Applications and Test Results

Summary of field and lab tests

Year	Company	Sector	Less Fuel Consumption	Reduction on Emissions
2019	Lafarge Holcim	Cement	8,6 ~ 13%	Not measured
2019	SC Johnson	Road Transport	10,9 ~ 11%	Not measured
2019	Risel Combustíveis	Fuel Trader	8,5%	Not measured
2019	Pedreira Irmãos	Mining	12,5%	Not measured
2019	Galileo EU Patent Attorneys	Patent Attorneys	> 15%	Not measured
2019	Farid	Road Transport	9,5 ~ 12,7%	Not measured
2019	Rosolen	Road Transport	10,11 ~ 16,53%	Not measured
2019	Herculano	Mining	17,51 ~ 19,87%	Not measured
2018	Isomonte	Mining	Temp increase 876 ~ 924C	Speed temp increase 72,7%
2017	Suape	Energy	Temp increase 610 ~ 691C	Speed temp increase 62,5%
2017	Tschudi	Shipping	13,49%	Not measured
2017	CAT/SGS/Marin	Shipping	Other measurements'	HC 31,6%, CO 17,8%
2017	Anglo American	Mining	Temp increase 829 ~ 871C	Speed temp increase 72,5%
2016	Fakt	Roller Bench Test	Not measured	CO 73%, HC 26%, NOx 26%
2016	Maha	Roller Bench Test	Not measured	CO 41%, HC 100%
2016	Amag	Turbidity Test	From 1,48 down to 0,56	Not measured
2015	TÜV	Test Bench	Not measured	CO 73,6%, HC 34,5%, CH4 80,4%
2015	Auto Kaiser	Real Test Drive	12,5%	CO 100%, HC 66%

2019 Verified Real Test Drive

LafargeHolcim

Diesel Fuel Truck / Excavator

13% saving
Truck Mercedes Axor 3131

12,7% saving
Truck Mercedes Axor 3131

12,7% saving
Excavator Caterpillar 336D

ecomanda

RL – Recommendation Letter

LafargeHolcim

To ecomanda Americas

Rua Luiz Spiandorelli, 60
Torre Paineira Sala 910
CEP:13271-570 - Valinhos - SP

Att.
Messrs.
Wolfgang Foerg - CEO ecomanda AG
Antonio Ticianeli Neto - Director ecomanda Americas

Subject: Letter of Recommendation regarding Field Testing

To whom it may concern,

I, **Fernando M. P. De Menezes Leal, Mining Coordinator** of the company **LafargeHolcim (Brasil) S.A.** located at **Fazenda Catolé, S/N°, Zona Rural, Caaporã - PB – Brasil, CEP 58.326-000**, duly registered in the **CNPJ 60.869.336/0224-39**, declare that the following statements are true and correct.

During the period from **October 08** to **October 19**, the company **ecomanda Americas**, developed in our logistic partner, practical tests to determinate specific fuel consumption through the application of the **X-Fuel Energizer product**, for diesel engines in the equipment's listed below:

Equipament 1	
Type	Dump Truck
Brand	Mercedes Benz
Model	Axor 3131
Tag	CB-46
Service	Ore Transport
Period	Monday to Saturday
Duration (Days)	10
Total Load (ton)	7.475
Diesel (L)	764
Hours (h)	107
Consumption (L/h)	7,14
Saving	13,0%

Equipament 2	
Type	Dump Truck
Brand	Mercedes Benz
Model	Axor 3131
Tag	CB-51
Service	Ore Transport
Period	Monday to Saturday
Duration (Days)	11
Total Load (ton)	8.975
Diesel (L)	902
Hours (h)	129
Consumption (L/h)	6,99
Saving	12,7%

Equipment 3	
Type	Hydraulic Excavator
Brand	Caterpillar
Model	CAT-336D
Tag	EH-20
Service	Ore Extraction
Period	Monday to Saturday
Duration (Days)	3
Diesel (L)	1.385
Hours (h)	42
Consumption (L/h)	32,99
Saving	8,6%

Due to maintenance issues, we will not consider equipment 3 to measure the result due to the short testing time.

Therefore, at the end of the testing period, after running 236 hours consuming 1.666 liters of diesel oil, equipment 1 and 2 presented an average reduction in fuel consumption of **12,9%**.

I further certify that the product in question did not adversely affect the operation of the engine, as well as, it did not damage any piece or part of such equipment subject to this test.

Without further ado, I close our thoughts about our intentions recorded here.

Caaporã, 22 October 2019

Respectfully,

Fernando M. P. De Menezes Leal
Mining Coordinator
LafargeHolcim (Brasil) S.A.
CNPJ: 60.869.336/0224-39

2019 Verified Real Test Drive

SC Johnson
A family company
at work for a better world

Diesel Fuel Truck

11,1% saving
Truck Scania G400 A6x2

10,9% saving
Truck Volvo FH440 6x2T

RL – Reference Letter

To:

ecomanda Americas
Rua Luiz Spiandorelli, 60
Torre Paineira Sala 910
CEP:13271-570 - Valinhos - SP

Att.
Messrs.
Wolfgang Foerg - CEO ecomanda AG
Antonio Ticianeli Neto - Director ecomanda Américas

Subject: Letter of Recommendation regarding Field Testing.

To whom it may concern,

I, **Diego Distasi Coelho, Procurement Manager – LATAM** of the company **Ceras Johnson LTDA.** located at **Avenida Marginal do Ribeirão dos Cristais, 200 Galpão 01, bloco 1.300**, neighborhood **Jordanésia**, in the city of **Cajamar**, in the state of **São Paulo, ZIP CODE: 07750-972**, duly registered in the **CNPJ: 33.122.466/0008-95**, declare that the following statements are true and correct:

During the period from **June 18** to **July 02**, the company **ecomanda Americas**, developed in our logistic partner, practical tests to determinate specific fuel consumption through the application of the **X-Fuel Energizer product**, for diesel engines in the vehicles listed below.

Vehicle 1
Type –Truck
Tag – HEX 7406
Brand: Scania
Model: G400 A6x2
Saving: 11,1%

Vehicle 2
Type – Truck
Tag – EFO 8630
Brand: Volvo
Model: FH440 6x2T
Saving: 10,9%

And that at the end of the test period, after running 4.972 km consuming 1.900,9 liters of diesel oil, these vehicles presented an average reduction in fuel consumption of **11,0%**.

I further certify that the product in question did not adversely affect the operation of the engine, as well as, it did not damage any piece or part of such equipment subject to this test.

Without further ado, I close our thoughts about our intentions recorded here.

Cajamar, July 04, 2019

Respectfully.

Diego Distasi Coelho
Procurement Manager – LATAM
Ceras Johnson LTDA.
CNPJ: 33.122.466/0008-95

2019 Verified Real Test Drive

Risel COMBUSTÍVEIS

Diesel Fuel Truck

8,5% saving
Vehicle Volvo FH12 420

ecomanda

RL – Reference Letter

To ecomanda Américas

Rua Luiz Spiandorelli, 60
Torre Paineira Sala 910
CEP:13271-570 - Valinhos - SP

Att.
Ilmos. Srs.
Wolfgang Foerg - CEO ecomanda AG
Antonio Ticianeli Neto - Director ecomanda Américas

Subject: Reference letter from field tests

To whom it may concern.

Me, **Paulo Leite Bastos Serena, Director** from **Risel Combustíveis LTDA.**, located at Municipal Road PLN 145, nº 7000 – Boa Esperança – Paulínia/SP, CEP: 13148-080, duly registered in the **CNPJ: 46.677.860/0001-65**, and **Tower Brasil Petróleo LTDA.**, located at Av.: Rouxinol, nº 60 – Cj. 606 – Moema – São Paulo/SP, CEP.: 045516-000, duly registered in the **CNPJ: 68.110.501/0001-64, Fuel Distribution** companies, declare that the following statements are true and correct:

During the period from May, 30 to June, 05 the company ecomanda Américas developed in our business unit, field tests to determine fuel economy through the application of the X-Fuel Energizer product, for diesel engines in our vehicle listed below.

Vehicle 1

Type: Trailer Bitrem Tank

Tag: DTW 4455

Brand: Volvo

Model: FH12 420

Assembly: 2006

And, in the end of the field test, the vehicle presented a fuel reduction of **8,5%.**

I further certify that the product in question did not adversely affect the operation of the engine, as well as, it did not damage any part of the equipment subject to this test.

Without further ado, I close our thoughts about tour intentions recorded here.

São Paulo, June 26, 2019

Respectfully,

Paulo Leite Bastos Serena
Director
Risel Combustíveis LTDA.
CNPJ: 46.677.860/0001-65

Tower Brasil Petróleo LTDA.
CNPJ: 68.110.501/0001-64

2019 Verified Real Loading Test

PEDREIRA IRMÃOS MACHADO

Diesel Mining Loader

12,8% saving
Vehicle Volvo F90L

ecomanda

Pedreira Irmãos Machado – Highlights Test Details

- **City:** Ouro Preto – Minas Gerais
- **Ended on:** April, 17, 2019
- **Time length:** 15 days (6x refueling)
- **Test**: 110 hours – Total // 55 hours per equipment
- (Customer statement available soon)

2019 Verified Real Test Drive

Galileo®

Diesel Car Engine

> 15% saving
Mercedes GLE 350D SUV

Driven kilometers:
Without X-Fuel: 850~900 Kms
With X-Fuel: 1,200 Kms

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BECKER • KURIG • STRAUS
Patentanwälte Partnerschaft mbB

Galileo®

Patentanwälte Becker Kurig Straus • Bavariastr. 7 • D-80336 München

Ecomanda AG
Rothusstrasse 23

6531 Hünenberg
Schweiz

11. Juli 2019
(KG/KG)

Patent DE 60 2016 010 848.8
Anmelder / Inhaber: Ecomanda AG
Titel: Additiv for fuels
Unser Zeichen: 12437 DE/EP

Dear Sirs,

I have personally examined the fuel additive manufactured by Ecomanda, on my GLE 350d Mercedes Diesel SUV and I am more than satisfied.

While previously a full tank contents took me 850-900 km, I have observed that the fuel with the added Ecomanda composition now granted a mileage of 1200 km corresponding to a fuel saving of roughly 2,5 l/100 km.

This is an extraordinary benefit and stunning effect of a small volume additive.

Mit freundlichen Grüßen
Becker • Kurig • Straus

Dr. Thomas Kurig

Patent[1]- und Rechtsanwälte
European Patent Attorneys[2]
European Trademark Attorneys[3]

Dr. Alexander Straus[1.2.3.6], Dipl.-Chem.
Dr. Thomas Kurig[1.2.3.6], Dipl.-Phys.
Dr. Eberhard Becker[1.2.3.6], Chem.

Dr. Roman Vuille[2.3.5], Dipl.-Chem.
Friedrich von Braun[5], Rechtsanwalt
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Intellectual Property Advisors
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CH-1024 Ecublens

[6]Partner i.S.d. Part GG
PR 1410

Bank Details:

Becker Kurig Straus

HypoVereinsbank
SWIFT Code: HYVEDEMM448
IBAN: DE 03711200770331401110

Deutsche Bank
SWIFT Code: DEUTDEMMXXX
IBAN: DE 50700700100951365600

VAT-Nr.: DE812752671

2019 Verified Real Test Drive

FARID distribuidora

Diesel Truck

12,7% saving
Vehicle Scania R440 6x2T

12,0% saving
Vehicle Volvo FH460 6x2T

9,5% saving
Vehicle Volvo FH460 6x2T

9,5% saving
Vehicle MAN/TGX 28.440

Farid Distribuidora – Highlights Test Details

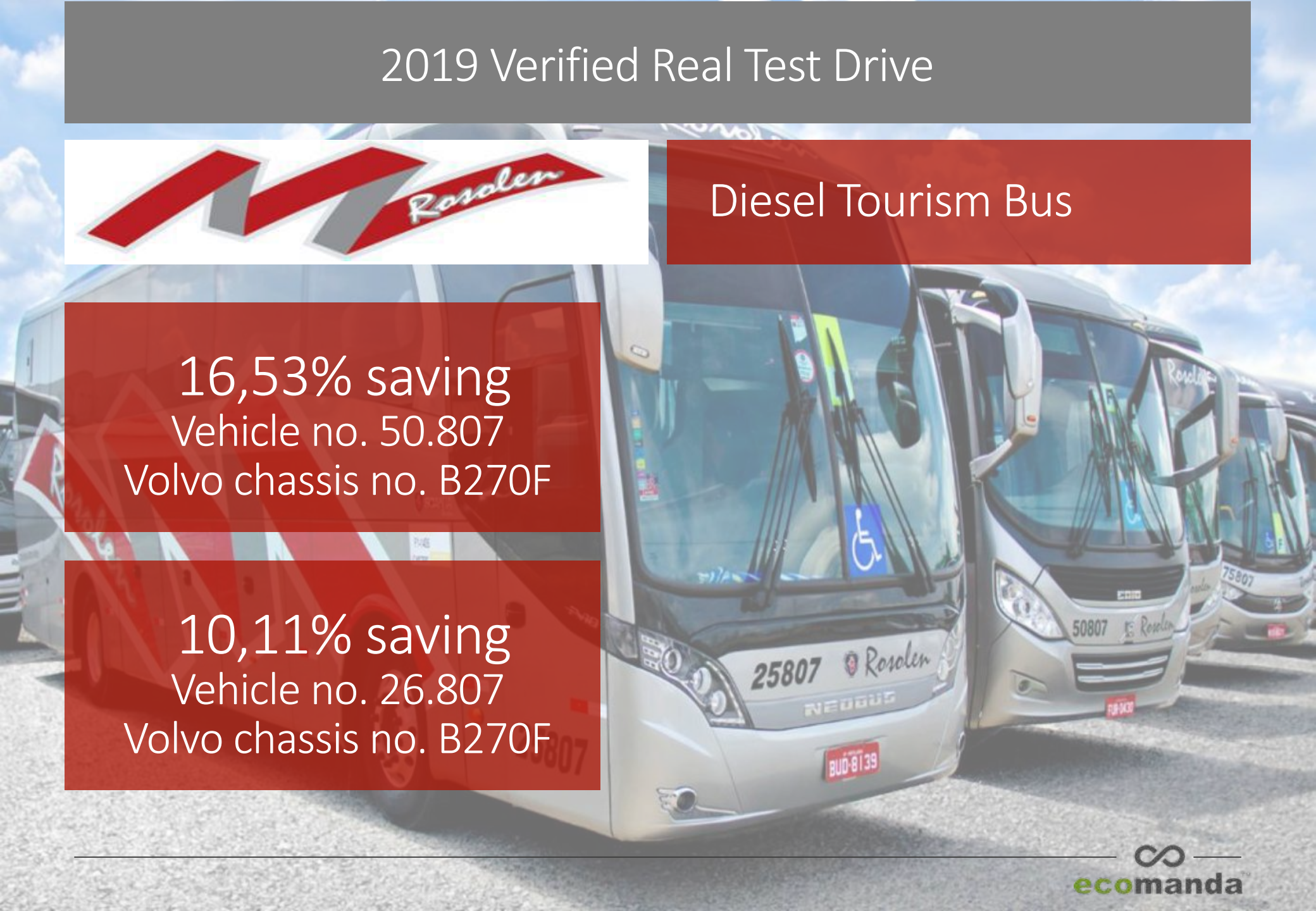
- **City:** Itabirito – Minas Gerais
- **Ended on:** April, 26, 2019
- **Time length:** 15 days (7x refueling)
- **Test**: 20,000 km – Total // Average 5,000 km per truck
- (Customer statement available soon)

2019 Verified Real Test Drive

Diesel Tourism Bus

16,53% saving
Vehicle no. 50.807
Volvo chassis no. B270F

10,11% saving
Vehicle no. 26.807
Volvo chassis no. B270F



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Recomendation Letter

I, **Roosevelt Belém, Traffic Coordinator** of the company **Rosolen Transportes e Turismo Ltda**, company in the segment of **Urban**, **Intercity and Intersate Transportation**, duly registered in the **CNPJ No. 68.912.054/0001-67**, registered in the **State Registration No. 748.013.526.119**, located at **Rua Antonio Fernandes Leite, 1401,** neighborhood **Jardim Santa Izabel**, in the city of **Hortolândia** in the state of **São Paulo**, **CEP: 13185-230**, declare to whom it may concern that:

- During the period from **02/15** to **02/25**, the company **ecomanda Américas**, developed in our business unit, practical tests to determine fuel economy through the application of the **X-Fuel Energizer product**, for diesel engines in our vehicles:

Vehicles 1	**Vehicles 2**
Type - charter bus	**Type - charter bus**
No. - 26.807	**No.** - 50.807
Brand: NEOBUS	**Brand:** CAIO Induscar
Model: Road R	**Model:** SOLAR
Chassi: Volvo B270F	**Chassi:** Volvo B270F
Tank: 280 liters	**Tank:** 370 liters

- And that at the end of the test period these vehicles presented a fuel economy percentage of:

Bus **No. 26.807**	Bus **No. 50.807**
10.11% saving	**16.53%** saving

I further certify that the product in question did not adversely affect the operation of the engine, as well as, it did not damage any piece or part of such equipment subject to this test.

Without further ado, I close our thoughts about tour intentions recorded here.

Hortolândia, February 26, 2019

Respectfully,

Roosevelt Belém
Traffic Coordinator
Rosolen Transportes e Turismo Ltda
CNPJ:68.912.054/0001-67

2019 Verified Real Loading Test

HERCULANO MINERAÇÃO

Diesel Mining Loader

17,51% saving
Loader no. CR-16
Volvo L120F

19,87% saving
Loader no. CR-17
Volvo L220G

ecomanda™

HERCULANO MINERAÇÃO

Recommendation Letter

I, **Renato Mariano Antunes Herculano,** General Manager of the company **Herculano Mineração Ltda**, company at the **Mining segment**, duly registered in the **CNPJ No. 41.785.833/0001-92**, registered in the **State Registration No. 338.789.292.00-36** located at **Fazenda Tanque Seco, S/N1,** neighborhood **Zona Rural**, in the city of **Itabirito** in the state of **Minas Gerais**, **CEP: 35.450-000**, declare to whom it may concern that:

- The company ecomanda Américas, in the period from **January 21** to **January 25**, developed in our business unit, tests with application of the **X-Fuel Energizer** product, in equipment such as **Loader**, model **L220G Volvo**, numbers **CR-16** and **CR-17**.
- And that at the end of the test period they presented a fuel economy percentage of **17.51%** for the equipment **CR-16** and of **19.87%** for the equipment **CR-17**.

I further certify that the product in question did not adversely affect the operation, as well as, it did not damage any piece or part of said equipment subject to this test.

Without further ado, I close our thoughts about our intentions recorded here.

Valinhos, February 6, 2019

Respectfully,

Renato Mariano Antunes
General Manager
Herculano Mineração Ltda
CNPJ:41.785.833/0001-92

2018 Verified X-Fuel Demonstration

ISOMONTE S.A.

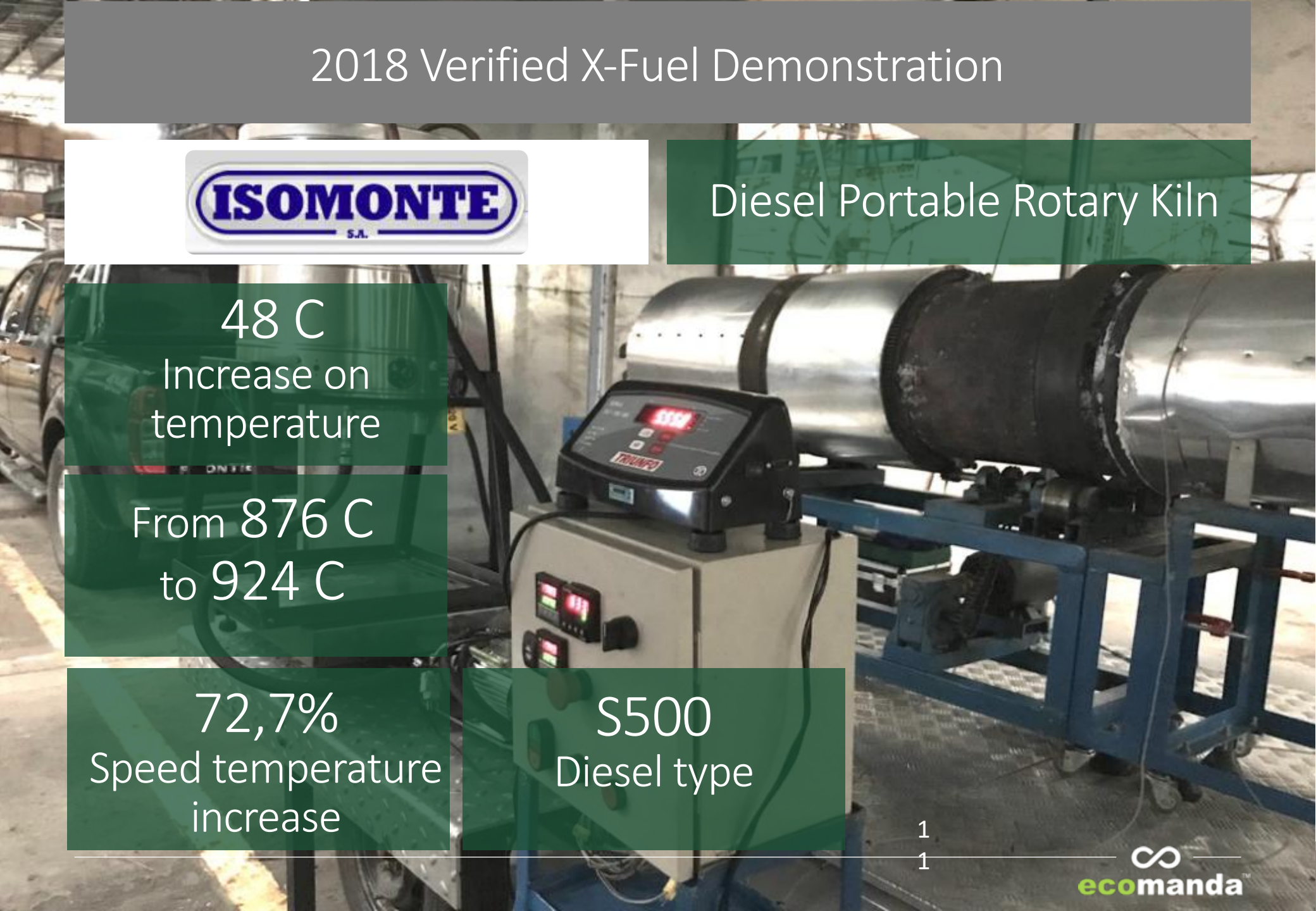
Diesel Portable Rotary Kiln

48 C
Increase on temperature

From **876 C** to **924 C**

72,7%
Speed temperature increase

S500
Diesel type



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Ecomanda AG
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Belo Horizonte, 20 de fevereiro de 2018

Relatório Técnico de ensaio piloto do Forno Rotativo na Isomonte S.A.

Local:

R. Cristiano França T. Guimarães, 265 – Cinco
Contagem – MG
CEP: 32010-130

1. Prêambulo

Antecipadamente a apresentação deste relatório e seus eventuais resultados, nós da **Ecomanda** gostaríamos de agradecer a **Isomonte**, em especial ao Sr. Jair, por toda a presteza, atenção e tempo dispendidos para conosco quando da ocasião dos testes.

Este presente documento tem como premissa principal demonstrar o resultado do teste do **X-Fuel Energizer** feito pela ECOMANDA nas instalações da ISOMONTE, o qual apresentou aumento da queima do combustível com aumento da temperatura quando utilizado o X-Fuel Energizer.

2. Introdução

Entre os dias **19** e **20** de **fevereiro** de **2018** foram conduzidos **2 (dois) testes** demonstrativos de desempenho no forno piloto construído pela **Ecomanda** exclusivamente para estes testes e que segue descrito nas alinha a seguir.

Os testes foram divididos em duas etapas, a primeira etapa foi executada no dia **19 de fevereiro**, onde este ensaio foi conduzido **sem a adição** do **X-Fuel** ao combustível e a segunda etapa foi executada no dia **20 de fevereiro** sendo este ensaio conduzido com a **adição** de **X-Fuel** ao combustível.

O ensaio teve como condutor o **Eng. Mecânico José Maria Corrêa** responsável pela montagem e operacionalização do forno piloto demonstrativo, e como testemunhas o **Sr. Jair Brugger** representando a **Isomonte** e os **Srs. Henrique Braun e Antonio Ticianeli Neto** que além do **Sr. José Maria**, estavam representando a **Ecomanda**.

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3. Objetivo

A otimização do aproveitamento da queima do combustível pode ser evidenciada através dos aumentos dos calores de combustão que refletem no aumento de temperatura.

Desta forma, propõem-se como objetivo de deste teste evidenciar o aumento dos calores de queima que foram registrados nos termopares do forno demonstrativo piloto.

4. Descrição do Ensaio

A premissa pela qual seguiu-se o teste do **X-Fuel** no forno demonstrativo piloto, sedia-se no fato, que a estrutura de funcionamento do forno é muito simples e o processamento do combustível, neste caso a queima deste, se dá forma direta, com visualização da operação facilitada, permitindo assim o aumento da temperatura de queima do combustível ao ser utilizar o X-Fuel.

Os testes assim como já relatado, foram conduzidos em duas etapas, uma sem adição de aditivo ao combustível e uma segunda sem com adição de aditivo ao combustível.

O tempo de duração ambos os testes foram de **110 minutos (1h50min)**, com fluxo de alimentação de combustível e ar constantes, diferenciando-se apenas pela presença e a ausência de **X-Fuel** no combustível.

+ Bico atomizador do queimador ; 0.4 g/h, ângulo de 60° e 4,5 head fuel

+ Vazão de ar: 1.0 cm de abertura na sucção do exaustor centrífugo

O combustível aplicado ao teste foi o **Diesel S-500**, que tem como principais características a presença de até 0.5% de **Enxofre** e a adição máxima de **Biodiesel** em **5.00%.**

Em ambas as etapas o sistema é drenado e desaerado de forma a mantê-lo descontaminado e com a possibilidade de falha na admissão de combustível minimizada.

Em ambos os casos, com o sistema equalizado, anteriormente a ignição do queimador, é feito registro da massa inicial de combustível no tanque de admissão e das temperaturas dos termopares 1, 2, e 3 localizados respectivamente no cabeçote do queimador, no meio do comprimento do corpo do forno e na exaustão do forno. Então o queimador é “startado”

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e as temperaturas nos termopares relatados anteriormente, são anotadas a cada 5 minutos juntamente com a massa de combustível representativa do momento da anotação das temperaturas, o que foi repetido até que se completasse o período relatado de **110 minutos**.

Figura 1. Forno Demonstrativo Piloto

5. Especificação do Equipamento

+ Forno Rotativo Piloto de demonstração, montado sobre um trailer;

+ Trailer com 3 m de comprimento por 2 m de altura com abertura nas laterais e eixo duplo;

+ Comprimento do forno de 2.0 m, diâmetro interno 0,25 m e revestimento interno e externo com manta de fibra cerâmica, com capacidade de trabalho até 1315° C. Janela de visita frontal e chaminé com abertura fixa da válvula.

+ Forno equipado com 3 termopares tipo k mineral de até 1250°C e sistema supervisório de monitoramento e registro.

+ Queimador Ecoflam max 8, monobloco equipado com bomba de combustível, exaustor centrifugo, sistema de ignição e BCU - programador de chama. (características técnicas fig.2)

+ Tanque de combustível com capacidade para 40 litros, equipado com sistema de aquecimento fixado sobre uma balança eletrônica com capacidade para 300 kg, com selo e lacre do **Inmetro**.

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6. Resultados

Antes de iniciarmos a avaliação dos dados dos testes realizados no forno demonstrativo piloto, precisamos indicar que alguns elementos ambientais, podem ter influenciado os resultados dos testes, porém foi possível a constatação dos fatores que se deseja evidenciar.

A seguir estão listadas as tabelas geradas a partir do período de teste, oportunamente foi externado e explicado, e a seguir, seus resultados serão debatidos.

Tabela 1. Teste sem X-Fuel

TESTE DEMONSTRAÇÃO - FORNO CALCINADOR

TESTE: FORNO REDUZIDO SEM GIRO **X-FUEL** Não **COMBUSTÍVEL** DIESEL S 500
AJUSTE QUEIMADOR DIESEL (Ecoflam max 8) **BICO ATOMIZADOR (Steiner)**
ADMISSÃO COMBUSTÍVEL HEAD 4.5 **ÂNGULO** 60°H
ADMISSÃO DE AR 1.0 **VAZÃO** 0.4 gph
DATA: 19/02/2018 **CLIENTE:** ISOMONTE

	TERMOPARES °C LEITURA			DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			PESO DO COMBUSTÍVEL (Kg)	
HORA	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA
14:40	24	28	26				7,25	0
14:45	786	722	661	762	694	635	6,75	0,5
14:50	812	756	710	26	34	49	6,55	0,2
14:55	817	761	721	5	5	11	6,3	0,25
15:00	821	773	736	4	12	15	6,1	0,2
15:05	827	775	738	6	2	2	5,9	0,2
15:10	831	781	743	4	6	5	5,6	0,3
15:15	836	788	750	5	7	7	5,3	0,3
15:20	837	789	751	1	1	1	5,2	0,1
15:25	843	795	757	6	6	6	5,05	0,15
15:30	848	799	759	5	4	2	4,85	0,2
15:35	848	803	764	0	4	5	4,6	0,25
15:40	854	807	771	6	4	7	4,45	0,15
15:45	857	809	776	3	2	5	4,35	0,1
15:50	859	810	778	2	1	2	4,25	0,1
15:55	860	814	783	1	4	5	4,15	0,1
16:00	864	819	784	4	5	1	4	0,15
16:05	866	820	787	2	1	3	3,85	0,15
16:10	869	822	791	3	2	4	3,7	0,15
16:15	870	823	793	1	1	2	3,55	0,15
16:20	874	825	794	4	2	1	3,45	0,1
16:25	873	825	796	-1	0	2	3,3	0,15
16:30	876	827	797	3	2	1	3,2	0,1
16:35	876	826	801	0	-1	4	3,05	0,15

TEMPO DE ENSAIO	**1:55**
CONSUMO TOTAL	**4,2 Kg**
CONSUMO POR HORA	**2,4 Kg/h**

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Tabela 2. Teste com X-Fuel

TESTE DEMONSTRAÇÃO - FORNO CALCINADOR

TESTE: FORNO REDUZIDO SEM GIRO **X-FUEL** Sim **COMBUSTÍVEL** DIESEL S 500
AJUSTE QUEIMADOR DIESEL (Ecoflam max 8) **BICO ATOMIZADOR (Steiner)**
ADMISSÃO COMBUSTÍVEL HEAD 4.5 **ÂNGULO** 60°H
ADMISSÃO DE AR 1.0 **VAZÃO** 0.4 gph
DATA: 19/02/2018 **CLIENTE:** ISOMONTE

	TERMOPARES °C LEITURA			DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			PESO DO COMBUSTÍVEL (Kg)	
HORA	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA
10:20	24	19	22			8,75	8,75	
10:25	835	767	710	811	748	688	8,55	0,2
10:30	853	796	749	18	29	39	8,35	0,2
10:35	862	805	762	9	9	13	8,1	0,25
10:40	862	807	765	0	2	3	7,9	0,2
10:45	871	817	780	9	10	15	7,7	0,2
10:50	874	825	787	3	8	7	7,55	0,15
10:55	881	829	789	7	4	2	7,25	0,3
11:00	885	837	796	4	8	7	7,05	0,2
11:05	892	839	798	7	2	2	6,8	0,25
11:10	895	842	808	3	3	10	6,65	0,15
11:15	897	848	812	2	6	4	6,45	0,2
11:20	903	852	814	6	4	2	6,3	0,15
11:25	907	852	822	4	0	8	6,1	0,2
11:30	910	854	820	3	2	-2	5,95	0,15
11:35	910	858	826	0	4	6	5,8	0,15
11:40	912	858	830	2	0	4	5,65	0,15
11:45	914	861	831	2	3	1	5,45	0,2
11:50	915	859	831	1	-2	0	5,3	0,15
11:55	918	863	833	3	4	2	5,1	0,2
12:00	918	853	834	0	-10	1	5	0,1
12:05	921	865	837	3	12	3	4,85	0,15
12:10	922	866	839	1	1	2	4,75	0,1
12:15	924	866	843	2	0	4	4,6	0,15

TEMPO DE ENSAIO	**1:55**
CONSUMO TOTAL	**4,15 Kg**
CONSUMO POR HORA	**2,45 Kg/h**

Gráfico 1. Evolução das temperaturas Tempo vs. Temperatura – Sem X-Fuel

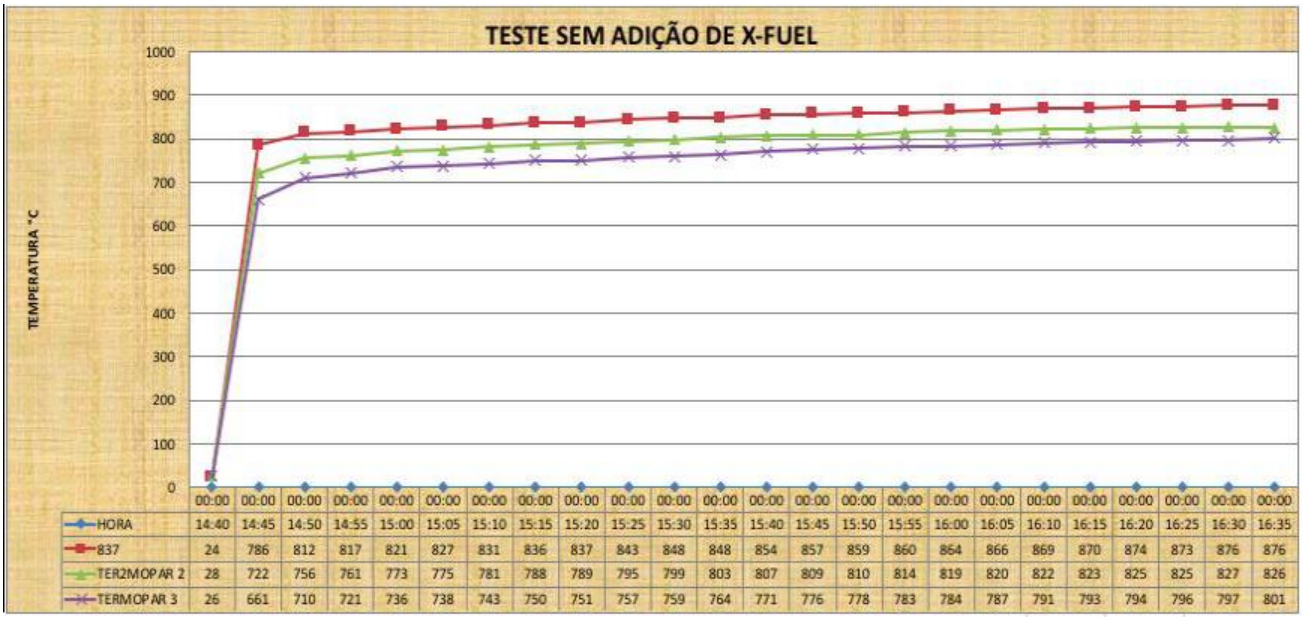

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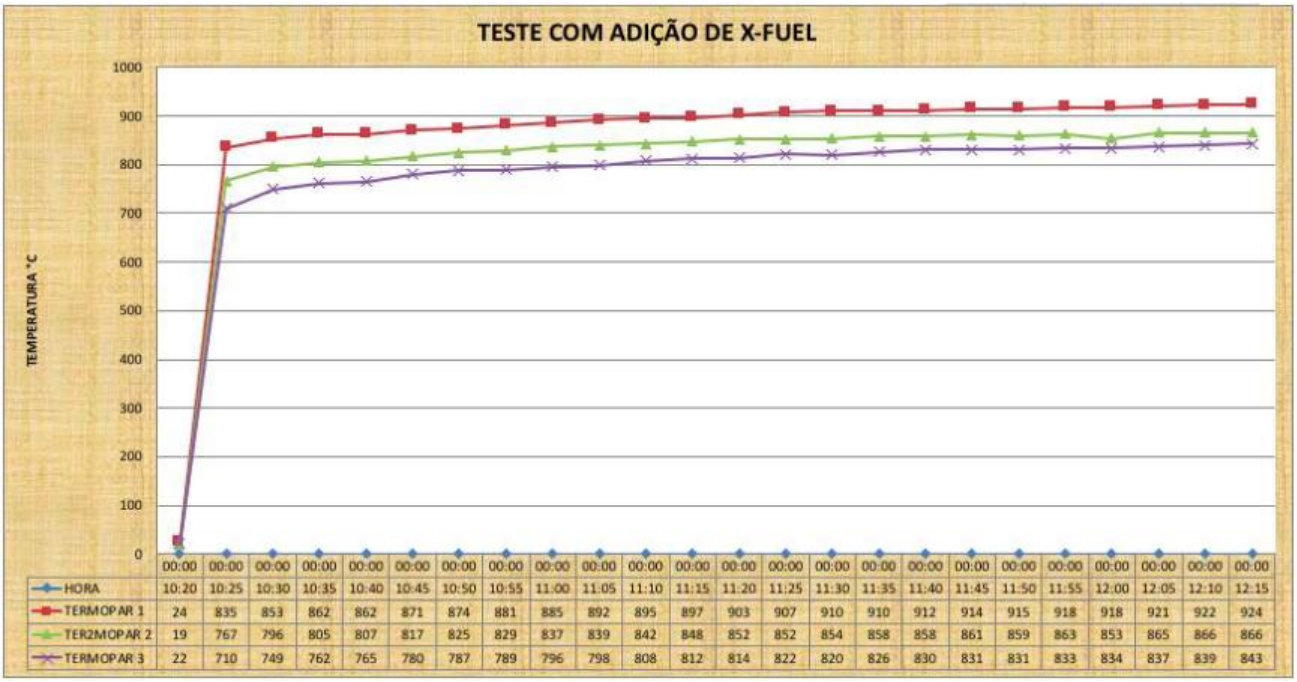
Gráfico 2. Evolução das temperaturas Tempo vs. Temperatura – Com X-Fuel



	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
HORA	10:20	10:25	10:30	10:35	10:40	10:45	10:50	10:55	11:00	11:05	11:10	11:15	11:20	11:25	11:30	11:35	11:40	11:45	11:50	11:55	12:00	12:05	12:10	12:15
TERMOPAR 1	24	835	853	862	862	871	874	881	885	892	895	897	903	907	910	910	912	914	915	918	918	921	922	924
TER2MOPAR 2	19	767	796	805	807	817	825	829	837	839	842	848	852	852	854	858	858	861	859	863	853	865	866	866
TERMOPAR 3	22	710	749	762	765	780	787	789	796	798	808	812	814	822	820	826	830	831	831	833	834	837	839	843

Em linhas gerais, o X-Fuel apresentou um aumento da temperatura de queima do combustível. As diferenças de temperaturas medidas nos termopares **5 minutos** (**T +5**) após o inicio da medição **sem X-Fuel** e **com XFuel** respectivamente, tiveram um delta de temperatura de **49ºC, 45ºC** e **49ºC** respectivamente nos termopares **1, 2** e **3.**

Tal análise pode ser confirmada novamente ao término do ensaio no tempo em **110 minutos** (**T_{+110}**), onde os deltas de temperatura entre a medição **sem X-Fuel** e **com X-Fuel** registraram diferenças de **48ºC, 40ºC** e **42ºC** respectivamente nos termopares **1, 2** e **3.**

Outro ponto a ser destacado é fator velocidade de aumento de temperatura em que ao parearmos a temperatura máxima encontrada durante o ensaio **sem o X-Fuel (ensaio 1)** e o ensaio **com o X-Fuel (ensaio 2)** , veremos que a temperatura máxima encontrada no ensaio foi de **876ºC** no tempo de **110 minutos**, e ao analisarmos o ensaio 2 veremos que a mesma temperatura foi alcançada no tempo de **30 minutos** de ensaio, o que demonstra uma velocidade de aquecimento **72.72%** maior quando comparado ao primeiro ensaio. Demonstrando assim um aumento representativo na temperatura de combustão do combustível e um aumento representativo no calor expelido pela chama.

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Em linhas gerais conclui-se que, o X-Fuel promoveu um aumento da qualidade da queima do combustível resultando em calores de queima muito mais altos e em tempo mais reduzidos.

.

Atenciosamente,

DS JFBJ

Isomonte S.A.
Testemunhado por:
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2017 Verified X-Fuel Demonstration

suape ENERGIA

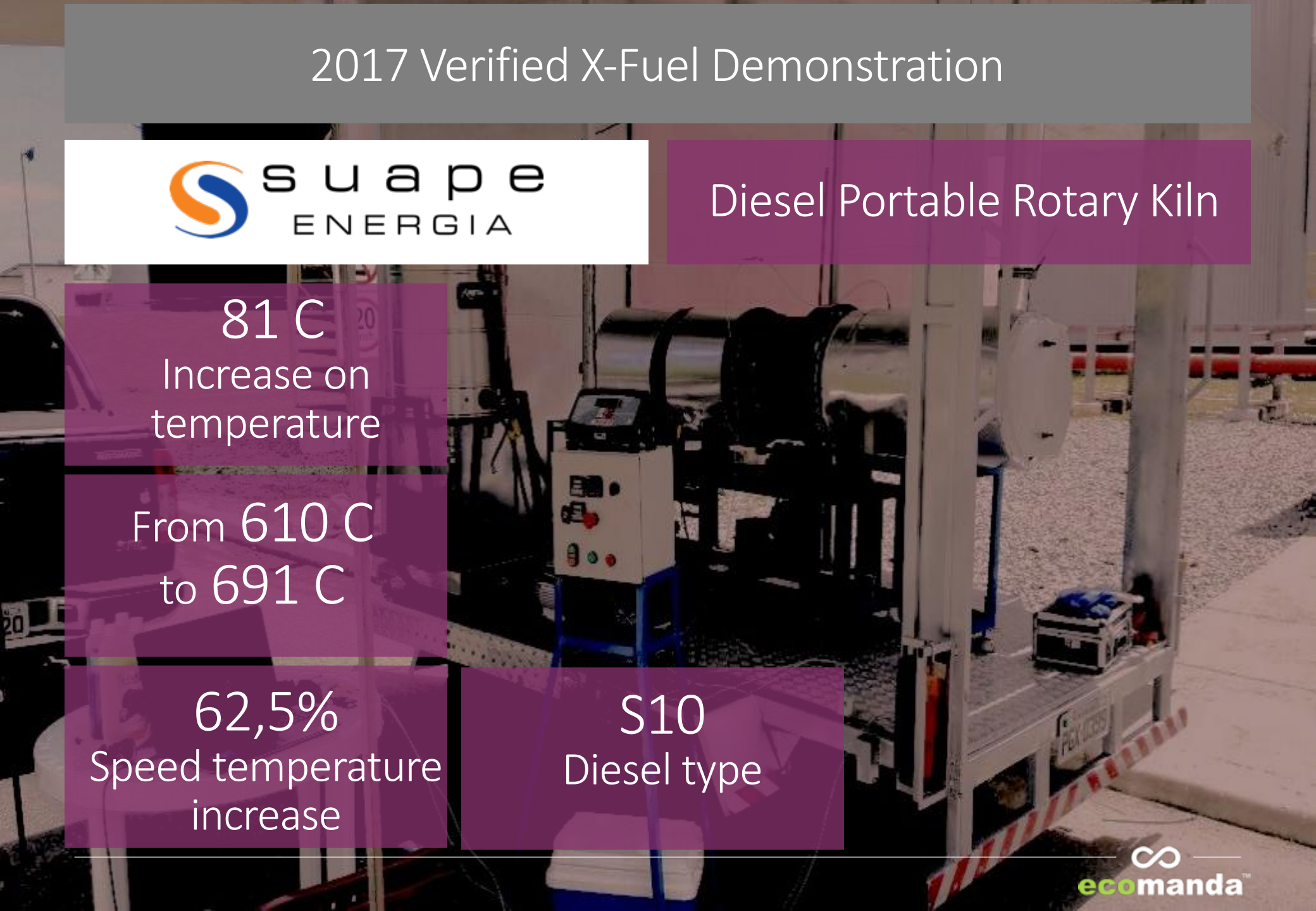
Diesel Portable Rotary Kiln

81 C
Increase on temperature

From **610 C** to **691 C**

62,5%
Speed temperature increase

S10
Diesel type



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O ensaio teve como condutor o **Eng. Mecânico José Maria Corrêa** responsável pela montagem e operacionalização do forno piloto demonstrativo, e como testemunhas o **Srs. Alexandre Venceslau** e **Gleison Araujo** representando a **Suape Energia** e os **Sr. José Maria** representando a **Ecomanda**.

3. Objetivo

Assim como reportado anteriormente de forma oportuna, o **X-Fuel** é um aditivo que se destaca por ser algo inédito no mercado por se tratar de uma solução física associada a um elemento químico.

Esta associação de fatores químico e físico gera um efeito sinérgico quando o aditivo é adicionado a combustíveis fósseis, em especial em combustíveis de alto peso molecular, a exemplo do combustível do **HFO – Heavy Fuel Oil**.

A otimização do aproveitamento da queima do combustível pode ser evidenciada através dos aumentos dos calores de combustão que refletem no aumento de temperatura.

Desta forma, propõem-se como objetivo de deste teste evidenciar o aumento dos calores de queima que foram registrados nos termopares do forno demonstrativo piloto.

4. Descrição do Ensaio

A premissa pela qual seguiu-se o teste do **X-Fuel** no forno demonstrativo piloto, sedia-se no fato, que a estrutura de funcionamento do forno é muito simples e o processamento do combustível, neste caso a queima deste, se dá forma direta, com visualização da operação facilitada, permitindo assim a produção imediata dos resultados prometidos pelo X-Fuel.

Os testes assim como já relatado, foram conduzidos em duas etapas, uma sem adição de aditivo ao combustível e uma segunda sem com adição de aditivo ao combustível.

O tempo de duração ambos os testes foram de **120 minutos (2hrs)**, com fluxo de alimentação de combustível e ar constantes, diferenciando-se apenas pela presença e a ausência de **X-Fuel** no combustível.

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+ Bico atomizador do queimador ; 0.4 g/h, ângulo de 60° e 4,5 head fuel

+ Vazão de ar: 1.0 cm de abertura na sucção do exaustor centrífugo

O combustível aplicado ao teste foi o **Diesel S10**, que tem como principais características a presença de até 0.5% de **Enxofre** e a adição máxima de **Biodiesel** em **5.00%.**

Em ambas as etapas o sistema é drenado e desaerado de forma a mantê-lo descontaminado e com a possibilidade de falha na admissão de combustível minimizada.

Em ambos os casos, com o sistema equalizado, anteriormente a ignição do queimador, é feito registro da massa inicial de combustível no tanque de admissão e das temperaturas dos termopares 1, 2, e 3 localizados respectivamente no cabeçote do queimador, no meio do comprimento do corpo do forno e na exaustão do forno. Então o queimador é “startado” e as temperaturas nos termopares relatados anteriormente, são anotadas a cada 5 minutos juntamente com a massa de combustível representativa do momento da anotação das temperaturas, o que foi repetido até que se completasse o período relatado de **120 minutos**.

Figura 1. Forno Demonstrativo Piloto

5. Especificação do Equipamento

+ Forno Rotativo Piloto de demonstração, montado sobre um trailer;

+ Trailer com 3 m de comprimento por 2 m de altura com abertura nas laterais e eixo duplo;

+ Comprimento do forno de 2.0 m, diâmetro interno 0,25 m e revestimento interno e externo com manta de fibra cerâmica, com capacidade de trabalho até 1315° C. Janela de visita frontal e chaminé com abertura fixa da válvula.

+ Forno equipado com 3 termopares tipo k mineral de até 1250°C e sistema supervisório de monitoramento e registro.

+ Queimador Ecoflam max 8, monobloco equipado com bomba de combustível, exaustor centrifugo, sistema de ignição e BCU - programador de chama. (características técnicas fig.2)

+ Tanque de combustível com capacidade para 40 litros, equipado com sistema de aquecimento fixado sobre uma balança eletrônica com capacidade para 300 kg, com selo e lacre do **Inmetro**.

6. Resultados

Antes de iniciarmos a avaliação dos dados dos testes realizados no forno demonstrativo piloto, precisamos indicar que alguns elementos ambientais, podem ter influenciado os resultados dos testes, porém foi possível a constatação dos fatores que se deseja evidenciar.

A seguir estão listadas as tabelas geradas a partir do período de teste, oportunamente foi externado e explicado, e a seguir, seus resultados serão debatidos.

Tabela 1. Teste sem X-Fuel

TESTE DEMONSTRAÇÃO - FORNO CALCINADOR										
TESTE	FORNO REDUZIDO SEM GIRO									
1	AJUSTE QUEIMADOR DIESEL (Ecoflam max 8)						BICO ATOMIZADOR (Steiner)			
	FUEL	HEAD 4.5		AIR	1.0		ÂNGULO	60°H	VAZÃO	0.4 gph
	COMBUSTÍVEL			ÓLEO DIESEL S10						
DATA	01/12/2017			SUAPE ENERGIA						
	TERMOPARES °C						BALANÇA (Kg) FUEL		X-FUEL	
	LEITURA			DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA	SIM	NÃO
HORA	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3				
10:50	32	26	29				6.850			X
10:55	649	555	495	617	529	466	6.650	0.200		X
11:00	665	581	535	16	26	40	6.500	0.150		X
11:05	675	597	551	10	16	16	6.350	0.150		X
11:10	679	591	561	4	-6	10	6.100	0.250		X
11:15	681	609	566	2	18	5	5.900	0.200		X
11:20	685	609	574	4	0	8	5.800	0.100		X
11:25	683	607	575	-2	-2	1	5.700	0.100		X
11:30	683	615	578	0	8	3	5.550	0.150		X
11:35	697	580	581	14	-35	3	5.450	0.100		X
11:40	703	573	583	6	-7	2	5.300	0.150		X
11:45	689	623	585	-14	50	2	5.200	0.100		X
11:50	690	626	590	1	3	5	5.050	0.150		X
11:55	693	623	592	3	-3	2	4.950	0.100		X
12:00	692	626	594	-1	3	2	4.800	0.150		X
12:05	701	615	595	9	-11	1	4.650	0.150		X
12:10	694	634	598	-7	19	3	4.550	0.100		X
12:15	694	635	599	0	1	1	4.450	0.100		X
12:20	694	635	600	0	0	1	4.250	0.200		X
12:25	694	635	601	0	0	1	4.100	0.150		X
12:30	697	637	605	3	2	4	3.950	0.150		X
12:35	697	639	608	0	2	3	3.800	0.150		X
12:40	696	638	608	-1	-1	0	3.650	0.150		X
12:45	695	633	605	-1	-5	-3	3.500	0.150		X
12:50	698	639	610	3	6	5	3.350	0.150		X
										X
										X
TEMPO TOTAL								CONSUMO TOTAL	CONSUMO EM Lb	
02:00								3.500	1.800	

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Tabela 2. Teste com X-Fuel

TESTE DEMONSTRAÇÃO - FORNO CALCINADOR										
TESTE	FORNO REDUZIDO SEM GIRO									
2	AJUSTE QUEIMADOR DIESEL (Ecoflam max 8)						BICO ATOMIZADOR (Steiner)			
	FUEL	HEAD 4.5	AIR	1.0			ÂNGULO	60°H	VAZÃO	0.4 gph
	COMBUSTÍVEL									
DATA	05/12/2017									
TERMOPARES °C							BALANÇA (Kg) FUEL		X-FUEL	
	LEITURA			DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA	SIM	NÃO
HORA	TERMOPAR 1	TER2MOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3				
13:20	39	36	38				6.950		X	
13:25	624	589	534	585	553	496	6.800	0.150	X	
13:30	650	616	578	26	27	44	6.650	0.150	X	
13:35	662	632	595	12	16	17	6.500	0.150	X	
13:40	670	638	606	8	6	11	6.350	0.150	X	
13:45	676	646	613	6	8	7	6.200	0.150	X	
13:50	680	652	620	4	6	7	6.050	0.150	X	
13:55	684	658	625	4	6	5	5.900	0.150	X	
14:00	690	663	631	6	5	6	5.800	0.100	X	
14:05	694	667	637	4	4	6	5.650	0.150	X	
14:10	700	671	642	6	4	5	5.500	0.150	X	
14:15	704	676	646	4	5	4	5.350	0.150	X	
14:20	708	681	652	4	5	6	5.200	0.150	X	
14:25	714	685	656	6	4	4	5.050	0.150	X	
14:30	716	688	659	2	3	3	4.950	0.100	X	
14:35	721	693	668	5	5	9	4.800	0.150	X	
14:40	725	697	672	4	4	4	4.650	0.150	X	
14:45	728	699	673	3	2	1	4.500	0.150	X	
14:50	729	700	677	1	1	4	4.400	0.100	X	
14:55	734	703	679	5	3	2	4.300	0.100	X	
15:00	736	707	682	2	4	3	4.150	0.150	X	
15:05	741	710	684	5	3	2	4.000	0.150	X	
15:10	741	711	686	0	1	2	3.850	0.150	X	
15:15	741	712	690	0	1	4	3.750	0.100	X	
15:20	745	714	691	4	2	1	3.600	0.150	X	
									X	
									X	
TEMPO TOTAL								CONSUMO TOTAL	CONSUMO EM Lb	
02:00								3.350	1.750	

Gráfico 1. Evolução das temperaturas Tempo vs. Temperatura – Sem X-Fuel

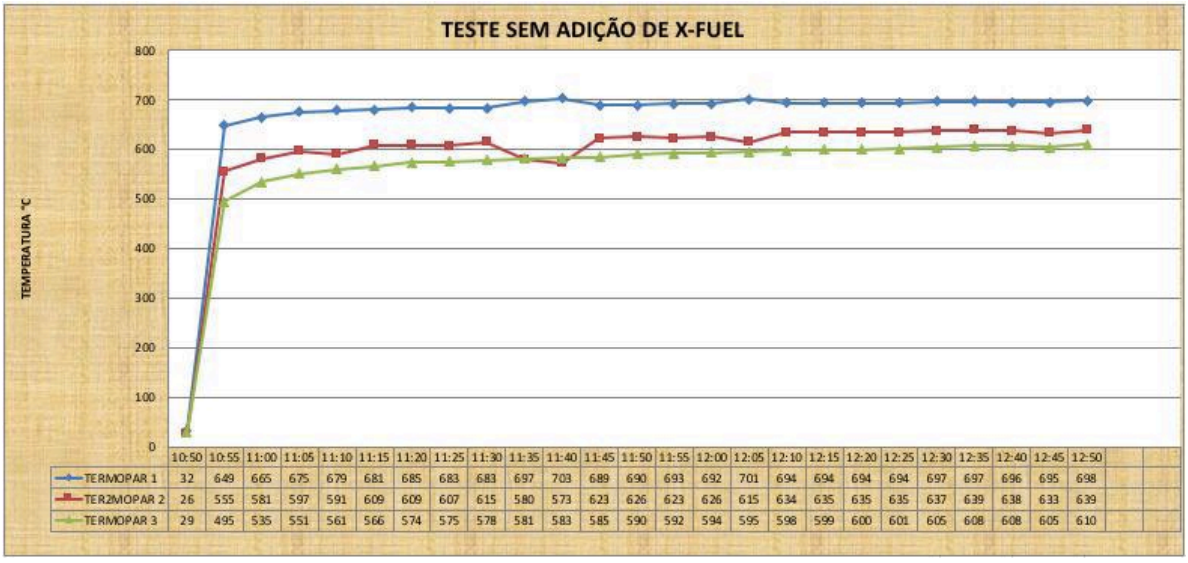

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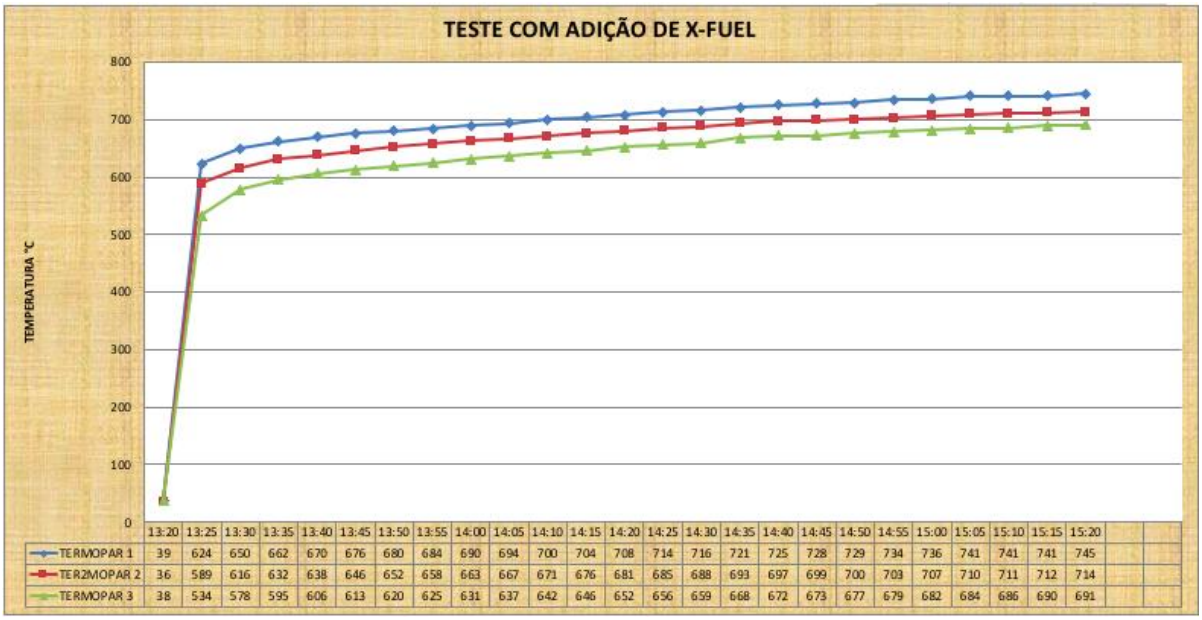
Gráfico 2. Evolução das temperaturas Tempo vs. Temperatura – Com X-Fuel



	13:20	13:25	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10	14:15	14:20	14:25	14:30	14:35	14:40	14:45	14:50	14:55	15:00	15:05	15:10	15:15	15:20
TERMOPAR 1	39	624	650	662	670	676	680	684	690	694	700	704	708	714	716	721	725	728	729	734	736	741	741	741	745
TER2MOPAR 2	36	589	616	632	638	646	652	658	663	667	671	676	681	685	688	693	697	699	700	703	707	710	711	712	714
TERMOPAR 3	38	534	578	595	606	613	620	625	631	637	642	646	652	656	659	668	672	673	677	679	682	684	686	690	691

Em linhas gerais, é possível, ainda que de forma inicial, afirmar que o **X-Fuel** demonstrou suas qualidades e atingiu seus objetivos quando aplicado ao combustível em questão durante a execução dos ensaios.

Tal possibilidade de afirmação se torna factível uma vez que as diferenças de temperaturas medidas nos termopares **5 minutos** (T_{+5}) após o inicio da medição **sem X-Fuel** e **com X-Fuel** respectivamente, apresentaram um delta de temperatura de **-25ºC, 34ºC** e **39ºC** respectivamente nos termopares **1, 2** e **3.** Tal análise pode ser confirmada novamente ao término do ensaio no tempo em **110 minutos** (T_{+110}), onde os deltas de temperatura entre a medição **sem X-Fuel** e **com X-Fuel** registraram diferenças de **47ºC, 75ºC** e **81ºC** respectivamente nos termopares **1, 2** e **3.**

Outro ponto a ser destacado é fator velocidade de aumento de temperatura em que ao parearmos a temperatura máxima encontrada durante o ensaio **sem o X-Fuel (ensaio 1)** e o ensaio **com o X-Fuel (ensaio 2)** , veremos que a temperatura máxima encontrada no ensaio 1 termopar 1 foi de **698ºC** no tempo de **120 minutos**, e ao analisarmos o ensaio 2 termopar 1 veremos que a mesma temperatura foi alcançada no tempo de **45 minutos** de ensaio, o que demonstra uma velocidade de aquecimento **62,50%** maior quando comparado ao primeiro ensaio.

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Demonstrando assim um aumento representativo na temperatura de combustão do combustível e um aumento representativo no calor expelido pela chama.

Em linhas gerais conclui-se que, o X-Fuel realmente promove um aumento da qualidade da queima do combustível resultando em calores de queima muito mais altos e em tempo mais reduzidos, que certamente se refletem na redução do consumo de combustível e por conseguintes nas emissões atmosféricas dos equipamentos nos quais se aplica o produto.

Sem mais para este momento, certifico e dou fé que os resultados apresentados refletem os ensaios realizados, atestando ainda que não houve manipulação de qualquer ordem ou espécie que visem a maquiagem de dados ou outrem.

Atenciosamente,

Suape Energia S.A.
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2017 Verified Field Test

TSCHUDI SHIP MANAGEMENT

Marine Diesel Generator

13,49%
Reduction on fuel consumption

ecomanda™

TSCHUDI
SHIP MANAGEMENT

Tschudi Ship Management AS Tallinn, Estonia

Ecomanda AG **12 June, 2017**

Chamerstrasse 172
CH-6300 Zug
Switzerland

Test certification about the use of Ecomand X-Fuel Energizer on board our Ship ITC Cyclone in Cadiz / Spain

Dear Mr. Foerg,

We've test the effect from your additive X-Fuel Energizer in one of our vessels (ITC Cyclone in Cardiz / Spain). This test was conducted on a Carterpillar generator model: SR4B Serial No.: 6EJ01712 Arrangement No.: 9Y-1449 during 28 days. All measurements were monitored and recorded accordingly.

We are glad to confirm you that, comparing to our fuel consumption history, a preliminary reduction in fuel consumption of 13.49 % has been successfully achieved.

Sincerely,

Signature Managing Director

Tschudi Ship Management AS
4 Sadama Street, 15096 Tallinn, Estonia
Reg. No 10788166 VAT No EE100708642

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17,8%
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CO emissions.

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SGS

EFFICIENCY IMPROVEMENT BY FUEL ADDITIVES

Test bed measurements on Caterpillar 3512B for Ecomanda

Summary

Report No.	:	30249-1-TM-sum
Date	:	February 2018
Version	:	0.1

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1 INTRODUCTION

Ecomanda AG has developed fuel additives to improve the combustion characteristics of marine fuels. An improved combustion should reduce emissions, increase the efficiency and reduce the maintenance of the engine used. Ecomanda contacted MARIN as an independent research institute to conduct, supervise and report verification tests of the Ecomanda 'X-Fuel Energizer' fuel additive specifically for marine fuels and engines.

The test bed of Pon Power in Papendrecht, The Netherlands provided a controllable environment for the scope of work in this project. Pon Power also provided a fresh overhauled Caterpillar 3512B diesel engine. This type of engine is typical for marine propulsion of inshore vessels.

Figure 1: Test bed at Pon Power (courtesy Pon Power)

The test bed is equipped to control temperatures of air and cooling water and provides sufficient measurement parameters to allow analyses of the performance and influences of the fuel additive to the motor performance. The load of the engine is controlled by a water brake. Engine brake power is set by the maker's protocol as per below table1:

Table 1: Protocol brake power and revolutions data for Caterpillar 3512B engine

General Performance Data :Prop Demand Curve P

ENGINE SPEED RPM	ENGINE POWER BKW	ENGINE TORQUE N.M	ENGINE BMEP KPA	FUEL BSFC G/BKW-HR	FUEL RATE LPH	INTAKE MFLD TEMP DEG C	INTAKE MFLD P KPA	INTAKE AIR FLOW M3/MIN	EXH MFLD TEMP DEG C	EXH STACK TEMP DEG C	EXH GAS FLOW M3/MIN
1600	1,305.0	7,789	1,671	192.100	298.8	40.4	173.8	110.5	537.1	396.3	258.4
1500	1,075.3	6,845	1,469	195.000	249.9	38.0	137.3	91.3	544.3	414.0	219.2
1400	874.2	5,963	1,280	196.400	204.7	36.7	98.6	71.4	551.5	440.2	178.0
1300	700.0	5,142	1,103	197.600	164.9	36.3	67.1	55.8	549.0	452.1	141.8
1200	550.5	4,381	940	199.600	131.0	36.1	44.1	44.4	535.8	444.1	111.5
1100	424.1	3,681	790	201.500	101.8	36.0	26.8	35.5	503.5	424.9	86.7
1000	318.6	3,042	653	202.200	76.8	35.6	14.8	29.1	443.1	380.2	66.3
900	232.3	2,464	529	202.800	56.1	35.0	9.9	25.5	363.9	302.4	50.8
800	163.1	1,947	418	206.800	40.2	35.4	7.8	22.7	295.3	234.0	39.6
650	87.5	1,285	276	227.800	23.8	33.2	3.2	17.4	221.6	178.6	26.9

Fuel supply was made available from 3 tanktainers. The fuel was provided clean, with separate supply and return connections, to and from the engine. The engine-driven fuel supply pump drew freely from the lower side of the tank with only little overhead. Return from the engine was directed into the top of the tank, allowing the content of the tank to mix continuously. Fuel consumption was measured by 2 inter-connected volumetric VAF flow meters. One in the supply-line and one in the return-line. The digital display unit of the flow meters presented the, for 15°C temperature corrected, difference in flow between both meters as consumed volume in liters per hour.

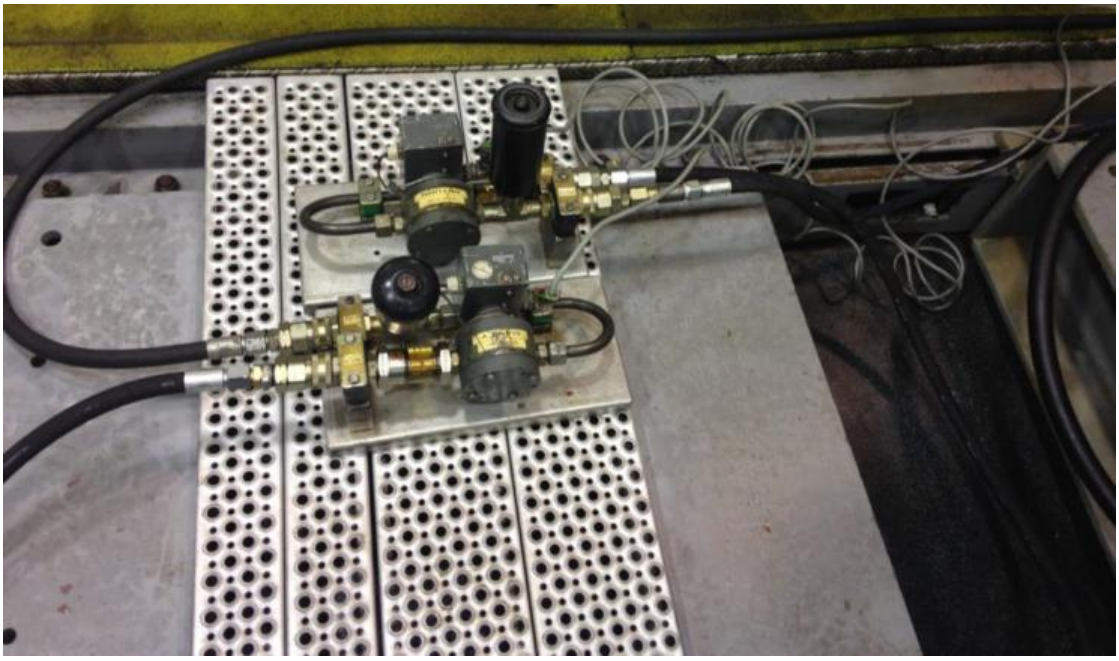


Figure 2: Fuel flow meters arrangement

The fuel used for the test setup is so-called ‘blank diesel’. This is not a marine grade fuel, but had to be used because the Dutch custom authorities did not allow the usage of marine grade fuels in a land-based test bed. Therefore it could not be avoided that traces of biodiesel and possible additives might have been present in the consumed fuel. It is considered that the engine’s performance would rather benefit by this ‘better quality’ fuel instead of becoming poorer.
The fuel additive ‘X-Fuel Energizer’ was provided by Ecomanda. The fuel, in different mixtures with additive, was sampled and analysed by SGS.

Mixing of the fuel with the additive was done by Ecomanda in the exact same batch of delivered diesel after the runs without additives were completed.

All measurements by MARIN, Caterpillar’s Dewesoft system and VAF flow meters were time-stamped and checked on deviation. Deviated or off-set recordings have not been used. All instruments were confirmed to be recently calibrated.
Engines emissions are measured by SGS, relevant details are included in chapter 3.

2 TEST PROGRAM

The test outline was to first monitor the performance of the engine without X-Fuel Energizer added to the fuel at engine load settings of 25%, 50%, 75% and 100% (Run 1.1-1.4 in 1). Then the additive was mixed with the fuel and the engine was run for 6 hours at 100% load to ensure the engine and fuel system was well adjusted to the fuel with additive (Run 2.0 in Table 1). A mixing rate of 1:10,000 was used. After these 6 hours, again runs of 30 minutes length were done at load settings of 25%, 50%, 75% and 100% (Run 2.1-2.4 in Table 1).

Table 1: Overview of performed test program

Test ID	Mixing ratio	Engine load	Engine rpm	Test date	Test duration
Run 1.1	No additive	25%	1000	April 19, 2017	30 min
Run 1.2	No additive	50%	1300	April 19, 2017	30 min
Run 1.3	No additive	75%	1500	April 19, 2017	30 min
Run 1.4	No additive	100%	1600	April 19, 2017	30 min
Run 2.0	1:10,000	100%	1600	April 20, 2017	6 hours
Run 2.1	1:10,000	25%	1000	April 20, 2017	30 min
Run 2.2	1:10,000	50%	1300	April 20, 2017	30 min
Run 2.3	1:10,000	75%	1500	April 20, 2017	30 min
Run 2.4	1:10,000	100%	1600	April 20, 2017	30 min

3 RESULTS

This chapter presents an overview of measurements of key parameters during the different test runs. The values in section 3.1 are taken from the SGS report

3.1 Run exhaust gas measurements

Table shows the readings of the exhaust gas samples as measured by SGS. Values of CO, NO_x and C_xH_y are taken from their report. These values are corrected to a standard condition of 15 vol% O_2. The values of SO_2 are taken from SGS measurements during the tests.

Table 2: Average emission measurements

Test ID	RPM	CO [mg/m_0^3]	NO_x [mg/m_0^3]	C_xH_y [mg C/m_0^3]	SO2 [ppm]
Run 1.1	1000	91.0	1365.3	35.6	0
Run 1.2	1301	80.0	1069.3	23.2	0
Run 1.3	1502	48.3	956.8	20.6	0
Run 1.4	1601	38.1	1272.8	20.3	0
Run 2.1	998	81.8	1398.2	26.8	2.6
Run 2.2	1303	78.1	1096.1	18.7	3.2
Run 2.3	1501	42.2	964.1	16.4	2.4
Run 2.4	1603	35.7	1273.5	16.7	2.3

Table 3 on the next page shows the comparison between the emissions measured during the zero measurements (Run 1.1- 1.4, without X-Fuel Energizer) and the runs with additive.

Table 3: Average emission measurement comparison

Test ID	RPM	CO [diff%]	NO_x [diff%]	C_xH_y [diff%]
Run 1.1	1000	0	0	0
Run 1.2	1301	0	0	0
Run 1.3	1502	0	0	0
Run 1.4	1601	0	0	0
Run 2.1	998	-10.1	+2.4	-24.7
Run 2.2	1303	-2.4	+2.50	-19.4
Run 2.3	1501	-12.6	-0.8	-20.4
Run 2.4	1603	-6.3	-0.1	-17.7

4 PRESENTATION AND DISCUSSION OF RESULTS

The engine has been run for approximately 7800 kWh on additives before a comparison was made in various power-ranges between the runs without and with X-Fuel Energizer. During the various runs, data collection runs were made over a period of time. The collected data is checked on deviations and averaged to present.

4.1 Improvement of specific fuel oil consumption

The prime intention of the use of additives in fuel is to improve engine's efficiency. Efficiency at various operating ranges is expressed in specific fuel oil consumption (SFOC). SFOC is a value which describes the mass of fuel used to produce an amount of energy. Because fuel may have different caloric values (the amount of energy contained by the fuel) ISO correction of the SFOC for caloric value is done.

4.1.1 Mass of fuel

The consumed fuel was measured by the volumetric flow meters and monitored by a calculated value of flow. This calculated flow is derived from the measured revolting speed of the engine and the fuel index setting at the fuel pump. The deviation from the calculated flow and the measured flow is caused by the temperature difference and by a misreading of the index. The deviation is found to be steady at each range, so the calculated volume is corrected to the deviation and used in the comparison. The volume is corrected for temperature to 15°C and converted into mass by the given specific gravity of the fuel at the same reference temperature.

4.1.2 Produced power

The produced power is measured at the shaft by a pressure transmitter fitted on the brake. The measured power on the brake is verified against the measured torsion on the shaft. The measured torsion could identify the equal distribution of combustion over the various cylinders and possible early or delayed ignition. None were witnessed.

4.1.3 Comparison of measured data

The SFOC is calculated by dividing the consumed mass of fuel by the produced effective power on the shaft. In figure 4 the SFOC is shown from the average records where the specific runs are represented as follows;

run 1; ‘sfoc without X-Fuel’
run 2; ‘sfoc with X-Fuel’

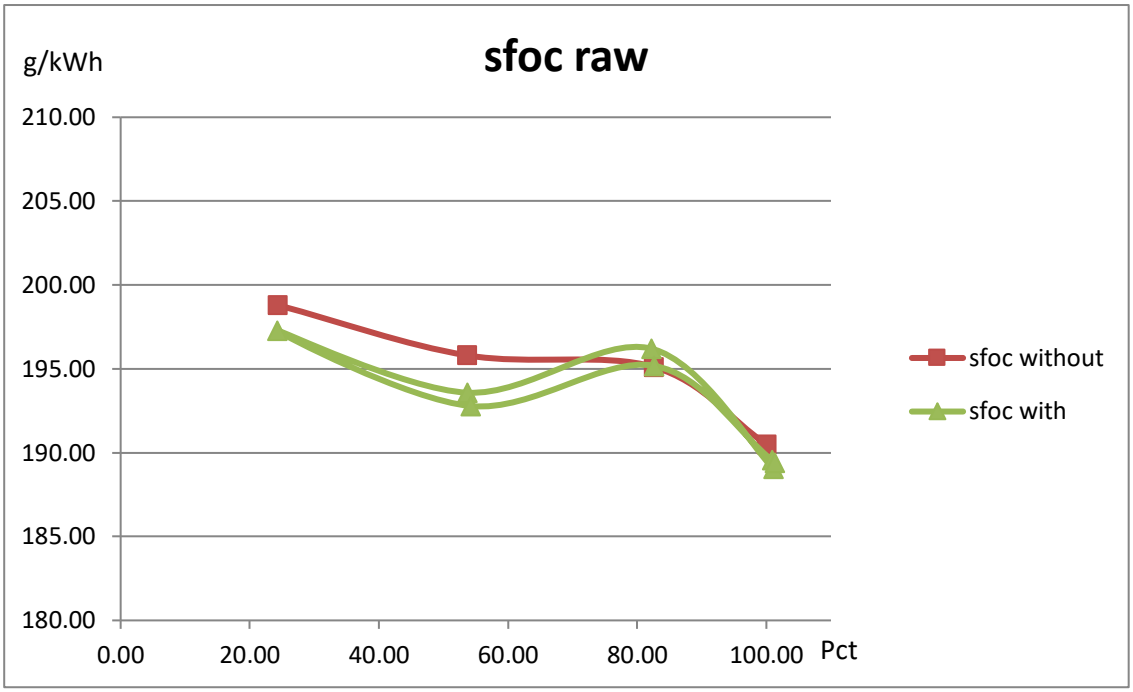


Figure 3: SFOC without ISO corrections

In the lower power range an improvement of the efficiency was witnessed. To further identify the changes measurements are to be ISO corrected to the caloric values of the fuel based on the analysed samples of fuel.

Figure 4 displays the SFOC of the various runs over the power range of the engine corrected for the differences in the caloric values against the protocol values. The used fuel had a lower caloric value as the engine's protocol fuel.

A more clear reduction of the SFOC is seen at the lower ranges.
The values at the running-in period are near to the test runs with additives.

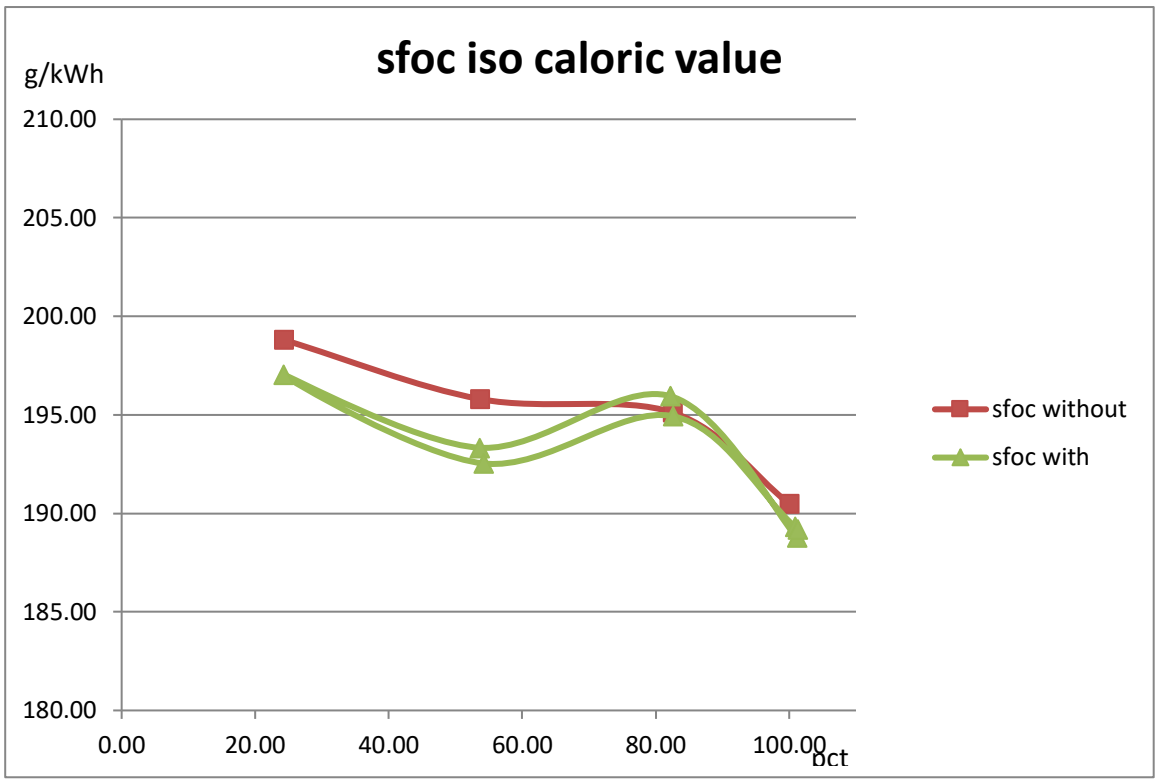


Figure 4: SFOC (grams fuel per KWh) over percentage of power

Ruling out differences between ambient conditions, being chamber air temperature and barometric pressure and scavenging air temperature, by applying ISO 3046-1 corrections, did only enhance the above mentioned effects. The ambient conditions apply to all runs, so with- as well as without additive runs are corrected in such a way that only the difference between protocol and test-runs is magnified. For the purpose of this report this is considered irrelevant.

4.2 Produced energy distribution

The combusted fuel is converted into energy; mechanical as well as thermal energy. The amount of fuel consumed represents an amount of potential energy by the caloric value of the fuel. Mechanical energy is the beneficial source of shaft power. This power was controlled by the brake to a present value. To confirm that no power was lost temperatures are measured; the differential temperature (delta-t) of cooling water and lubrication oil are an indication of produced thermal energy, as well as the exhaust gasses and the radiation onto the test-bed area.

4.2.1 Engine temperature differences

Between the runs without and with additives no significant differences in delta-t of either cooling water or lubrication oil was measured.

The cooling water withdraws heat from the scavenging air and the cylinder-liner and head. Similar delta-t of the cooling water over the engine indicates that during the combustion cycle the same amount of heat is generated inside the combustion chamber. This coincides with the same amount of power produced.

The lubrication oil withdraws heat from the shaft bearings and the piston crowns. A similar delta-t of the lubrication oil over the engine indicates that during the complete cycles of the rotating shaft no higher power has been exposed to the shaft bearings, nor that more heat is generated in the combustion chamber. This again coincides with the produced power, but also indicates no timing problems with respect to the ignition moment are experienced; when combustion would take place prior top-dead-centre of a piston counter-rotating forces would be applied to the pistons and the energy would be lost in heat absorbed by the lubricant.
The active torsion measurement on the engine shaft did not reveal such counter-rotating force. The lubrication oil was analysed after the tests confirming not to be affected either.

The measurements support that no additional energy produced by the improved combustion was transferred into thermal energy carried by either cooling water or lubrication oil when using additives.

4.2.2 Exhaust gas temperature differences

With additive the exhaust gas temperatures in general increased somehow. This could be an effect of a prolonged duration of the combustion.

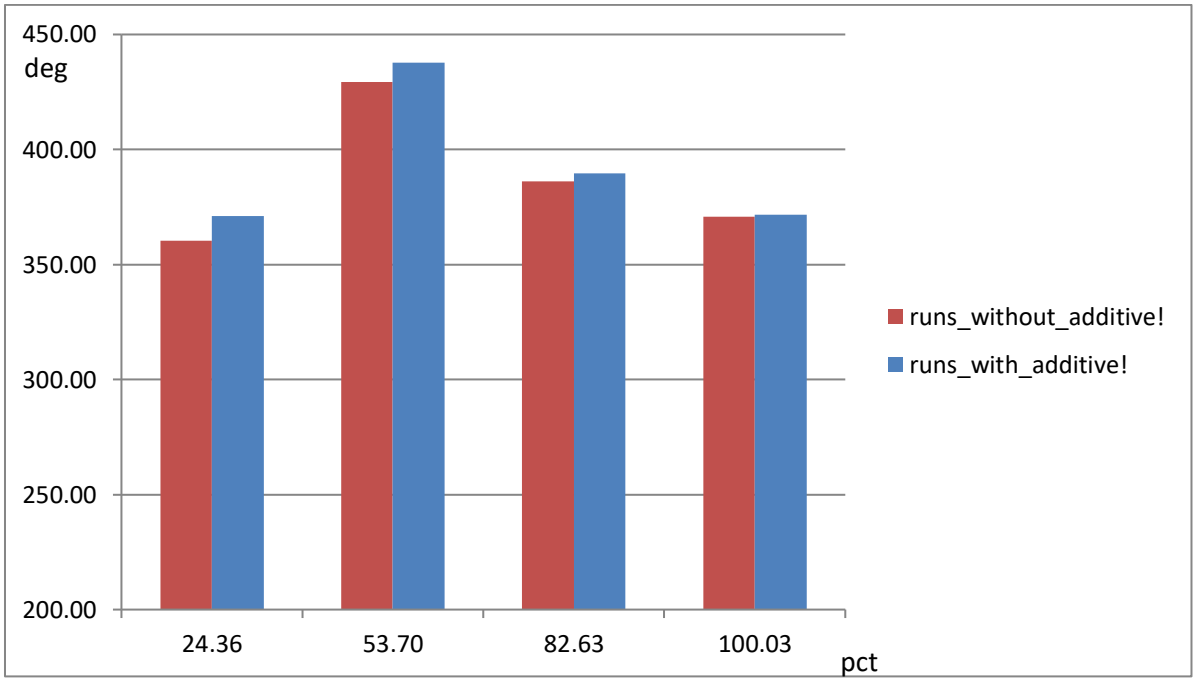


Figure 5: exhaust gas temperature in degC per average power in kW

The fuel, once ignited, burns completely (less hydrocarbons, HC's, are measured in the exhaust gasses). The turbocharger should benefit from a higher exhaust gas temperature but no increase in charge or boost air is witnessed as per figure 6. The air-condition inside the combustion chamber can hence be considered as similar with as without additive dosing. The additional energy in the higher exhaust gas temperature appears lost with the exhaust gasses.

When it is considered that the increased temperature is lost energy, this has to be related to the mass flow of exhaust gas. The below table are assumed values of increased energy lost in heat per power range;

Table 4: potential recoverable energy in heat

	25%	50%	75%	100%
volume flow exhaust gas (m3/min)	66.3	141.8	219.2	258.4
Delta T (degC)	1	1	1	1
Thermal energy (kJ)	1.109	2.373	3.668	4.324

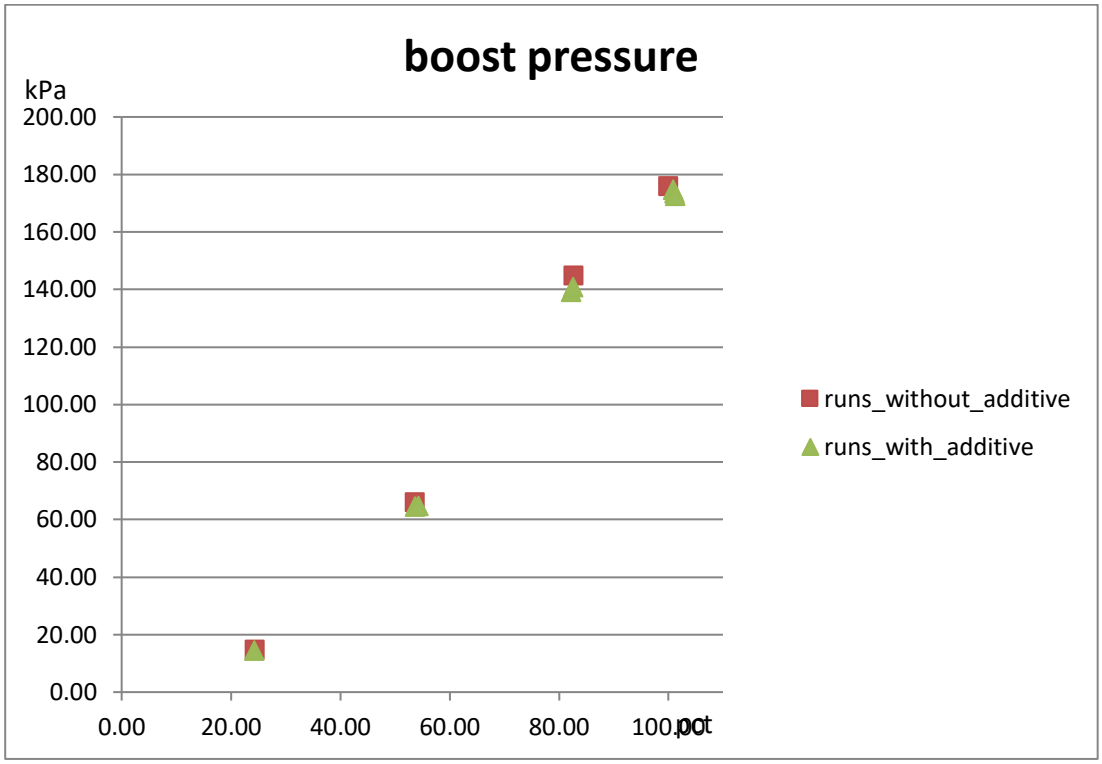


Figure 6: boost air pressure over percentage of power

To convert the thermal energy into mechanical power and increase the engine's efficiency requires modification of either engine's construction (timing / shape of camshaft, turbine nozzle ring) or software (injection timing). The latter seems the most efficient and should be discussed with the engine manufacturer.

4.2.3 Ambient temperature differences

Despite being controlled the ambient temperature of the test-room was found hard to control and varied slightly. The radiated heat from the engine was noticeable increased. However this was not measured and cannot be quantified.
The effect of slight differences in chamber temperature and pressure on combustion air was corrected in the SFOC figures and can be neglected.

4.3 Emission differences

Emissions were measured and reported by SGS independently from the measurements by MARIN and Pon Power but in the same runs. SGS report is attached as appendix D.

4.3.1 HC

In the runs with additives the measured number of HC's reduced, particularly in the 75% range. SGS reported a reduction up to 31.6%. A decreased count of HC indicates on a more complete, improved, combustion of fuel. The increased amount of HC in the runs with a triple dosage of additive supports our assumption that the combustion is prolonged and lasts beyond the opening of the exhaust valves. The fouling of the injectors could therefore be entirely caused by these runs.

4.3.2 CO

Measured reductions remained within the accuracy of the measurements. A reduction was noticed however up to 17,8%.

4.3.3 CO2

Measured reductions remained within the accuracy of the measurements and therefore considered as not significant.

4.3.4 NOx

Measured reductions remained within the accuracy of the measurements, however reaching up to 20%. The run with a double dosage of additive revealed a reduction considered as significant.

4.3.5 SOx

SGS did measure, but did not report on SOx. Despite that the fuel did not contain sulphur, Sox was measured upon request of the customer. The measured amount of Sox raised with the increased dosage of additive, a little bit from 0.0015 to 0.0016%. It is assumed the additive contains some sulphur components. The fuel analyses support same (see appendix 2).

5 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions summarise the findings of the present project:

- There is a reduced consumption in the lower power ranges.
- In all power ranges increased temperatures of the exhaust gasses were measured, whilst remaining engine's operating temperatures remain alike. The scavenging air pressure remained the same and the scavenging air temperature was steadily controlled, so the conditions in the combustion chamber were similar. The temperature increase on the exhaust gasses can hence only be an effect from a change in the combustion process. This indicates towards an improved but also prolonged combustion. The reduction of HC's indicates the same.
- The above could only have been verified with combustion chamber pressure measurements, however this is not possible on the used type of engine. In future tests combustion pressure measurements are highly recommended.
- The use of the additive causes temperatures to increase but does not affect the power produced by internal combustion to the expected extend. Some energy is lost by radiation-heat and was not measured. Exhaust gas temperatures rose as well and were quantified. The most significant difference in temperature is found at 50% power range, where an average temperature difference of 8 degrees represents a loss of energy of 18kW based on the protocol mass flow of exhaust gasses at this power range.
- The engine seems not to have enough time to convert this energy into mechanical power because of the opening of the exhaust valves. The potential power increase can be converted into shaft power by changing timing of the engine's injection or valve-opening or turbine efficiency. With such adjustment, when technically possible, X-Fuel may perform ultimately on improving the combustion resulting on a more significant reduction of fuel consumption and emissions. This is to the engine's manufacturer to consider and explore.
- The consumed fuel was a higher quality than common marine grade diesel fuels. Combustion improvement by X-fuel on a lower grade of fuel is expected to be higher.
- Overdosing with X-fuel did not damage engine components. Upon inspection and lubricant analyses after the full range of the test no remarks were made apart from the wet injectors.
- Caloric values of the fuel used did not increase after adding X-Fuel (see appendix).

Wageningen, May 2017 MARITIME RESEARCH INSTITUTE NETHERLANDS

Ir. H.J.J. van den Boom Manager Trials and Monitoring

EZMO-2017-03-00029

APPENDIX 2: ANALYSIS CERTIFICATES

SGS NEDERLAND B.V.
ENVIRONMENT, HEALTH AND SAFETY
Postbus 5252
6802 EG Arnhem

ANALYTICAL REPORT SR-6136.01.A02 P.1/2

grade	DIESEL
reference no.	EZMO-2017-03-00029
sample 001	Sample received from client Sample packed in plastic, quantity approx. 0.25L Sample marked as Diesel (DMO) Pon Power 18.04.2017
sample 002	Sample received from client Sample packed in plastic, quantity approx. 0.25L Sample marked as DMO+Fuel 19.04.2017
sample 003	Sample received from client Sample packed in plastic, quantity approx. 0.25L Sample marked as Ecomanda DMO+Fuel(1:4000) 21.04.2017
date received	03.05.2017

	001	002	003
Q Calorific value, gross, MJ/kg (ASTM D 240)	45.665	45.590	45.500
Calorific value, nett, MJ/kg (ASTM D 240)	42.780	42.725	42.615
Q Carbon, % wt (ASTM D 5291)	85.5	86.2	86.5
Q Hydrogen, % wt (ASTM D 5291)	13.6	13.5	13.6
Nitrogen, % wt (ASTM D 5291)	<0.75	<0.75	<0.75
Sulphur, % wt (ASTM D 2622)	0.0015	0.0016	0.0016

EZMO-2017-03-00029

SGS

SGS

ANALYTICAL REPORT SR-6136.01.A02 P. 2/2

	001	002	003
Oxygen (calculated by difference), % wt (SGS SPI 398)	<1.0	<1.0	<1.0
Density at 15°C, kg/L (ASTM D 4052)	0.8316	0.8316	0.8316

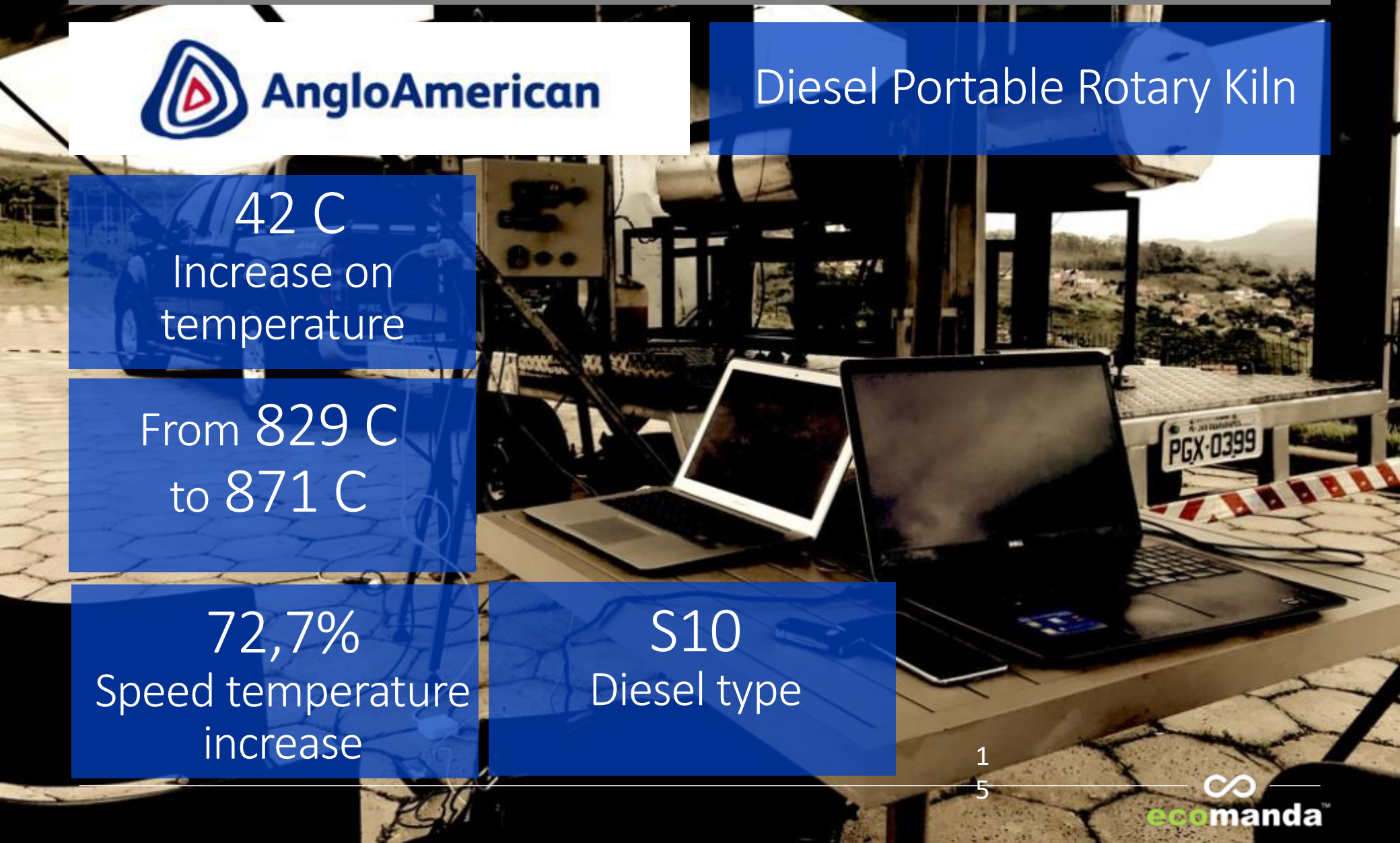
[Q] Tests marked with Q are performed under RvA ISO 17025 Accreditation (L092)

End of analytical results

Spijkenisse, the 9th May 2017
SGS Nederland B.V. - Oil, Gas and Chemicals

M. Audier
Laboratory Manager

2017 Verified X-Fuel Demonstration



AngloAmerican

Diesel Portable Rotary Kiln

42 C
Increase on temperature

From **829 C** to **871 C**

72,7%
Speed temperature increase

S10
Diesel type

ecomanda™

RELATORIO DE TESTE : ANGLO AMERICAN

1 - INTRODUÇÃO :

Nos dias **14/12/17 e 15/12/17** foram realizados testes SEM e COM aditivo **X-Fuel Energizer**, consecutivamente, em forno demonstrativo portatil, para a empresa **ANGLO AMERICAN**, localizada no município de Conceição do Mato Dentro MG, Brasil. Aditivo o qual potencializa combustíveis líquido fósseis otimizando a energia gerada na combustão e conseqüentemente reduzindo o consumo. Fabricado pela empresa Ecomanda AG, sediada na cidade de Zug, Suiça. Teste conduzido por **José Maria do Carmo Correa**, Consultor técnico **Ecomanda AG**, acompanhado pelos Engenheiros **Sr. César Cristovam de Oliveira e o Sr. Rodrigo Vaz,** ambos do corpo de engenharia **ANGLO AMERICAN.**

2 - OBJETIVO :

Comprovar a eficiência do Aditivo **X - Fuel Energizer** aditivado no óleo diesel no 2º TESTE, registrando a melhor otimização da chama nos termopares 1, 2 e 3 em comparação com o combustível comum do 1º TESTE, SEM a adição do aditivo .

3 - EQUIPAMENTO :

Utilizado forno rotativo piloto de demonstração, montado sobre um trailer com as seguintes características; (Fig.1)

3.1 - Trailer com 3 m de comprimento por 2 m de altura com abertura nas laterais e eixo duplo.

3.2 - Comprimento do forno de 2.0 m, diâmetro interno 0,25 m e revestimento interno e externo com manta de fibra cerâmica, com capacidade de trabalho até 1315° C. Janela de visita frontal e chaminé com abertura fixa da válvula.

3.3 - Forno equipado com 3 termopares tipo k mineral de até 1250°C e sistema supervisorio de monitoramento e registro.

3.4 - Queimador Ecoflam max 8, monobloco equipado com bomba de combustível, exaustor centrifugo, sistema de ignição e BCU - programador de chama. (características tecnicas fig.2)

3.5 - Tanque de combustível com capacidade para 40 litros, equipado com sistema de aquecimento fixado sobre uma balança eletrônica com capacidade para 300 kg, com selo e lacre do **inmetro**. Toda massa de combustível consumida no forno é mensurada.

Fig.1 Fig.2

4 - PROCEDIMENTO DO TESTE

4-1 O primeiro teste foi realizado por 2 horas corridas no dia 14/12/17 de 13:30 às 15:30 horas, sem interrupção, SEM a adição do aditivo X-Fuel Energizer, onde foi monitorado e registrado elevação de temperatura nos três termopares, 1, 2 e 3 e consumo de combustível, medindo a massa em balança eletronica.

4-2 O segundo teste foi realizado também por 2 horas corridas no dia 15/12/17 de 09:55 às 11:55 horas, sem interrupção COM adição do aditivo X-fuel Energizer, na proporção de 1 litro para 10.000 litros de óleo diesel. Para o volume utilizado de 6,5 litros de diesel no teste foi adicionado ~0,65 ml de X- Fuel Energizer e monitorado elevação de temperaturas nos mesmos termopares e consumo de combustível pelo mesmo período de 2 horas corridas, sem interrupção.

4-3 Os ajustes dos parâmetros de chama no queimador, balança e forno foram iguais nos dois testes.

4-3-1 Bico atomizador do queimador ; 0.4 gph, ângulo de 60° e 4,5 head fuel

4-3-2 Vazão de ar ; 1.0 cm de abertura na sucção do exaustor centrifugo

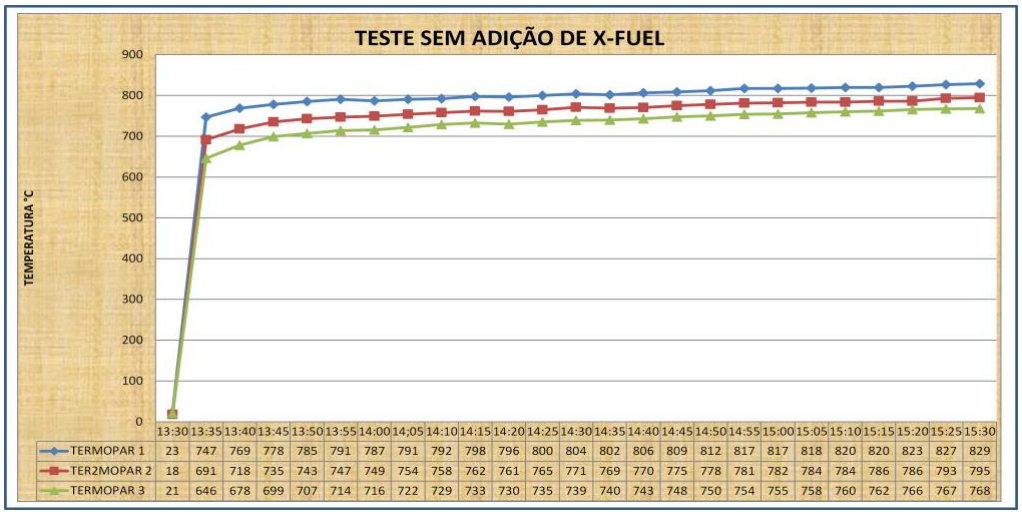
4-3-3 O testes iniciaram com os três termopares do forno a partir da temperatura ambiente, obedecendo período de clima semelhantes (dia).

4-3-4 Os valores de temperaturas e massa de combustível foram registrados através do supervisorio e lançados e visualizados em graficos e planilha padrão.

4-3-5 Óleo diesel S10, de mesmo lote, utilizado nos dois testes.

5 - ANÁLISE DOS RESULTADOS

5-1 Planilhas e gráficos de controle e registro; **SEM ADIÇÃO DE X-FUEL ENERGIZER**

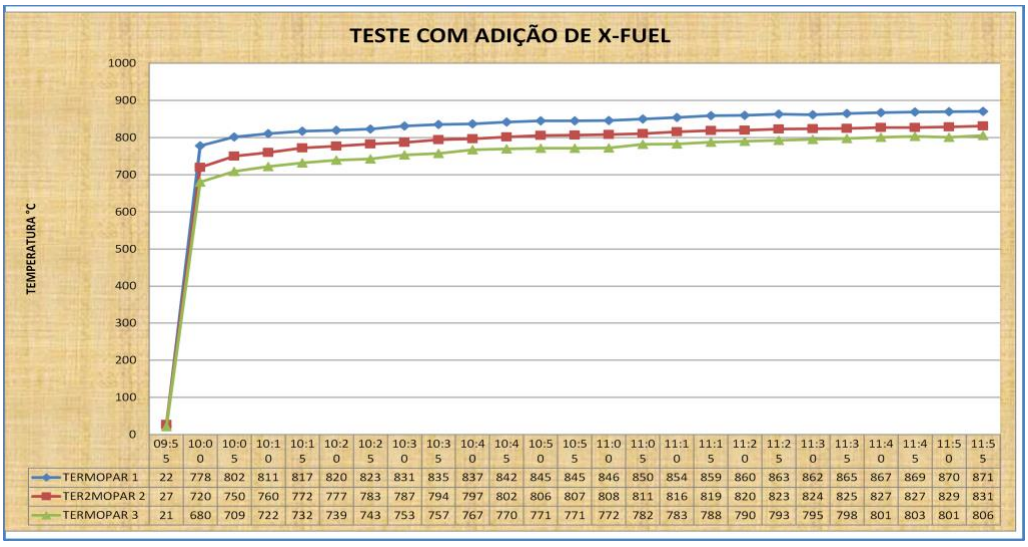


	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10	14:15	14:20	14:25	14:30	14:35	14:40	14:45	14:50	14:55	15:00	15:05	15:10	15:15	15:20	15:25	15:30
TERMOPAR 1	23	747	769	778	785	791	787	791	792	798	796	800	804	802	806	809	812	817	817	818	820	820	823	827	829
TER2MOPAR 2	18	691	718	735	743	747	749	754	758	762	761	765	771	769	770	775	778	781	782	784	784	786	786	793	795
TERMOPAR 3	21	646	678	699	707	714	716	722	729	733	730	735	739	740	743	748	750	754	755	758	760	762	766	767	768

ecomanda AG

TESTE DEMONSTRAÇÃO - FORNO CALCINADOR											
TESTE	FORNO REDUZIDO SEM GIRO										
1	AJUSTE QUEIMADOR DIESEL (Ecofiam max 8)						BICO ATOMIZADOR (Steiner)				
	FUEL	HEAD 4.5		AIR	1.0		ÂNGULO	60°H	VAZÃO	0.4 gph	
	COMBUSTÍVEL			ÓLEO DIESEL S10							
DATA	14/12/2017			ANGLO AMERICAN							
	TERMOPARES °C						BALANÇA (Kg) FUEL		X-FUEL		
	LEITURA			DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA	SIM	NÃO	
HORA	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3					
13:30	23	18	21				6,200			X	
13:35	747	691	646	724	673	625	5,950	0,250		X	
13:40	769	718	678	22	27	32	5,800	0,150		X	
13:45	778	735	699	9	17	21	5,600	0,200		X	
13:50	785	743	707	7	8	8	5,400	0,200		X	
13:55	791	747	714	6	4	7	5,200	0,200		X	
14:00	787	749	716	-4	2	2	5,050	0,150		X	
14;05	791	754	722	4	5	6	4,900	0,150		X	
14:10	792	758	729	1	4	7	4,700	0,200		X	
14:15	798	762	733	6	4	4	4,500	0,200		X	
14:20	796	761	730	-2	-1	-3	4,400	0,100		X	
14:25	800	765	735	4	4	5	4,250	0,150		X	
14:30	804	771	739	4	6	4	4,050	0,200		X	
14:35	802	769	740	-2	-2	1	3,900	0,150		X	
14:40	806	770	743	4	1	3	3,800	0,100		X	
14:45	809	775	748	3	5	5	3,600	0,200		X	
14:50	812	778	750	3	3	2	3,500	0,100		X	
14:55	817	781	754	5	3	4	3,350	0,150		X	
15:00	817	782	755	0	1	1	3,200	0,15 0		X	
15:05	818	784	758	1	2	3	3,050	0,150		X	
15:10	820	784	760	2	0	2	2,900	0,150		X	
15:15	820	786	762	0	2	2	2,750	0,150		X	
15:20	823	786	766	3	0	4	2,600	0,150		X	
15:25	827	793	767	4	7	1	2,450	0,150		X	
15:30	829	795	768	2	2	1	2,300	0,150		X	
										X	
										X	
TEMPO TOTAL								CONSUMO TOTAL	CONSUMO EM Lts		
02:00								3,900	2,150		

5-2 Planilhas e gráficos de controle e registro; **<u>COM ADIÇÃO DE X-FUEL ENERGIZER</u>**



	09:55	10:00	10:05	10:10	10:15	10:20	10:25	10:30	10:35	10:40	10:45	10:50	10:55	11:00	11:05	11:10	11:15	11:20	11:25	11:30	11:35	11:40	11:45	11:50	11:55
TERMOPAR 1	22	778	802	811	817	820	823	831	835	837	842	845	845	846	850	854	859	860	863	862	865	867	869	870	871
TER2MOPAR 2	27	720	750	760	772	777	783	787	794	797	802	806	807	808	811	816	819	820	823	824	825	827	827	829	831
TERMOPAR 3	21	680	709	722	732	739	743	753	757	767	770	771	771	772	782	783	788	790	793	795	798	801	803	801	806

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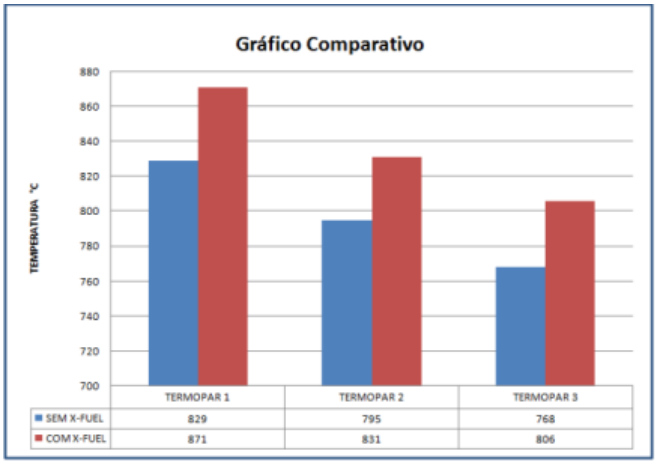
TESTE DEMONSTRAÇÃO - FORNO CALCINADOR										
TESTE	FORNO REDUZIDO SEM GIRO									
2	AJUSTE QUEIMADOR DIESEL (Ecoflam max 8)						BICO ATOMIZADOR (Steiner)			
	FUEL	HEAD 4.5		AIR	1.0		ÂNGULO	60°H	VAZÃO	0.4 gph
	COMBUSTÍVEL									
DATA	15/12/2017			ANGLO AMERICAN						
TERMOPARES °C							BALANÇA (Kg) FUEL		X-FUEL	
LEITURA				DIFERENÇA DE TEMPERATURA ENTRE INTERVALOS DE LEITURA			VOLUME INICIAL	CONSUMO POR INTERVALO DE LEITURA	SIM	NÃO
HORA	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3				
09:55	22	27	21				6,500		X	
10:00	778	720	680	756	693	659	6,300	0,200	X	
10:05	802	750	709	24	30	29	6,150	0,150	X	
10:10	811	760	722	9	10	13	5,950	0,200	X	
10:15	817	772	732	6	12	10	5,700	0,250	X	
10:20	820	777	739	3	5	7	5,500	0,200	X	
10:25	823	783	743	3	6	4	5,400	0,100	X	
10:30	831	787	753	8	4	10	5,200	0,200	X	
10:35	835	794	757	4	7	4	5,050	0,150	X	
10:40	837	797	767	2	3	10	4,850	0,200	X	
10:45	842	802	770	5	5	3	4,700	0,150	X	
10:50	845	806	771	3	4	1	4,500	0,200	X	
10:55	845	807	771	0	1	0	4,300	0,200	X	
11:00	846	808	772	1	1	1	4,200	0,100	X	
11:05	850	811	782	4	3	10	4,050	0,150	X	
11:10	854	816	783	4	5	1	3,900	0,150	X	
11:15	859	819	788	5	3	5	3,700	0,200	X	
11:20	860	820	790	1	1	2	3,550	0,150	X	
11:25	863	823	793	3	3	3	3,350	0,200	X	
11:30	862	824	795	-1	1	2	3,200	0,150	X	
11:35	865	825	798	3	1	3	3,050	0,150	X	
11:40	867	827	801	2	2	3	2,850	0,200	X	
11:45	869	827	803	2	0	2	2,700	0,150	X	
11:50	870	829	801	1	2	-2	2,550	0,150	X	
11:55	871	831	806	1	2	5	2,450	0,100	X	
									X	
									X	
TEMPO TOTAL								CONSUMO TOTAL	CONSUMO EM Lts	
02:00								4,050	2,200	

5-2 Quadro comparativo com gráficos das temperaturas nos termopares 1, 2 e 3 ao final de 2 horas de teste.



	TERMOPAR 1	TERMOPAR 2	TERMOPAR 3
% EFICIÊNCIA NA CHAMA	5,06%	4,53%	4,95%

6 - CONSIDERAÇÕES FINAIS :

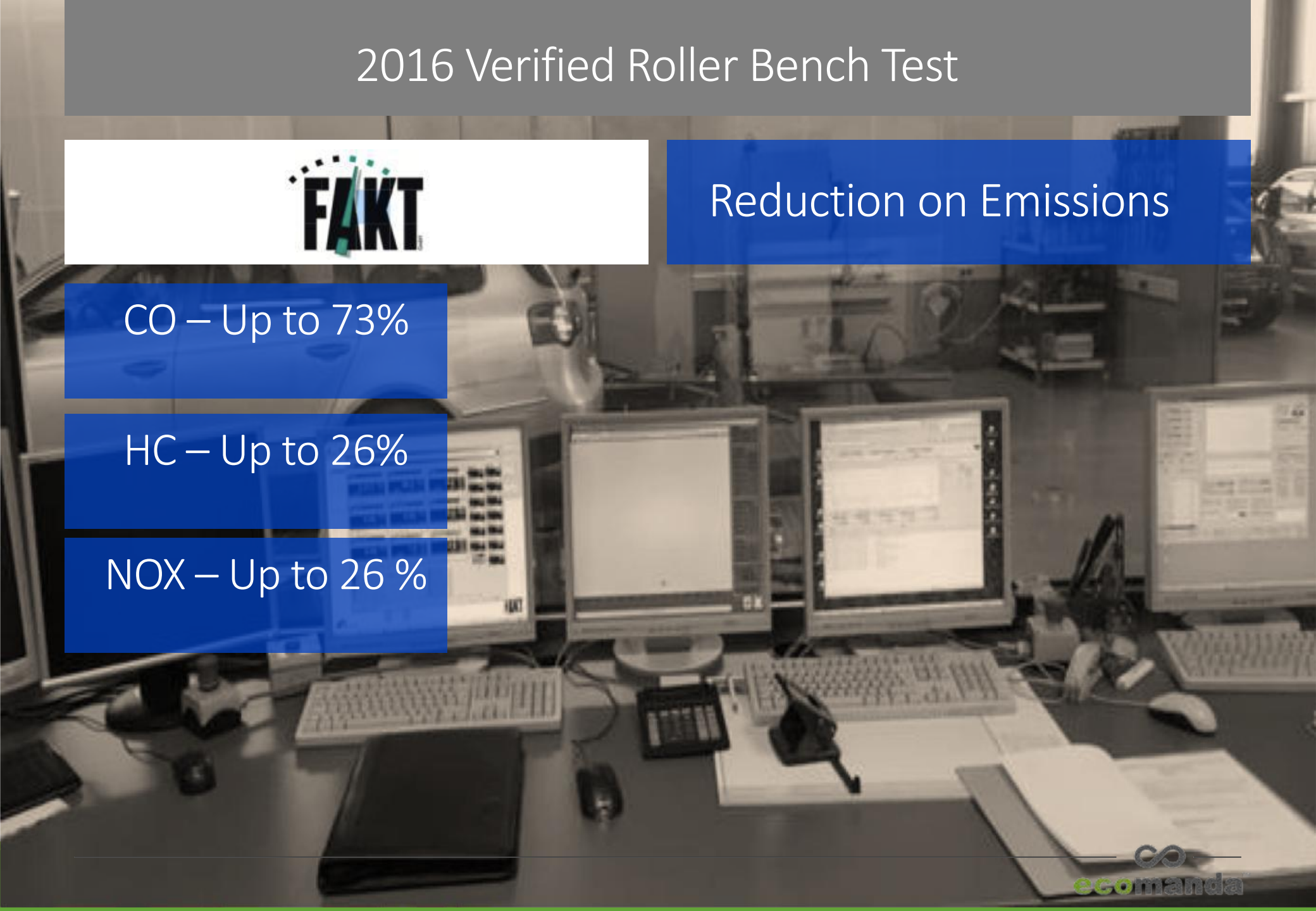
De acordo com os gráficos houve diferença na chama nos três termopares comparando os dois testes. X-Fuel Energizer proporciona uma otimização da chama e conseqüentemente maior irradiação de calor dentro do forno. O teste mostrou no final um consumo total de combustível 3,9 kg para o teste 1 (SEM aditivo) e 4,05 kg para o teste 2 (COM X-Fuel), consumo muito semelhante nos dois testes. Para aplicação do **X-FUEL Energizer** em processos onde há uma automação nos controles de vazão e temperatura, a redução de consumo de combustível acontece mantendo as temperaturas de trabalho. Pois, com o aditivo ocorre tendência maior no aumento de energia durante a combustão fazendo com que os controladores atuem na redução de vazão de combustível.

.

José Maria do C. Corrêa

ecomanda AG, CH-6300 Zug, Switzerland
jm.correa@ecomanda.ch
T: +41 41 740 20 50 M: +55 81 9 98982211

2016 Verified Roller Bench Test



FAKT

Reduction on Emissions

- CO – Up to 73%
- HC – Up to 26%
- NOX – Up to 26 %

ecomanda

FAKT roller test bench

Test cycle: EPA US06 (about 13 km)

Test vehicle: VW Golf Diesel Euro 3;181 000 km 27/01/2016

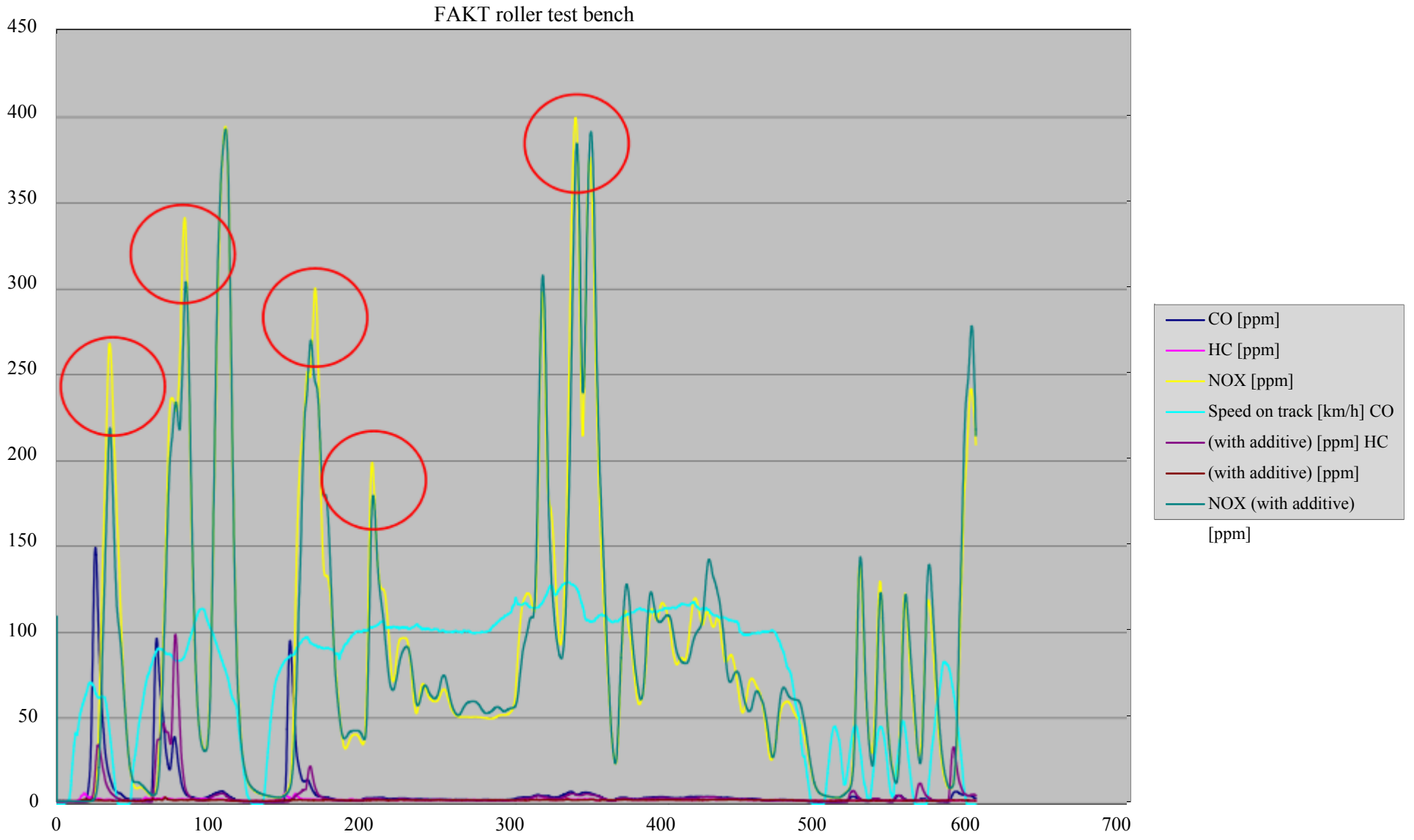
Test results

Track Type	Average Speed	CO [ppm]	HC [ppm]	NO [ppm]
City / without X-Fuel-E.	42,5 km/h	27,71111253	2,86218774	69,28094652
City / with X-Fuel-E.		7,58499109	2,11778468	50,97227827
Emission variation:		-20.126 -73 %	-0,744 -26 %	-18,309 -26 %
Slowdown / without X-Fuel-E	0 km/h	4,545775	2,146565278	76,49847222
Slowdown / with X-Fuel-E		2,262699	2,003761111	66,15244444
Emission variation:		-2,283 -50 %	-0,143 -7 %	-10,346 -14 %
Interurban / without X-Fuel-E	76.66 km/h	13,2433816	2,6945166	130,291942
Interurban / with X-Fuel-E		13,7028076	2,3027597	125,455966
Emission variation:		0,459 3 %	-0,392 -15 %	-4,836 -4 %
Slowdown / without X-Fuel-E.	0 km/h	1,540821429	1,860935714	6,82265
Slowdown / with X-Fuel-E.		1,242108571	1,894374286	7,23063
Emission variation:		-0,299 -19 %	0,033 2 %	0,408 6 %
Motorway / without X-Fuel-E	100,91 km/h	4,887206508	2,612761229	99,11465408
Motorway / with X-Fuel-E		3,245606173	2,353601089	98,51109413
Emission variation:		-1,642 -34 %	-0,259 -10 %	-0,604 -1 %

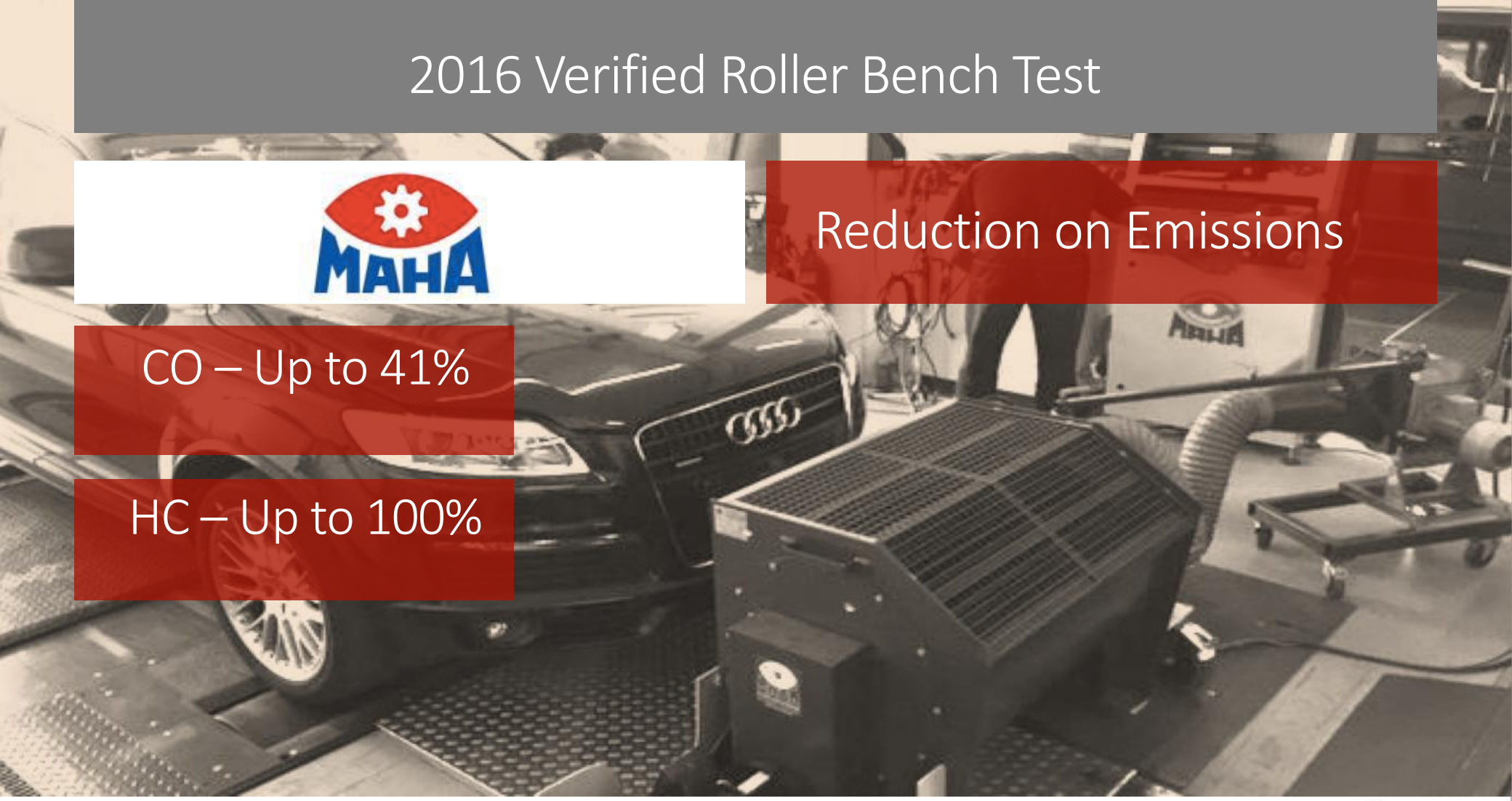
Comments:

Excerpt of the test report on the rotation frequency within the city, the country side and on a motorway.

Track of about 5 km (see diagram)


FAKT roller test bench
450
400
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
700
CO [ppm]
HC [ppm]
NOX [ppm]
Speed on track [km/h] CO
(with additive) [ppm] HC
(with additive) [ppm]
NOX (with additive)
[ppm]

2016 Verified Roller Bench Test

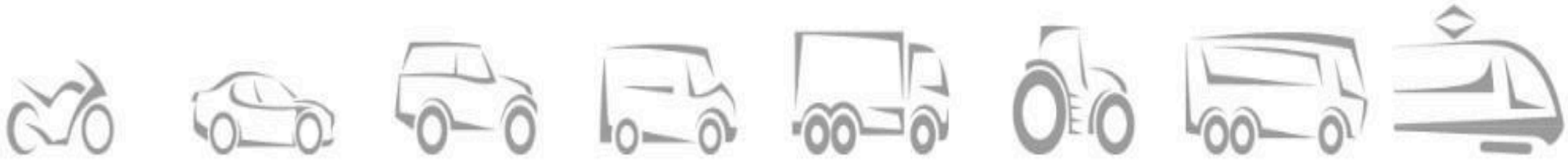


MAHA

Reduction on Emissions

CO – Up to 41%

HC – Up to 100%



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MAHA roller test bench

Test cycle: EPA US06 (about 13 km)

Type of vehicle AUDI Q7 4.2 l

12/11/2015

Test results

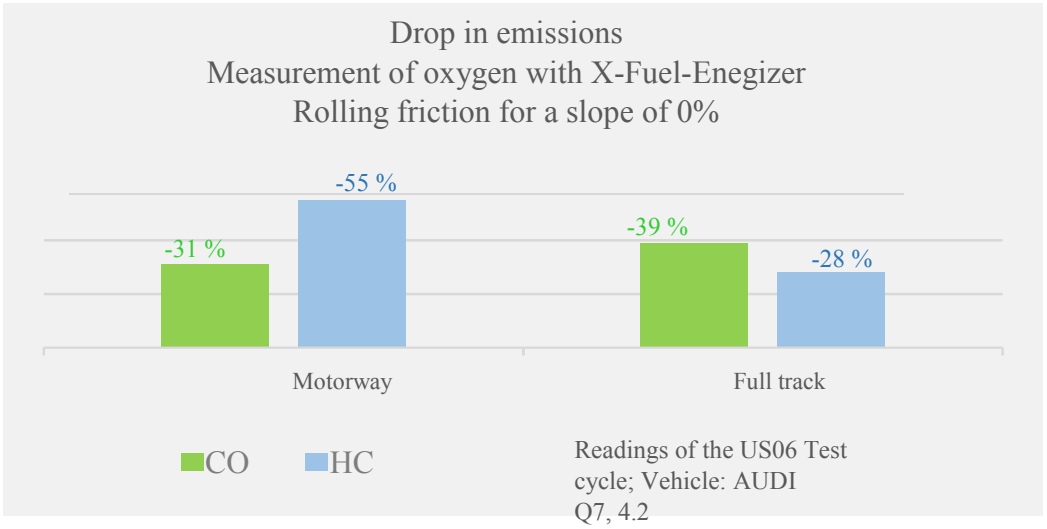
Rolling friction for a slope of 0%

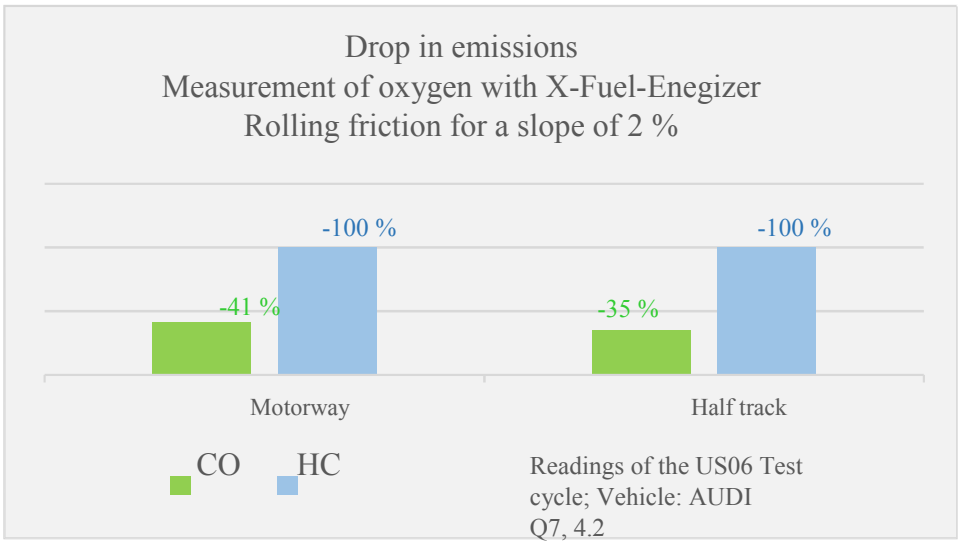
Track	Measurement value-/ Data		Speed Average		
Half track		v	ch (> 0)	CO	HC
Motorway up to 129 km/h max.	3 587	100,556	16,350	0.045	0.127
Motorway 129 km/h max.	3 594	100,815	16,310	0.065	0.279
Difference				0.020	0.153
A drop of				31 %	55 %
Full track WITH X-Fuel-E.	6 300	73,377	14,497	0.031	0.160
Full track WITHOUT X-Fuel-E.	6 270	74,130	14,820	0.050	0.223
Difference				0.019	0.062
A drop of				39 %	28 %

Test results

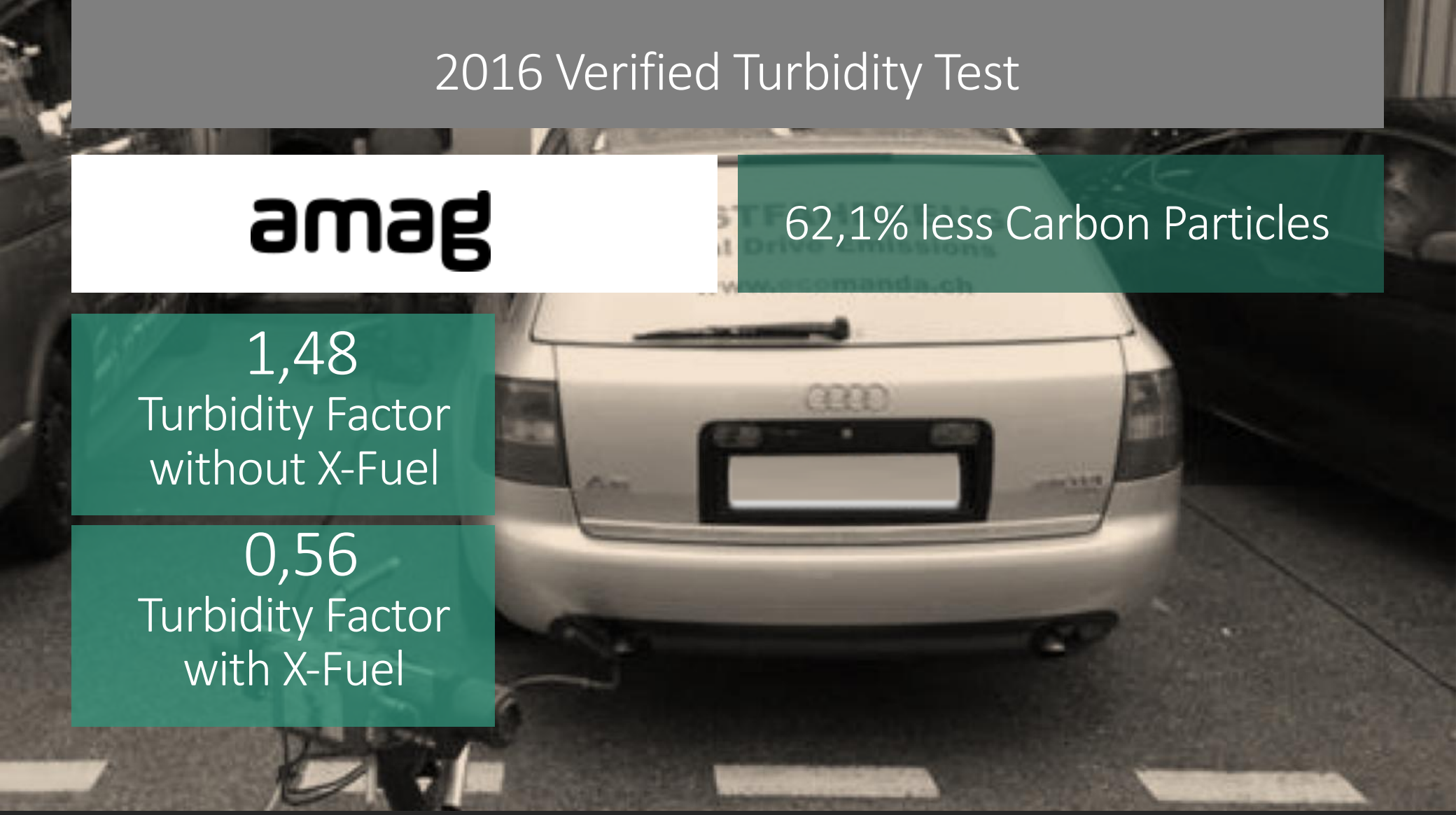
Rolling friction for a slope of 2 %

Track	Measurement value-/ Data		Speed Average		
Half track		v	ch (> 0)	CO	HC
Motorway up to 130 km/h max.	3 587	102,205	17,310	0.053	0.000
Motorway 130 km/h max.	3 594	101,148	23,864	0.089	4.377
Difference				0.036	4.377
A drop of				41 %	100
Full track WITH X-Fuel-E.	7 012	66,811	13,592	0.039	0.000
Full track WITHOUT X-Fuel-E	6 152	75,399	19,382	0.060	4.819
Difference				0.021	4.819
A drop of				35 %	100


Drop in emissions
Measurement of oxygen with X-Fuel-Enegizer
Rolling friction for a slope of 0%
-55 %
-31 %
-39 %
-28 %
Motorway
Full track
CO
HC
Readings of the US06 Test cycle; Vehicle: AUDI Q7, 4.2


Drop in emissions
Measurement of oxygen with X-Fuel-Enegizer
Rolling friction for a slope of 2 %
-100 %
-100 %
-41 %
-35 %
Motorway
Half track
CO
HC
Readings of the US06 Test cycle; Vehicle: AUDI Q7, 4.2

2016 Verified Turbidity Test



amag

62,1% less Carbon Particles

1,48
Turbidity Factor
without X-Fuel

0,56
Turbidity Factor
with X-Fuel

Volkswagen Audi SEAT ŠKODA BENTLEY PORSCHE Nutzfahrzeuge

ecomanda™

amag

AMAG, Alte Steinhauserstrasse 1, 6330 Cham

ecomanda AG
Chamerstrasse 172
6300 Zug

Datum Cham, 14. September 2016

Betreff **Confirmation emission tests on AUDI A6 Diesel, chassis no WAUZZZ4B94N027670**

Sehr geehrte Damen und Herren

AMAG Zug

AMAG Automobil- und Motoren AG
Kundendienst Audi
Marcel Da Silva
Alte Steinhauserstrasse 1
6330 Cham
Telefon +41 41 748 67 76

On behalf of Mr. Foerg of ecomanda AG we have made a technical alteration on your testing car AUDI A6 Diesel (chassis no WAUZZZ4B94N027670) on 16th of august 2016. In this task a separation valve has been fixed on the exhaust manifold and in front of the catalyst converters. Thus the emission test can be effected and protocolled on the raw emissions.

On august 18th 2016 we have then made several emission tests about the turbidity factor (carbon particles) of the raw emissions on the exhaust manifold. The four test results recorded an average turbidity factor of 1.48.

On august 30th 2016 we have made further emission tests, similar to the ones of august 18th 2016, but having added your product X-Fuel Energizer into the fuel tank before.
The following four tests showed on their printout an average turbidity factor of 0.56, that represents a reduction of the carbon particles of 62.1%.

Best regards,

Marcel Da Silva
Maintenance Consultant

2015 Verified Bench Test

TÜVRheinland®

Diesel Car Engine

73,6%
reduction on
CO emission

34,5%
reduction on
HC emissions

80,4%
reduction on
CH4 emissions

ecomanda™

Date : 14/09/2015 1:11 p.m. Page 1 of 1

Class: AUTOMOBILE VEHICLE 01
Model: UNIQUE 0200

Manufacturer DAIMLER-BENZ 0709
Type : 123 D 303057
Option / Version / Design: C

Emission Code: WDB1231231C CLASSIC CARS 0098
1915
ID No.: AUGUST *1982/18513*
Fz: *0*
P.T.A.C:
Eff./km:

Exhaust emissions 105021

Results:
Compliant

Dear customers,

The exhaust emission of your vehicle is currently compliant with existing Standards.

Your advisor, Mr Kern

Thank you for your contribution and drive safely. TÜV's website: www.tuev-sued.de

Test Certificate
On emission testing

N°.5430374415

TUV SUD Auto Service GmbH Lahr

14/09/2015

Reg.: OG-JK828

Manufacturer: DAIMLER-BENZ 0709
Type: 303057
ID No.: WDB1231231 Km.: 185130
0 3 5 9 5 7 2

Diesel engine vehicle

Reg. -Measurement	Min.	Max.	Actual Val.	Results:
Slowdown (*1/min):*	650	850	704	i.O.
Idle *(1/min):*	4 700	5 300	4 913	i.O.

Sensor: 1
Mode: B

Free acceleration		1st Meas.	2nd Meas.	3rd Meas.
Idle	*(1/min) :*	4,827	5070	5,070
Haze value	*(1/m) :*	1,54	1,64	1,59
Time Used	(s) :	135	0.69	0.63

Comments:

Result of measurement	Max	Actual Val	Result
Average turbidity (*1/m):*	2,80	1,59	
Width of the turbidity band *(1/m):*	0,5	0,10	i.O.
Measuring time tx (s):	1,0		LO.

Final result:

Test passed

(Kern)

TÜV®

Date :	14/09/2015 3: 37	Page 1 of 1
Class:	AUTOMOBILE VEHICLE	01
Model:	UNIQUE	0200
Manufacturer	DAIMLER-BENZ	0709
Type :	123 D	303057
Option / Version / Design:		C
Emission	CLASSIC CARS	0098
Code: ID No.:	VVDB12312310359572	
Fz:	1915	
PTAC:	AUGUST *1982/1851*	
Eff/km:	*39*	

Exhaust Emissions

105021

Results:
Compliant

Dear customers,

Kunde,

The exhaust emission of your vehicle is currently compliant with existing Standards.

Your advisor, Mr Kern

Thank you for your contribution and drive safely. TÜV's website: www.tuev-sued.de

Test Certificate

On Emission testing

No. 5430374434

TUV SUD Auto Service GmbH Lahr

14/09/2015

Reg.: OG-JK828H

Manufacturer: DAIMLER-BENZ 0709
Type: 303057
ID No.: WDB1231231 0 3 5 9 5 7 2 Km.: 185139

Diesel engine vehicle

Comments:

Reg.-Measurement	Min.	Max.	Actual Value	Results
Slowdown (1/min):	650	850	700	i.O.
Idle (1/min):	4 700	5 300	5 087	I.O.

Free acceleration		1st Meas.	2nd Meas.	3rd Meas.	Sensor :1
Idle	(1/min) :	5,060	4959	4978	Mode: B
Haze value	*(1/m) :*	0.90	1.02	1.05	
Time Used	(s) :	0,59	0,86	0,60	

Results of measurements.	Max.	Actual Value	Results
Average turbidity *(1/m):*	*2,80*	*0,99*	i.O.
Width of the turbidity band *(1/m):*	*0,5*	*0,15*	i.O.
Measuring time (s):	1.0		

Final result:

Test passed

Ordered by: Terraclean AG / Switzerland

Results of the measurement of exhaust emissions in accordance

with Directive 70/220/EEC i.d.F. 98/69/B/EG

Carried out on: 28/09/2015

TÜV Rheinland Pfalz.

Vehicle: Hyundai i/30/CW 1.6 LTR 66 KW **First entry into the market: 02/2010**

Fuel: Diesel

KM: 158800

Roller test bench: Average values for 2 tests carried out on 11km each with and without additive

Test cycle: NEFZ

Mass Emission in g	City		Variation	Motorway		Variation
	Without	With Add.	With Add. in %	Without	With Add.	With Add. in%
CO	0,512	0,135	**-73,6**	0,108	0,091	**-15,7**
HC	0,165	0,108	**-34,5**	0,072	0,049	**-31,9**
NOx	1,286	1,335	+0,38	1,797	1,892	+5,3
CH4	0,102	0,020	**-80,4**	0,048	0,005	**-89,6**
CO2	636,683	645,944	+1,5	849,078	872,322	+2,7

2015 Verified Real Test Drive

AUTO KAISER ZUG
Mercedes-Benz

- 12,5% reduction on fuel consumption verified
- 100% less CO Emissions
- 66% less HC Emissions
- Better reaction to cold start
- Much more silent engine
- Greater dynamism on acceleration

ecomanda™

Mercedes-Benz

Auto Kaiser AG
Autorisierter Verkauf und Service
Mercedes-Benz Personenwagen,
Transporter und Jeep
Autorisierter Service Chrysler und Dodge

Ecomanda AG
Chamerstrasse 172
6300 Zug / Schweiz

Cham 15.01.2015

Re: Confirmation Emission Testing

Dear Mr Foerg

We can confirm, that we realised two emission testings (particle emission testing) on Wenesday 14th of January 2015 as requested on a Citroen C4 diesel engine, with number plate ZG 90U.

The first test was done at 10 am and gove a turbidity factor of 0.05, according to the electronic testing report. A second testing was made on 2 pm, with adding before your fuel additive X-Fule Energizer and showed the turbidity factor of 0.00, likewise according to the electronic testing report.

Thank you for your order

Mercedes-Benz
Auto Kaiser AG
Hinterbergstrasse 19-21
6330 Cham
Tel. 041 711 24 24
Auto Kaiser AG

Mercedes-Benz

Auto Kaiser AG
Mercedes Benz authorized dealer
Privately-owned vehicles
Mercedes-Benz authorized service
Privately-owned and light-duty vehicles

TERRACLEAN AG
Chamerstrasse 172
Train CH 6300

Confirming the measurement of exhaust emission requested on 31/07/2015

Sir/Madame,

By this letter, we are confirming your request of 31/07/2015 to compare the measurement of 2 exhaust emissions with/ without the use of additive fuel for Diesel engines. This is as follows:

Vehicle: Fiat Marea Baujahr 2001

Engine: 2.4 litres Turbo diesel

Chassis number: ZFH 18500000386398

Registration: LU 191138

Mileage: 291887

Comments: No particulate filters. Euroclass 02.

The measurement was conducted with a MAHA measurement equipment.

The pollution level is represented herein as the turbidity factor and has to do with the actual quantity of particulate emission from the exhaust gas system.

The 1st measurement (without additive) was conducted following the morning heating phase.

The 2nd measurement (when additives were added / quantity: 3 ml) in a fuel reservoir together with a later upgrade was equally carried out after the heating phase in the afternoon.

The following results were obtained:

1. During the 1st phase measurement without additive, the turbidity factors were subdivided for all the 6 measurement points, with an average value of 0.62.
2. During the 2nd phase measurement with additive, the turbidity factors were subdivided for all the 6 measurement points, with an average value of 0.32.

Hence, we can state that with the use of your additives, a drop in the pollution level of particulate emission, to the tune of 48.4% if compared to existing values, has been achieved.

Giving the age of the engine, void of particulate filters, the pollution factor is relatively higher, with a value of 0.62.

Thanks to the use of additives, the significant drop can therefore be considered as our extraordinary contribution to the protection of the environment, the aim being to improve on the protection of air and this tells of a highly efficient engine-technology.

Moreover, we wish you much success with your technology and are fully at your disposal, should you need advice.

Auto Kaiser AG
Hinterbergstrasse19-21
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Mercedes-Benz

Auto Kaiser AG
Autorisierter Verkauf und Service
Mercedes-Benz Personenwagen,
Transporter und Jeep
Autorisierter Service Chrysler und Dodge

Ecomanda AG
Chamerstrasse 172
6300 Zug / Schweiz

Cham 27.01.2015

Re.: Confirmation Emission Testing Range Rover Sport 4,4 V8 HSE

Dear Mr Foerg

We confirm, that we realised two emission testing on 23th of January 2015.

The car's data: Range Rover 4,4 lts petrol fuel engine, 8-cylinder, 300 HP, Euro 4.

The first test was done at 11 a.m., in no-load-operation with about 680 rpm and in partial-load operational range of 2'330 rpm.

The second test was done in the afternoon, 2 p.m. with same rpm-ranges and having added your additive X-Fuel Energizer into the fuel tank.

The electronic testing was done with a digital testing equipment of BOSCH.

The testing equipment show in their report a reduction of the emissions between the first test to the second test the results as following:

No-load-operation:

- CO testing: reduction from 0.008%vol to 0.003%vol = 62% less
- HC testing (hydrocarbon emission): reduction from 6.0 ppmvol to 0.0 ppmvol = 100% less
-

On partial-load operation:

- CO testing: reduction from 0.021%vol to 0.0%vol = 100% less
- HC testing: reduction from 6.0 ppmvol to 2.0 ppmvol = 66% less

Thank you for your order.

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Privately-owned and light-duty vehicles

Date: 25/1/2015

To
Terraclean AG
Chamerstrasse 172
CH-6300 Zug

Peugeot 306 GTi Test Drive

Sir/madame,

On your request, we have carried out road and usage test drives under real driving conditions on the Peugeot 306 GTi.

Here is the data on the vehicle:

Peugeot 306 GTi, registration: ZH 148457, 4-cylinder gasoline engine, 164 hp, KM: 125319

The test was conducted several times on the same track and under real driving conditions, with and without additive, the aim being to obtain representative values.

The results of all tests with additives show an average drop in consumption of 12.5%

In addition to this, we have recorded:

- a better reaction to cold start
- a much more silent engine
- a much greater dynamism on acceleration

Sincerely,

Andreas Herrmann
Customer Advisor

(Stamp/signature)

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