1.97 mg/m$^3$ |
| Treated | .91 mg/m$^3$ |
| | - 54% |
| **Average** | **- 47%** |

The reduction in soot particulate density (the mass of the smoke particles) was reduced by an average 47**%** after fuel treatment and engine conditioning with Fuel Factor X fuel catalyst **(See Graph 1, Appendix I).** Concentration levels were provided by Bacharach.

# Conclusion

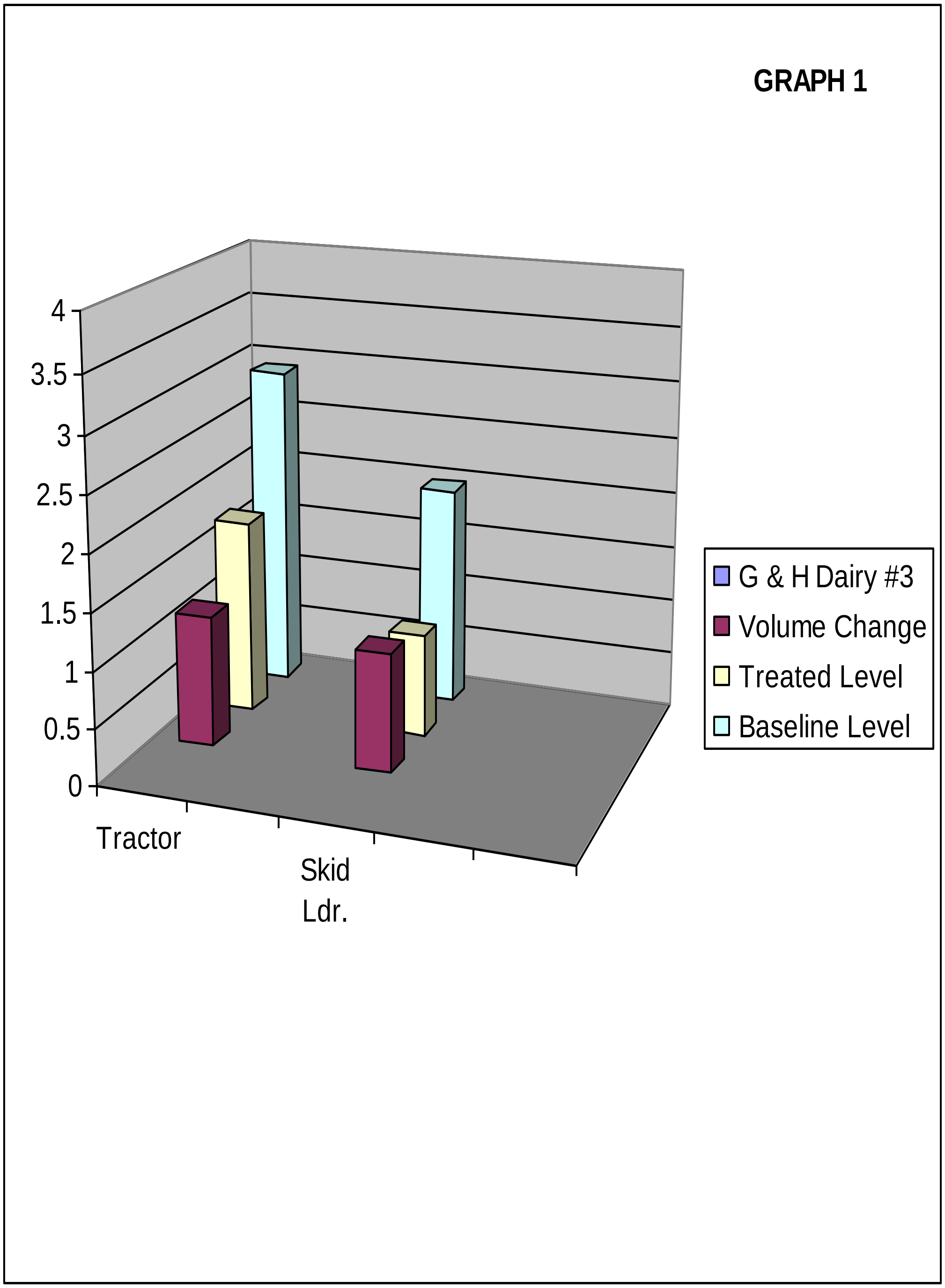
These carefully controlled engineering standard test procedures conducted on both pieces of test equipment; provide clear evidence of reduced fuel consumption in the range of 7.75%. In general, improvements utilizing the Carbon Mass Balance test, under static test conditions, generate results 2% - 3% less than those results generated with an applied load.

Fuel Factor X fuel catalyst's effect on improved combustion is also evidenced by the substantial reduction in soot particulates (smoke) in the range of 47% **(see Appendix I)**. The similar reduction in other harmful carbon emissions likewise substantiates the improved combustion created by the use of Fuel Factor X fuel combustion catalyst **(see raw data sheets, Appendix III)**.

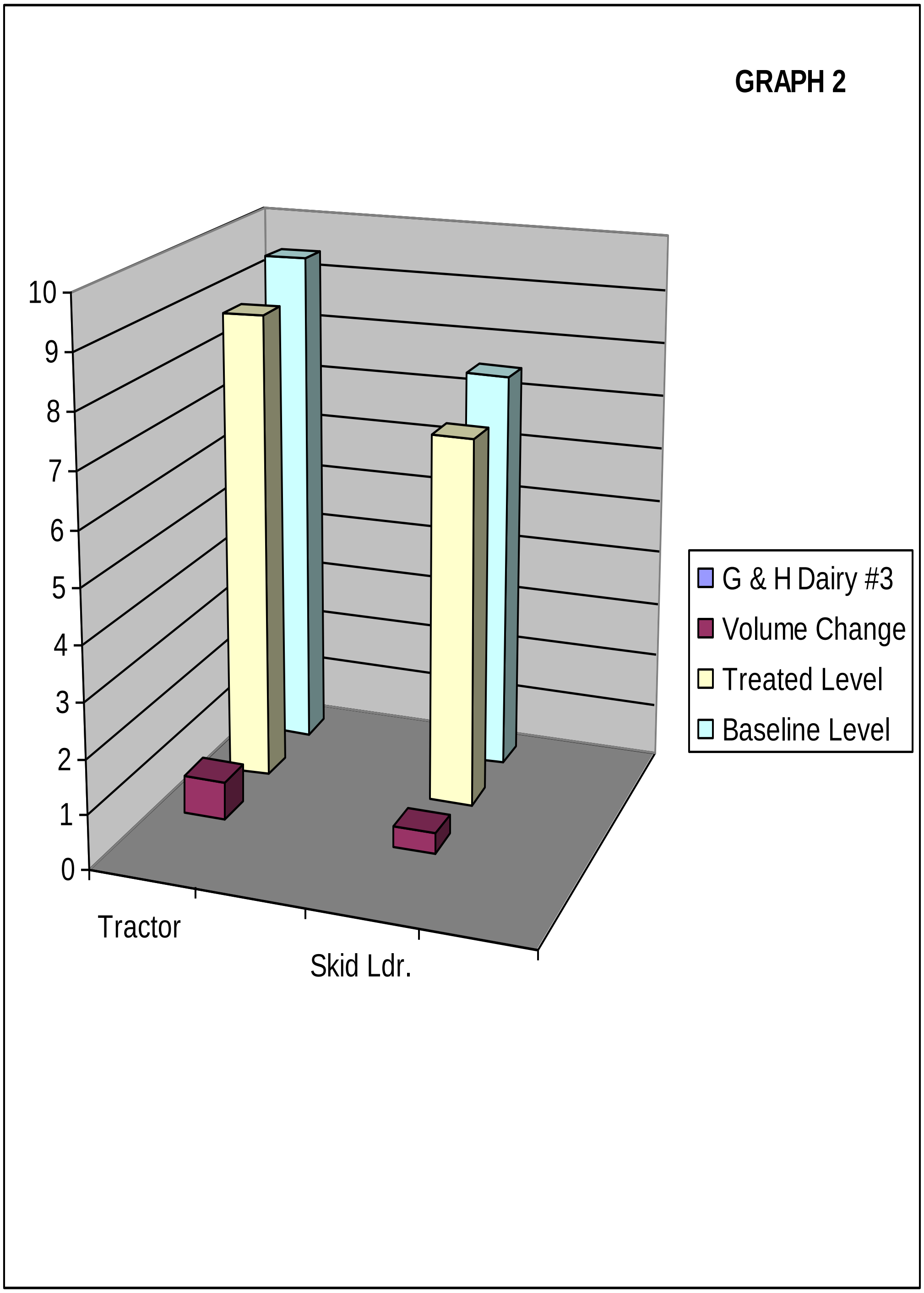
Additional to the fuel economy benefits measured and a reduction in soot particulates, a significant reduction, over time, in engine maintenance costs will be realized following treatment with Fuel Factor X . These savings are achieved through lower soot levels in the engine lubricating oil, which is a result of more complete combustion of the fuel. Engine wear rates are reduced resulting in less carbon build-up in the combustion area. Fuel Factor X also acts as an effective biocide should you experience water bottoms in fuel storage tanks; and, an excellent fuel system lubricant, which improves fuel system lubrication with today's low sulphur diesel fuels.

## *Appendix I*

# Exhaust Particulate and Fuel Graphs



**Soot Particulate Graph**



**Fuel Consumption Graph**

## *Appendix II*

# Carbon Mass Balance Compilation Sheets

## CARBON BALANCE RESULTS

| | | | |
|---|---|---|---|
| COMPANY : | G & H Dairy #3 | LOCATION : | Dayton, Idaho |
| EQUIPMENT : | Skid Loader | UNIT NR. : | N.A. |
| ENG. TYPE : | N.A. | MODEL : | 2007 New Holland L 190 |
| RATING : | Agriculture | FUEL : | Diesel .835 |

**BASELINE TEST** **DATE : 13/05/09**

| | | | |
|---|---|---|---|
| ENG. HOURS : | 3057 | ENG. RPM: | 2,450 |
| AMB. TEMP (C) : | 18 degrees C. | STACK(mm): | 74.25 |
| BAROMETRIC(mb): | 1012 | LOAD: | Static |

| | *TEST 1* | *TEST 2* | *TEST 3* | *TEST 4* | *TEST 5* | AVERAGE |
|---|---|---|---|---|---|---|
| PRES DIFF (Pa): | 219 | 219 | 219 | 219 | 219 | 219 |
| EXHST TEMP (C): | 253.5 | 253.6 | 253.6 | 253.8 | 253.6 | 254 |
| HC (ppm) : | 18 | 18 | 19 | 20 | 19 | 18.8 |
| CO (%) : | 0.08 | 0.09 | 0.09 | 0.08 | 0.09 | 0.086 |
| CO2 (%) : | 4.16 | 4.17 | 4.17 | 4.16 | 4.17 | 4.17 |
| O2 (%) : | 10.36 | 10.34 | 10.37 | 10.37 | 10.35 | 10.36 |
| CARB FLOW(g/s): | 7.500 | 7.534 | 7.535 | 7.500 | 7.535 | 7.521 |

**TREATED TEST** **DATE : 17/6/09**

| | | | |
|---|---|---|---|
| ENG. HOURS : | 3446 | ENG. RPM: | 2450 |
| AMB. TEMP (C) : | 18.2 degrees C. | STACK(mm): | 74.25 |
| BAROMETRIC(mb): | 1014 | LOAD: | Static |

| | *TEST 1* | *TEST 2* | *TEST 3* | *TEST 4* | *TEST 5* | AVERAGE |
|---|---|---|---|---|---|---|
| PRES DIFF (Pa): | 219 | 219 | 219 | 219 | 219 | 219 |
| EXHST TEMP (C): | 253.5 | 253.6 | 253.5 | 253.7 | 253.6 | 254 |
| HC (ppm) : | 9 | 10 | 11 | 10 | 10 | 10.0 |
| CO (%) : | 0.05 | 0.04 | 0.05 | 0.05 | 0.04 | 0.046 |
| CO2 (%) : | 3.84 | 3.83 | 3.83 | 3.84 | 3.83 | 3.83 |
| O2 (%) : | 10.22 | 10.24 | 10.21 | 10.23 | 10.23 | 10.23 |
| CARB FLOW(g/s): | 6.900 | 6.865 | 6.884 | 6.900 | 6.865 | 6.883 |

TOTAL HOURS ON TREATED FUEL : 389

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : **-8.5**

# Carbon Balance Results

| | | | |
|---|---|---|---|
| COMPANY : | G & H Dairy #3 | LOCATION : | Dayton, Idaho |
| EQUIPMENT : | 2008 Case 215 Tractor | UNIT NR. : | N.A. |
| ENG. TYPE : | N.A. | MODEL : | 215 Case Tractor |
| RATING : | Agriculture | FUEL : | Diesel .835 |

| | | | |
|---|---|---|---|
| **BASELINE TEST** | | **DATE :** | **13/05/09** |
| ENG. HOURS : | 1786 hrs. | ENG. RPM: | 2,000 |
| AMB. TEMP (C) : | 17.9 C. | STACK(mm): | 99 |
| BAROMETRIC(mb): | 1010 | LOAD: | Static |

| | *TEST 1* | *TEST 2* | *TEST 3* | *TEST 4* | *TEST 5* | AVERAGE |
|---|---|---|---|---|---|---|
| PRES DIFF (Pa): | 560 | 560 | 560 | 560 | 560 | 560 |
| EXHST TEMP (C): | 209.5 | 209.3 | 209.6 | 210.1 | 209.7 | 210 |
| HC (ppm) : | 12 | 12 | 11 | 12 | 11 | 11.6 |
| CO (%) : | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.024 |
| CO2 (%) : | 3.18 | 3.17 | 3.17 | 3.18 | 3.17 | 3.17 |
| O2 (%) : | 10.42 | 10.40 | 10.45 | 10.45 | 10.44 | 10.43 |
| CARB FLOW(g/s): | 9.457 | 9.460 | 9.455 | 9.451 | 9.424 | 9.449 |

| | | | |
|---|---|---|---|
| **TREATED TEST** | | **DATE :** | **17/6/09** |
| ENG. HOURS : | 2201 | ENG. RPM: | 2450 |
| AMB. TEMP (C) : | 18.1 degrees C. | STACK(mm): | 99 |
| BAROMETRIC(mb): | 1016 | LOAD: | Static |

| | *TEST 1* | *TEST 2* | *TEST 3* | *TEST 4* | *TEST 5* | AVERAGE |
|---|---|---|---|---|---|---|
| PRES DIFF (Pa): | 560 | 560 | 560 | 560 | 560 | 560 |
| EXHST TEMP (C): | 209.7 | 209.8 | 210.1 | 210.3 | 210.3 | 210 |
| HC (ppm) : | 8 | 9 | 9 | 9 | 9 | 9.0 |
| CO (%) : | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.010 |
| CO2 (%) : | 2.95 | 2.96 | 2.96 | 2.95 | 2.96 | 2.96 |
| O2 (%) : | 10.20 | 10.24 | 10.21 | 10.25 | 10.23 | 10.23 |
| CARB FLOW(g/s): | 8.776 | 8.806 | 8.803 | 8.772 | 8.801 | 8.792 |

TOTAL HOURS ON TREATED FUEL : 415

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -7.0

## *Appendix III*

# Raw Data Sheets

# Carbon Mass Balance Field Data Form

Company: G & H Dairy #3 Location: Dayton, Idaho Date: 5-13-09

Water Temp: 0 Oil Pres: 0 Fan Clutch: N.A. Smoke No: 1.97 mg/m3 Exhaust Diameter: 74.25 ~~Inches~~ MM

Test Portion: Baseline: X Treated: ____ Engine Make/Model: 2007 New Holland L190 Air Inlet Velocity: 0

Exhaust Manifold Temp: 0 Miles/[✓ Hours]: 3057 ID#: N.A. Fuel Specific Gravity: .835

Type of Equipment: Skid Loader Exhaust Side: Rear Barometric Pressure: 1012

RPM: 2450 Load: static Oil Pressure Temp. 0

| Fuel Type | Exhaust Temp °C | P Inches Of $H_2O$ | CO | HC PPM | $CO_2$ | 02 | Ambient Temp. C. | Instrument Calibration | Observer | Time Begin To Time End |
|---|---|---|---|---|---|---|---|---|---|---|
| Diesel | 253.5°C | 219 | .08 | 18 | 4.16 | 10.36 | 18°C. | Yes | | 2:45 p.m |
| | 253.6°C | 219 | .09 | 18 | 4.16 | 10.34 | | | | |
| | 253.6°C | 219 | .09 | 19 | 4.17 | 10.37 | | | | |
| | 253.8°C | 219 | .08 | 20 | 4.17 | 10.37 | | | | |
| | 253.6°C | 219 | .09 | 19 | 4.17 | 10.35 | 18°C. | | | 2:55 p.m. |

New
Holland
Skid L

# Carbon Mass Balance Field Data Form

Company: G&H Dairy #3 Location: Dayton, Idaho Date: 6-17-09

Water Temp: 0 Oil Pres: 0 Fan Clutch: N.A Smoke No: .91 mg/m³ Exhaust Diameter: 74.25 ~~Inches~~ MM

Test Portion: Baseline: ____ Treated: X Engine Make/Model: 2007 New Holland L190 Air Inlet Velocity: 0

Exhaust Manifold Temp: 0 Miles/[✓ Hours]: 3446 ID#: N.A. Fuel Specific Gravity: .835

Type of Equipment: Skid Loader Exhaust Side: Rear Barometric Pressure: 1014

RPM: 2450 Load: static Oil Pressure Temp. 0

| Fuel Type | Exhaust Temp °C | P Inches Of $H_2O$ | CO | HC PPM | $CO_2$ | 02 | Ambient Temp. C. | Instrument Calibration | Observer | Time Begin To Time End |
|---|---|---|---|---|---|---|---|---|---|---|
| Diesel | 253.5°C | 219 | .05 | 9 | 3.84 | 10.22 | 18.2°C | Yes | | 1:32 p.m |
| | 253.6°C | 219 | .04 | 10 | 3.83 | 10.24 | | | | |
| | 253.5°C | 219 | .05 | 11 | 3.83 | 10.21 | | | | |
| | 253.7°C | 219 | .05 | 10 | 3.84 | 10.23 | | | | |
| | 253.6°C | 219 | .04 | 10 | 3.83 | 10.23 | 18.2°C | | | 1:42 p.m. |

# Carbon Mass Balance Field Data Form

Company: G & H Dairy #3 Location: Dayton, Idaho Date: 5-13-09

Water Temp: 0 Oil Pres: 0 Fan Clutch: NA Smoke No: 2.91 mg/m³ Exhaust Diameter: 99 ~~Inches~~ mm

Test Portion: Baseline: X Treated: ____ Engine Make/Model: 2008 215 Case Air Inlet Velocity: 0

Exhaust Manifold Temp: 0 Miles [✓ Hours] 1786 ID#: ____ Fuel Specific Gravity: .835

Type of Equipment: Tractor Exhaust Side: Right Barometric Pressure: 1010

RPM: 2000 Load: Static Oil Pressure Temp. 0

| Fuel Type | Exhaust Temp °C | P Inches Of $H_2O$ | CO | HC PPM | $CO_2$ | 02 | Ambient Temp. C. | Instrument Calibration | Observer | Time Begin To Time End |
|---|---|---|---|---|---|---|---|---|---|---|
| Diesel | 209.5°c | 560 | .02 | 12 | 3.18 | 10.42 | 17.9°c | Yes |  | 1:02 pm |
|  | 209.3°c | 560 | .03 | 12 | 3.17 | 10.40 |  |  |  |  |
|  | 209.6°c | 560 | .03 | 11 | 3.17 | 10.45 |  |  |  |  |
|  | 210.1°c | 560 | .02 | 12 | 3.18 | 10.45 |  |  |  |  |
|  | 209.7°c | 560 | .02* | 11 | 3.17 | 10.44 | 17.9°c |  |  | 1:12 pm |

Case
Tractor

# Carbon Mass Balance Field Data Form

Company: G & H Dairy #3 Location: Dayton, Idaho Date: 6-17-09

Water Temp: 0 Oil Pres: 0 Fan Clutch: N.A. Smoke No: 1.74 mg/m3 Exhaust Diameter: 99 ~~Inches~~ mm

Test Portion: Baseline: ____ Treated: X Engine Make/Model: 2008 215 Case Air Inlet Velocity: 0

Exhaust Manifold Temp: 0 Miles/[✓ Hours]: 2201 ID#: ____ Fuel Specific Gravity: .835

Type of Equipment: Tractor Exhaust Side: Right Barometric Pressure: 1016

RPM: 2000 Load: static Oil Pressure Temp. 0

| Fuel Type | Exhaust Temp °C | P Inches Of $H_2O$ | CO | HC PPM | $CO_2$ | 02 | Ambient Temp. C. | Instrument Calibration | Observer | Time Begin To Time End |
|---|---|---|---|---|---|---|---|---|---|---|
|  | 209.7°C | 560 | .01 | 8 | 2.95 | 10.20 | 18.1°C | Yes |  | 2:32pm |
|  | 209.8°C | 560 | .01 | 9 | 2.96 | 10.24 |  |  |  |  |
|  | 210.1°C | 560 | .01 | 9 | 2.96 | 10.21 |  |  |  |  |
|  | 210.3°C | 560 | .01 | 9 | 2.95 | 10.25 |  |  |  |  |
|  | 210.3°C | 560 | .01 | 9 | 2.96 | 10.23 | 18.1°C |  |  | 2:42pm |

## *Appendix IV*

# Estimated Fuel Savings

# Monthly and Annual
# Fuel Savings
# With the Fuel Factor X Fuel Catalyst

**Estimated:** CMB

| | Carbon Balance Savings |
|---|---|
| Monthly Fuel Consumption: | 100,000.00 gals. . |
| Monthly Fuel Costs ($2.00/gal.): | $200,000.00 |
| Improvement in Fuel Efficiency: | .0775% |
| Monthly Gross Fuel Savings: | $15,500.00 |

| | |
|---|---|
| Gross Annual Savings Based On 1,200,000 Gallons of Diesel Fuel Consumed: | **$186,000.00** |

Using the fuel savings data produced from the Carbon Balance test procedure, the results show that G & H Dairy #3 will reduce annual fuel consumption costs by a minimum of $186,000.00. Other cost reducing factors that will enhance the use of the Fuel Factor X fuel catalyst include reduced repairs due to carbon related failures; extended oil change intervals as experienced by other Fuel Factor X fuel catalyst customers; reduced fuel system repairs with the additional fuel system lubricant contained in the catalyst; and, increased engine life. These factors and many more are the reason that so many companies are opting to implement Fuel Factor X fuel catalyst as part of their preventive maintenance program.

Other benefits in using Fuel Factor X fuel catalyst are as follows:

| | |
|---|---|
| **Demulsifier:** | Removes water from fuel. |
| **Biocide:** | Helps control bacterial growth in fuel. |
| **Polymerization Retardant:** | Helps prevent the formation of solids in fuel. |
| **Dispersant:** | Helps to eliminate existing solids in fuel. |
| **Lubricant:** | Lubricates the fuel system (fuel pump and injectors). |
| **Detergent:** | Cleans the fuel pump and injectors. |
| **Corrosion Inhibitor:** | Protects against fuel tank corrosion. |
| **Metal Deactivator:** | Prevents catalytic oxidation. |