Testing Facility “Universalneftekhim” of VTil Ltd.

Accreditation certificate granted by the National Accreditation Agency of Ukraine № 2T 495, valid until August 29, 2018 in accordance with the requirements of DSTU ISO/IEC 17025:2006 (ISO/IEC 17025:2005)

Approved by:

Director of the Testing Facility “Universalneftekhim”

_____ P.V. Karnozhitsky

February 11, 2014

Confirmation of efficiency

Product:	Multifunctional additive to oil “Atomic Metal Conditioner XADO MAXIMUM FOR DIESEL TRUCK” with revitalizant 1 STAGE, package 950.0 ml Manufactured according to ТУ У 24.6-31233443-005:2010
Manufacturer:	XADO-Technology Ltd., 23 Avgusta Lane 4, 61103 Kharkov, Ukraine
Field of application:	four-stroke diesel engines of trucks, buses, marine and locomotive engines with the oil system capacity of up to 30–45 L

Kharkiv 2014

Content of the test run: 1. Research of the efficiency of Atomic Metal Conditioner XADO MAXIMUM FOR DIESEL TRUCK (hereinafter the PRODUCT) during application in diesel engines relative to the following parameters: exhaust toxicity, fuel consumption, compression volume in cylinders, oil pressure.

2. Analysis: restorative properties of the PRODUCT on friction parts of engine, change in motor oil lubricity, metal content of oil.

1. Description

The test subject was determination whether use of the PRODUCT leads to change in geometry of friction parts of the engine, exhaust toxicity, fuel consumption, compression rate, oil pressure, engine capacity, oil lubricity.

2. Performed tests

1. Compression measurement with the help of recording equipment (ZECA 363, Motometer, according to the application instructions).
2. Restorative properties of the product and stability of the size of parts were determined by direct measurements during micrometering of the engine parts, and also indirectly by measuring the pressure in the engine lubrication system according to GOST 14846-81.
3. Measurement of exhaust toxicity in a diesel engine (smoke) according to DSTU 4276-2004.
4. Measurement of fuel consumption according to GOST 20306-90.
5. Determination of metal content in the motor oil according to GOST 27860-88.
6. Analysis of tribological properties of motor oil according to GOST 9490-75.

The test was held during the period from January 18, 2011 till January 25, 2014.

The following 6 test vehicles with the diesel engine were used:

Analysis according to § 1

MAN TG-A (743,800 km);

LAZ-52528 (71,363 km);

MAN F2000 (630,740 km);

Analysis according to § 2

MAN F2000 (630,740 km);

KAMAZ-53202 (520,640 km);

Analysis according to § 3

MAN ME220-18.220 (793,252 km);

Analysis according to § 4

MAN ME220-18.220 (793,252 km);

Analysis according to § 5

DAF GAG 85.430 (1,885,900 km);

Analysis according to § 6

DAF GAG 85.430 (1,885,900 km).

3. Results

The series of conducted tests presents measuring and recording of current values on chosen vehicles before and after the application of the PRODUCT.

3.1 Compression

Application of the PRODUCT increases and equalizes the compression in the engine cylinders (Fig. 1-3). During the initial measurement before the application of the PRODUCT uneven compression pressure in the cylinders was observed. On average fluctuations between the cylinders were up to 3.5 bar. After application of the PRODUCT the variations between the compression pressure values decreased. Fluctuations of the compression pressure in the cylinders were on average not more than 0.8 bar.

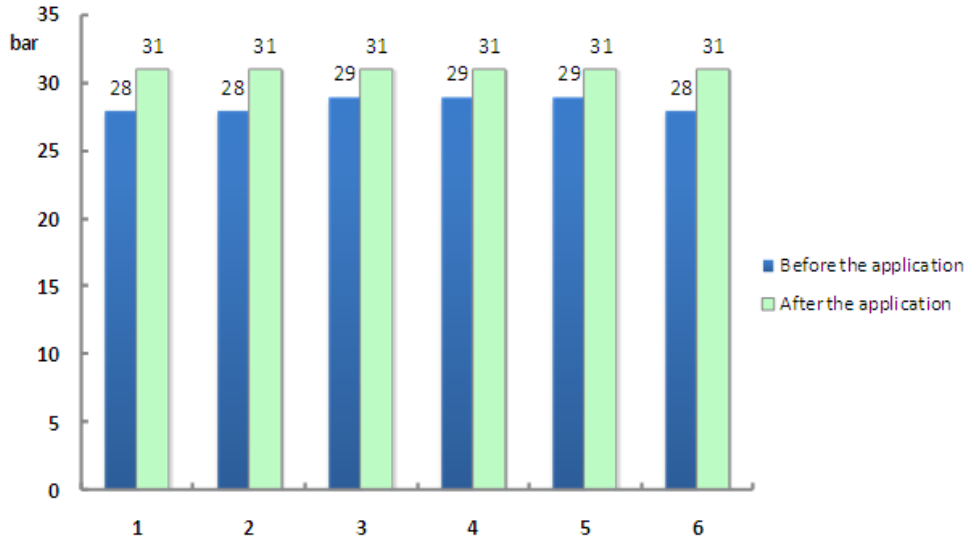

Fig. 1 Average compression values in the cylinders of the MAN TG-A engine before and after application of the PRODUCT

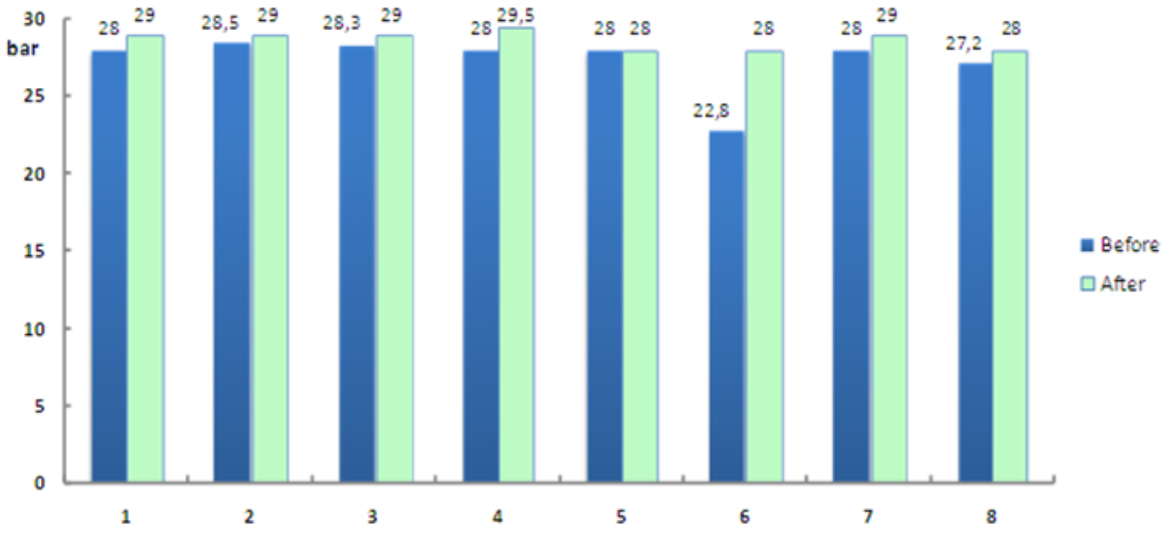

Fig. 2 Average compression values in the cylinders of the engine of LAZ-52528 bus before and after application of the PRODUCT

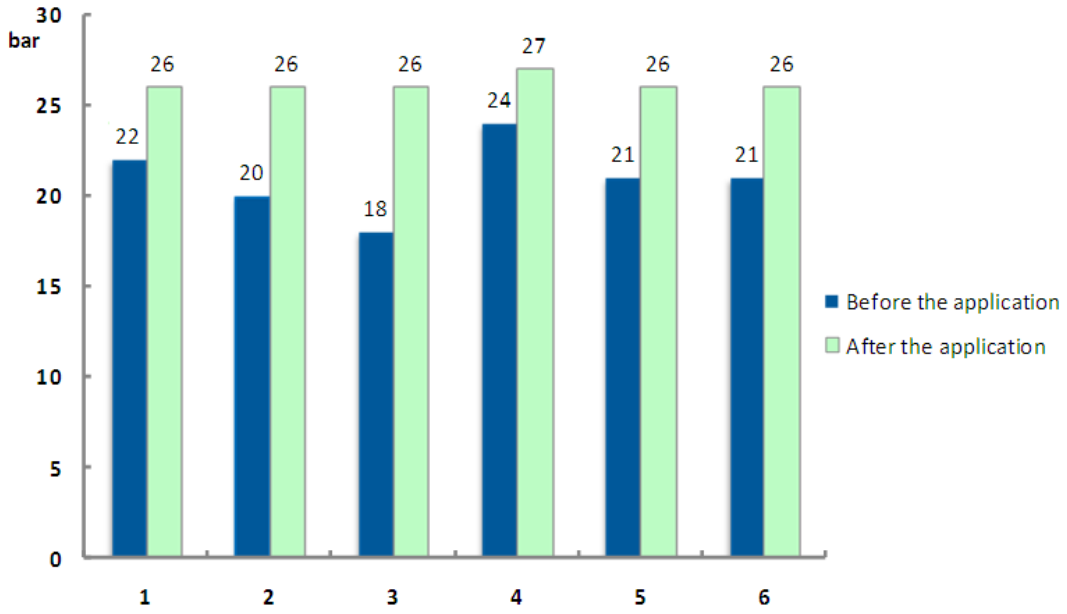

Fig. 3 Average compression values in the cylinders of the MAN F2000 engine before and after application of the PRODUCT

3.2 Restorative and protective properties

Application of the PRODUCT had a positive impact on the geometry of working surfaces of the parts of cylinder-piston and crank group of the engine. The results of measuring geometrical size of diameters of working surfaces of cylinders and crankpins of the engine crankshaft are presented in tables 1, 2, 3 and 4.

After application of the PRODUCT the pressure in the engine lubricating system increased by 0.2 bar at idle (600 rpm), at 2000 rpm the oil pressure increased by 0.5 bar (Fig.4)

Table 1 Measurements of the cylinder diameters at height of 40 mm

Number of cylinder	Diameter of operating part of the cylinder, mm.			
		Before application and run of 631,612 km	After application and run of 637,155 km	After application and run of 909,742 km
I	Axis A	128.12	128.07	128.07
	Axis B	128.14	128.1	128.11
II	Axis A	128.1	128.07	128.07
	Axis B	128.13	128.1	128.11
III	Axis A	128.11	128.06	128.07
	Axis B	128.14	128.11	128.12
IV	Axis A	128.11	128.07	128.08
	Axis B	128.13	128.09	128.1
V	Axis A	128.12	128.07	128.08
	Axis B	128.14	128.1	128.1
VI	Axis A	128.11	128.06	128.07
	Axis B	128.14	128.1	128.1

Table 2 Measurements of the cylinder diameters at height of 150 mm

	Diameter of operating part of the cylinder, mm			
Number of cylinder		Before application and run of 631,612 km	After application and run of 637,155 km	After application and run of 909,742 km
I	Axis A	128.1	128.05	128.06
	Axis B	128.11	128.06	128.07
II	Axis A	128.1	128.05	128.06
	Axis B	128.1	128.07	128.07
III	Axis A	128.09	128.04	128.05
	Axis B	128.11	128.06	128.07
IV	Axis A	128.09	128.05	128.05
	Axis B	128.1	128.07	128.07
V	Axis A	128.08	128.05	128.05
	Axis B	128.1	128.06	128.06
VI	Axis A	128.09	128.05	128.05
	Axis B	128.1	128.06	128.07

Table 3 Measurements of the cylinder diameters at height of 210 mm

Number of cylinder	Diameter of operating part of the cylinder, mm			
		Before application and run of 631,612 km	After application and run of 637,155 km	After application and run of 909,742 km
I	Axis A	128.03	128.02	128.02
	Axis B	128.03	128.03	128.02
II	Axis A	128.04	128.03	128.02
	Axis B	128.04	128.03	128.02
III	Axis A	128.03	128.03	128.03
	Axis B	128.04	128.03	128.03
IV	Axis A	128.03	128.02	128.03
	Axis B	128.04	128.03	128.03
V	Axis A	128.03	128.02	128.02
	Axis B	128.04	128.02	128.03
VI	Axis A	128.03	128.02	128.03
	Axis B	128.04	128.03	128.03

Table 4 Measurements of diameters of crankpins of the engine crankshaft

Number of cylinder	Diameter of crankpins of the engine crankshaft, mm.			
		Before application and run of 631,612 km	After application and run of 637,155 km	After application and run of 909,742 km
I	Axis C	89.93	89.96	89.96
	Axis D	89.92	89.95	89.95
II	Axis C	89.92	89.95	89.95
	Axis D	89.92	89.94	89.95
III	Axis C	89.92	89.95	89.95
	Axis D	89.92	89.94	89.94
IV	Axis C	89.92	89.96	89.96
	Axis D	89.92	89.95	89.95
V	Axis C	89.93	89.96	89.95
	Axis D	89.91	89.95	89.95
VI	Axis C	89.92	89.95	89.95
	Axis D	89.91	89.95	89.95

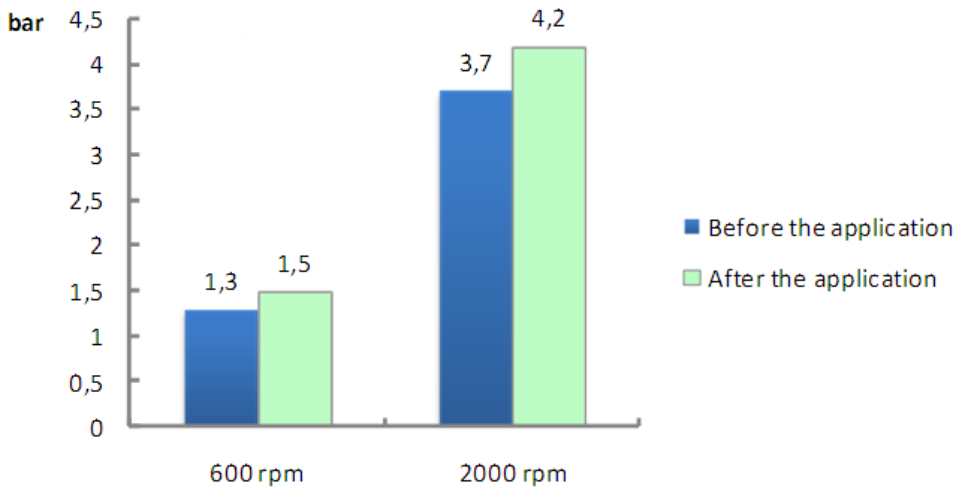

Fig. 4 Pressure in the engine lubricating system of KAMAZ-53202 before and after application of the PRODUCT

3.3 Exhaust toxicity

Application of the PRODUCT resulted in positive changes as to smoke of a diesel engine (Fig.5).

Change of the average value of natural absorption of light from 1.438 m^{-1} to 1.21 m^{-1} corresponds with decrease in smoke by 15.7%.

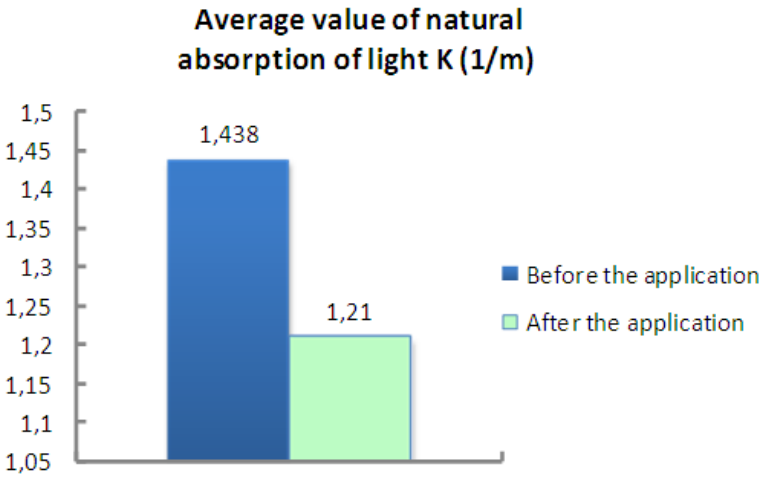

Fig. 5 Comparison of average smoke values before and after application of the PRODUCT for the MAN ME220-18.220 engine

3.4 Fuel consumption

As a result of application of the PRODUCT, decrease of fuel consumption was recorded through comparative analysis. The

average value of fuel consumption in operating mode (controlled fuel consumption, Fig. 6) increased on average by 4.15% and by long-distance run (Fig.7) on average by 2.95%.

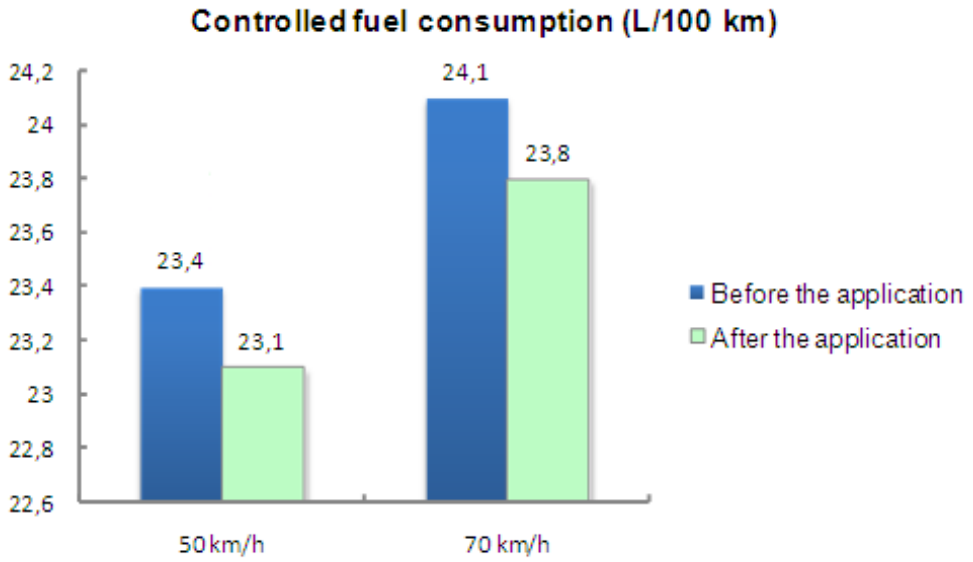

Fig. 6 Comparison of average fuel consumption values in operating mode (controlled fuel consumption) of MAN ME220-18.220 car before and after application of the PRODUCT.

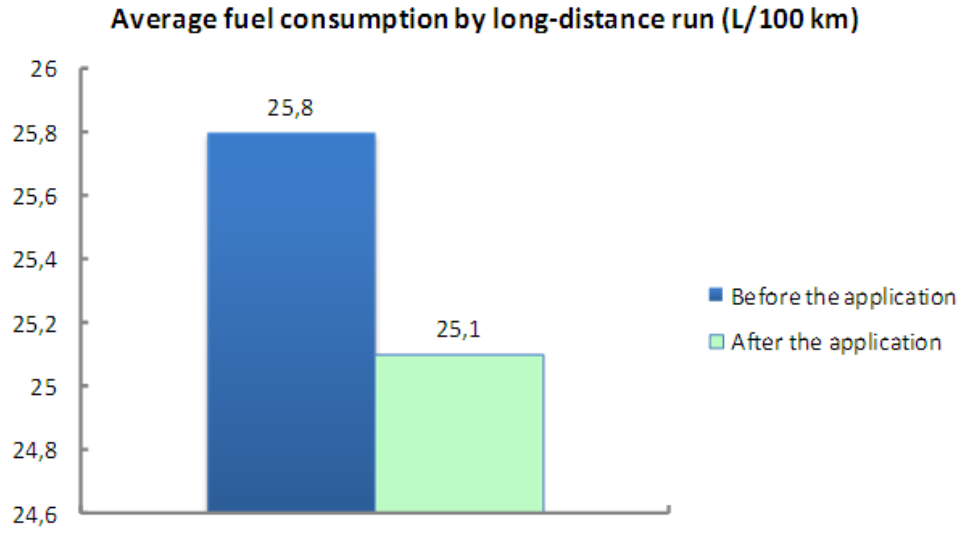

Fig. 7 Comparison of average fuel consumption values of MAN ME220-18.220 car by long-distance run before and after application of the PRODUCT.

3.5 Metal content in the motor oil

Application of the PRODUCT resulted in decreased content of metal products of wear in the motor oil. (Table 5)

Table 5 Content of metal products of wear in the oil of the DAF GAG 85.430 engine

Run, thousand km	Fe	Pb	Cu	Ni	Total metal content, mg/kg
186	136	12	38	15	201
249	70	0	38	22	130
279	49	6	36	18	109
314	49	10	23	0	82

3.6 Tribological properties of motor oil

Application of the PRODUCT resulted in improvement of tribological characteristics (wear scar, critical load, welding load) of the motor oil (Table 6).

Table 6 Tribological characteristics of the motor oil in a DAF GAG 85.430 car

Tribological characteristics	$D_{и}$, mm	$P_{к}$, H	$P_{св}$, H
New oil	0,27	823	1744
After application, at the end of the oil service life	0,25	921	1960

Summary results:

The conducted analysis of application of XADO MAXIMUM FOR DIESEL TRUCK confirmed its positive impact on operational characteristics of engines.

Application of the PRODUCT in the chosen group of trucks:

1. Increases compression by 10.75% and decreases its variation in the cylinders from 3.5 to 0.8 bar.
2. Restores the geometry of worn friction parts of the engine: cylinders (decreased diameter) by 0.04 mm; crankpins of the engine crankshaft (increased diameter) by 0.03 mm. Keeps the restored size by more than 250,000 km of run.
3. Increases the pressure in the lubricating system: by 0.2 bar at idle and by 0.5 bar at 2000 rpm.
4. Decreases the exhaust toxicity (smoke) by 15.7%.
5. Decreases fuel consumption in operating mode by 4.15% and by long-distance run by 2.95%.
6. Decreases the total content of metal products of wear in the oil by a factor of 2.5 and preserves its antiwear properties during 128,000 km of run.
7. Improves tribological characteristics of the oil: antiwear by 8%, antiwelding by 11.5%.