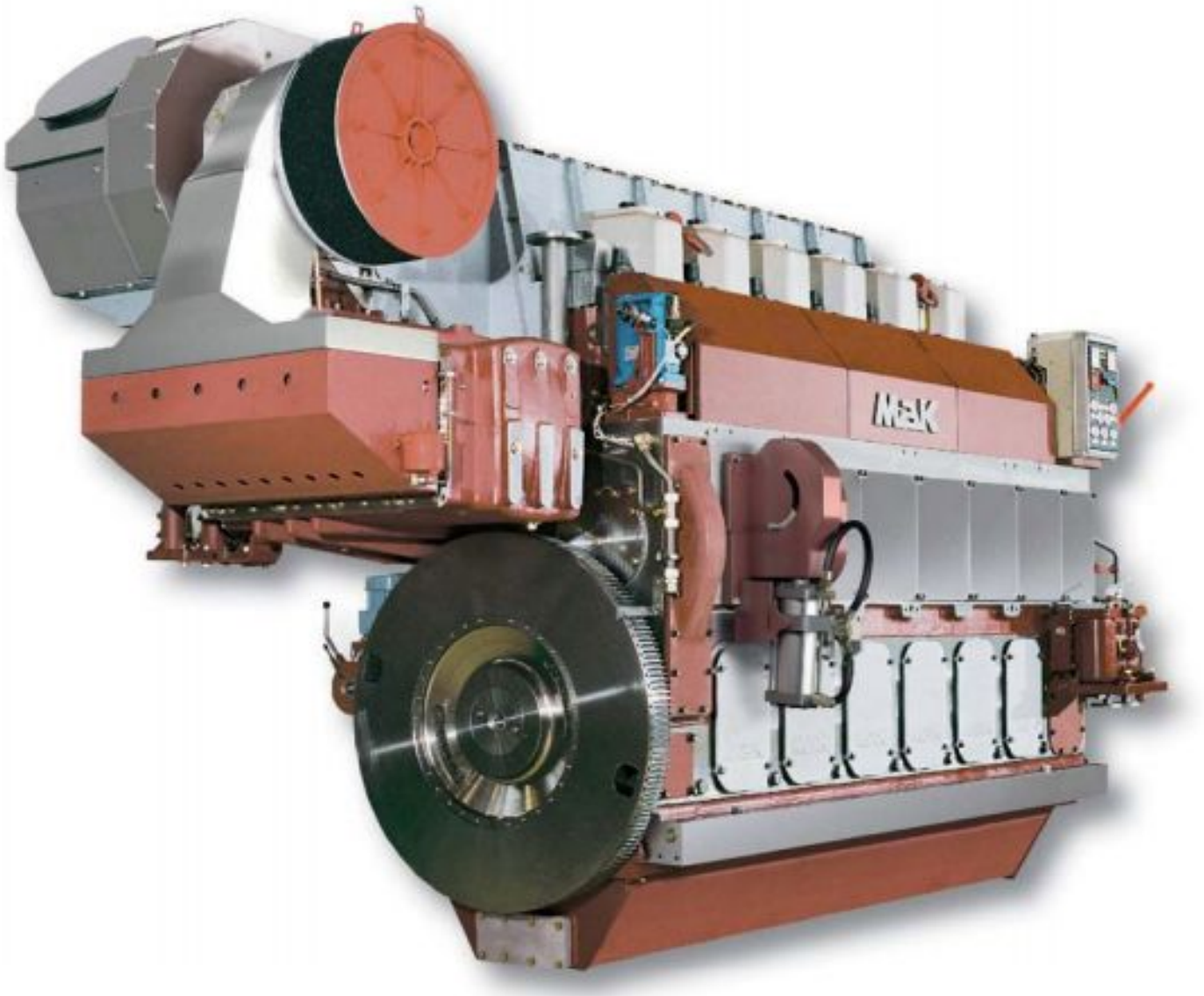
REPORT:
MaK CATERPILLAR



Summary

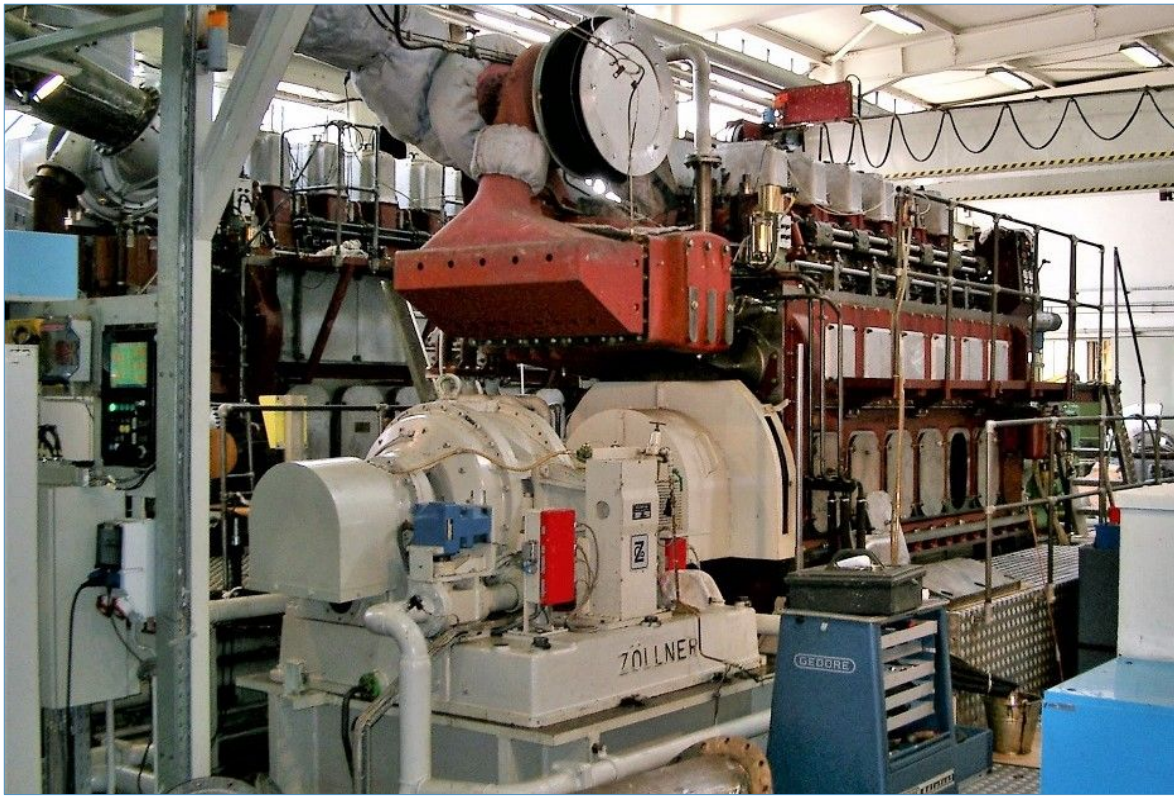
XBEE
ENZYME FUEL TECHNOLOGY

Context

In April 2003, at the request of **XBEE**, the company VISTO contacted the Research & Development department of the original equipment manufacturer Caterpillar Motoren GmbH & Co. KG in Kiel, Germany.

Malte Rautenstrauch, Senior Test Engineer of the laboratory, tested **XBEE Enzyme Fuel Technology** on their MaK 6M25 engine test bench.

This test took place in optimal conditions, namely a clean engine, excellent quality fuel and only 15 hours of operation.



Data

1 | Conditions of the evaluation

The tests were carried out in April 2003 on a medium speed MaK M25 test engine. It was powered by MDO and was tested as an ISO 3046 ship engine.

It should be noted that the gas emissions were measured in compliance with the ISO 8178 standard, thus making it possible to weigh the results according to specific test cycles.

ISO 8178 Test cycles						
Power	100%	75%	50%	35%	25%	10%
Kilo Watt (kW)	1,980	1,481	990	698	495	198
RPM	750	681	595	529	476	357
D2 Cycle weighing factors	0.05	0.25	0.30	-	0.30	0.10
E3 Cycle weighing factors	0.20	0.50	0.15	-	0.15	-

2 | Measured parameters

Caterpillar has measured several parameters:

- Power (kW and %)
- Speed (rpm)
- Specific fuel oil consumption - SFOC (g/kWh)
- Temperatures (°C)
- NO_x (ppm and g/kWh)
- CO (ppm)
- CO_2 (%)
- Particulate matter (PM)

Raw data analysis

Analysis of raw data provided by Caterpillar Research & Development Laboratory* already makes it possible to establish that **XBEE Enzyme Fuel Technology** pays for itself within only 15 hours of operation, whereas it significantly reduces toxic gas emissions.

Excerpts:

MaK 6M25 test engine						
Power	100%	75%	50%	35%	25%	10%
Kilo Watt (kW)	1,980	1,481	990	698	495	198
RPM	750	681	595	529	476	357
SFOC	-0.11	-0.22	-0.53	-0.10	-2.68	-1.38
NO_x	-15.09	-13.85	-16.00	-11.16	-10.98	-18.32
CO_2	-2.68	-5.95	-7.07	-5.01	-9.36	-4.44
PM	-38.89	-30.77	-20.00	-40.00	-33.33	-23.33

When calculating a regular average, we observe that the specific fuel oil consumption reduced by -0.87%, while CO_2 emissions decreased by -5.96%, NO_x emissions by -14.40%, and particulate matter by -30.77%.

**Original data provided by MaK Motoren GmbH are available in annexes.*

Weighed data analysis

Given the fact that the data have been measured in compliance with the ISO 8178 standard, we can apply weighing factors that allow us to refine our analysis:

Specific fuel oil consumption	
Flat average	-0.87%
Weighed according to D2 cycle	-1.16%
Weighed according to E3 cycle	-0.61%
CO_2 emissions	
Flat average	-5.96%
Weighed according to D2 cycle	-6.99%
Weighed according to E3 cycle	-5.98%
NO_x emissions	
Flat average	-14.40%
Weighed according to D2 cycle	-14.15%
Weighed according to E3 cycle	-13.99%
Emissions of particulate matter	
Flat average	-30.77%
Weighed according to D2 cycle	-27.97%
Weighed according to E3 cycle	-31.16%

Conclusions

Duration

15 hours

SFOC

CO_2

Based on these measures, carried out by the MaK - Caterpillar test laboratory in Germany, we can confirm that **XBEE Enzyme Fuel Technology** acts instantly in the fuel. Beyond the well-known cleaning effect of our enzymes, we can see that they reduce the specific fuel consumption of a clean engine, thus making it possible to pay for itself in just a few hours of treatment.

Therefore, Malte Rautenstrach and his management, in view of the excellent results, decided to publish a letter of recommendation:

"*The evaluation proved considerable improvements at all measuring points (see the testing records) which was a very positive surprise for us.*

[...]

We believe that using this fuel additive with diesel engines, the operating characteristics of the engines will be improved considerably. Due to the reduction of emissions, there will be a positive effect for the environment too.

Therefore, we may recommend that our customers could use this fuel additive."

XBEE Enzyme Fuel Technology is global partner with Green Marine environmental program and allows shipowners to improve the performance of their ships on at least three key indicators!

GREEN MARINE PARTNER

Annexes

Original database

6M25 Motor MAK-Dieseltest		Leistung auf Propeller gefahren					
%	Leistungsstufen	100% P	75% P	50% P	35% P	25% P	10% P
kW	Kilowatt	1980	1481	990	698	495	198
n	Drehzahl	750	681	595	529	476	357
be ohne	spez.Vebrauch	184.50	183.50	189.90	196.90	205.50	210.70
be mit Xbee		184.30	183.10	188.90	196.70	200.00	207.80
Abweichung in %		-0.11	-0.22	-0.53	-0.10	-2.68	-1.38
le ohne	spez.Luftdurchsatz	7.20	7.03	6.46	6.26	6.07	8.69
le mit Xbee		7.31	7.04	6.50	6.30	6.44	9.28
Abweichung in %	Erhöhung erwünscht	1.53	0.14	0.62	0.64	6.10	6.79
tAvT ohne	Abgastemperatur vor Turbine	477	468	501	519	515	368
tAvT mit Xbee		472	465	496	516	511	387
Abweichung in %		-1.05	-0.64	-1.00	-0.58	-0.78	5.16
tAnZ ohne	Abgastemperatur nach Zylinder	346	335	353	361	364	303
tAnZ mit Xbee		341	332	349	359	359	311
Abweichung in %		-1.45	-0.90	-1.13	-0.55	-1.37	2.64
tAnT ohne	Abgastemperatur nach Turbine	290	315	386	429	427	345
tAnT mit Xbee		291	320	385	432	446	385
Abweichung in %	Erhöhung erwünscht	0.34	1.59	-0.26	0.70	4.45	11.59
NOx ppm ohne	Stickoxide	1060	1155	1250	1210	1320	1610
NOx ppm mit Xbee		900	995	1050	1075	1175	1315
Abweichung in %		-15.09	-13.85	-16.00	-11.16	-10.98	-18.32
NOx gKW/h ohne	Stickoxide am Auspuff	12.45	13.43	13.13	12.29	13.00	20.66
NOx gkW/h mit Xbee		10.84	12.08	11.65	11.33	12.03	16.89
Abweichung in %		-12.93	-10.05	-11.27	-7.81	-7.46	-18.25
CO ppm ohne	Kohlenmonoxid Menge	102	94.00	142.00	268.00	318.00	170.00
CO ppm mit Xbee		94	92.00	208.00	384.00	326.00	212.00
Abweichung in %		-7.84	-2.13	46.48	43.28	2.52	24.71
CO2 ohne	Kohlendioxid Prozent	5.22	5.38	6.22	6.78	7.48	5.86
CO2 mit Xbee		5.08	5.06	5.78	6.44	6.78	5.60
Abweichung in %		-2.68	-5.95	-7.07	-5.01	-9.36	-4.44
FSN ohne	Schwärzungszahl Rußpartikel	0.18	0.13	0.15	0.20	0.21	0.30
FSN mit Xbee		0.11	0.09	0.12	0.12	0.14	0.23
Abweichung in %		-38.89	-30.77	-20.00	-40.00	-33.33	-23.33

German original letter of recommendation

CATERPILLAR®

Caterpillar Motoren GmbH & Co. KG

Verteiler:

Fa.Visto
z.Hd Herrn Frey
Mallaustraße 61
68219 Mannheim

Ihr Zeichen	Unsere Zeichen	Telefon-Durchwahl	24157 Kiel
	Rts	+49 (0) 431 3995-3793	19.5.03
		Fax 3995-5793	
		oder 3995-2246	
		E-mail rautenstrauch_malte@CAT.com	

Motorenprüfstandstest mit Xbee

Sehr geehrter Herr Frey, sehr geehrter Herr Filler !

Die Motorenentwicklung und Versuchsabteilung von MaK/Caterpillar wurden von Ihnen gebeten den Kraftstoffzusatz Xbee auf seine Wirkungsweise bei Dieselverbrennungsmotoren hin zu prüfen.

Diesen Versuch haben wir im April 2003 abgeschlossen und sind zu folgendem Ergebnis gekommen:

Der Versuchsmotor, ein Mittelschnellläufer der Baureihe M25, wurde auf alle für den Betrieb relevanten Daten zuerst ohne und anschließend – die gleichen Messpunkte- mit ihrem Zusatz Xbee getestet.

Die Testauswertung ergab erhebliche Verbesserungen in sämtlichen Messpunkten (siehe Messprotokoll), worüber wir sehr positiv überrascht waren.

Aufgrund der starken Rußpartikelreduzierung (bis zu 40%) vermuten wir, daß sich die Kohlenstoffablagerungen durch den Zusatz stark reduzieren und die Wartungsintervalle dadurch verlängern könnten.

Durch das Beimischen Ihres Produktes in den Kraftstoff konnte während des Betriebes am Motor keine Beschädigung festgestellt werden.

Caterpillar Motoren GmbH & Co. KG
Falckensteiner Straße 2, 24159 Kiel
Postfach, 24157 Kiel
Sitz der Gesellschaft: Kiel
Handelsregister: Amtsgericht Kiel HRA 3735

Telefon: +49 (0) 431 3995-01
Telefax: +49 (0) 431 3995-2193
http://www.mak-global.com

Komplementärin:
Caterpillar Motoren Verwaltungs-GmbH
Sitz der Gesellschaft: Kiel
Handelsregister: Amtsgericht Kiel HRB 4621
Geschäftsführer: Jan E. Grundtman, Vorsitzender
Oswald Schöffel, Paul Wroblewski

00.58/01.03

German original letter of recommendation

Caterpillar Motoren GmbH & Co. KG

Von unserer Seite aus bestehen keinerlei Bedenken Xbee bei all unseren Motoren einzusetzen und erteilen hiermit eine Freigabe.

Wir sind der Meinung, daß sich durch den Einsatz dieses Kraftstoffzusatzes bei Dieselmotoren das Motorverhalten wesentlich verbessert und des weiteren durch die erzielten Emissionsreduzierungen zur Umweltentlastung beigetragen wird.

Wir können unseren Kunden empfehlen, diesen Kraftstoffzusatz einzusetzen.

Mit freundlichem Gruß

i. A.

00.17/08.00

English original letter of recommendation

CATERPILLAR®

Caterpillar Motoren GmbH & Co. KG

Verteiler:

Visto Mannheim
Att. Mr. Frey
Mallaustrasse 61
68219 Mannheim
Germany

Your Reference	Our Reference	Telephone	24157 Kiel
	Rts	Direct dialling	
		+49 (0) 431 3995-3793	19.5.03
		Fax	3995-5793 or 3995-2246
		E-mail	Rautenstrauch_malte@CAT.com

Test Bench Results with Xbee

Dear Mr. Frey, dear Mr. Filler!

The department of motor development and testing of MaK/Caterpillar has been requested by your company to test the fuel additive Xbee for its efficacy with diesel combustion engines.

We have concluded this test in April 2003 with these results:

The test engine, a medium speed type M25, has been tested for all relevant operating data and at the same measuring points firstly without and thereafter with your additive Xbee.

The evaluation proved considerable improvements at all measuring points (see the testing records) which was a very positive surprise for us.

We suppose that any deposits of carbons will be considerably reduced using this additive and that the intervals of maintenance could be extended due to the reduction of the quantity of soot particles (up to 40%) within the exhaust gas.

Caterpillar Motoren GmbH & Co. KG
Falckensteiner Straße 2, 24159 Kiel
P. O. Box, 24157 Kiel
Registered Seat: Kiel
Register of Companies: Local Court of Kiel HRA 3735

Phone: +49 (0) 431 3995-01
Telefax: +49 (0) 431 3995-2193
http://www.mak-global.com

General Partner:
Caterpillar Motoren Verwaltungs-GmbH
Registered Seat: Kiel
Register of Companies: Local Court of Kiel HRB 4621
Management Board: Jan E. Grundtman, Chairman
Oswald Schöffel, Paul Wroblewski

00.58/01.03

English original letter of recommendation

Caterpillar Motoren GmbH & Co. KG

We could not state any damages at the engine having mixed this additive with the diesel fuel.

For our part we do not see any problem for the use of Xbee with all of our engines and we herewith issue a general release for its use.

We believe that using this fuel additive with diesel engines the operating characteristics of the engines will be improved considerably. Due to the reduction of emissions there will be a positive effect for the environment too.

Therefore we may recommend that our customers could use this fuel additive.

With kind regards

i. A.

XBEE
ENZYME FUEL TECHNOLOGY

8, am Wapp
3841 Schifflange
Luxembourg

customerservice@xbee.com
+352 691 668900