ADDINOL®

THE ART OF OIL • SINCE 1936

ADDINOL High-performance Lubricants for Gas Engines

ADDINOL – German Quality since 1936
Solutions for all lubrication-related challenges

ADDINOL is one of the few companies in the German mineral oil industry acting independently of any large business group and has distributor partners on all continents in more than 90 countries. Our high-performance lubricants are design elements reflecting the most recent state-of the-art. Development and production are carried out according to latest standards at the chemical site in Leuna in the heart of Germany. Our lubricants reveal their full performance in symbiosis with engines, drives, chains, bearings and hydraulic systems.

ADDINOL provides intelligent solutions which guarantee optimum lubrication and ensure responsibility towards the environment at the same time. Many of our high-performance lubricants increase energy efficiency of plants and engines considerably. They achieve significantly longer drain intervals compared to conventional products and extend the service life of the components lubricated.

ADDINOL – Improve the Performance!

Then and now – Research and development make up a vital part of the company's core competence.

ADDINOL Gas engine oils – for maximum efficiency and reliable operation

ADDINOL Gas engine oils are state-of-the-art. They have been developed in close co-operation with leading additive manufacturers and OEM, tailored to the complex and versatile requirements of demanding gas engines.

ADDINOL offers the perfectly fitting product for each application and all operating conditions. Whether plants are operated with natural or special gases – the advantages of our gas engine oils speak for themselves. Benefit from the constantly high quality of our gas engine oils, our service and our know-how!

- ✓ **stable operation and long engine lifetimes**
- ✓ **highest engine cleanliness**
- ✓ **reliable protection against wear, deposits and corrosion**
- ✓ **maximum oil operating life**
- ✓ **comprehensive analyses service**
- ✓ **highest operational safety**
- ✓ **the perfectly fitting product for all gas types and conditions**
- ✓ **approved by internationally leading engine manufacturers.**

ADDINOL Gas engine oils – Tried and tested in practice many a time

Successful application in the largest landfill gas plant of Scandinavia

The operation of gas engines with landfill gas, which is usually high in hydrogen sulphide, does mean enormous loads both for engine and engine oil. In the largest landfill gas site in Scandinavia in Espoo/ Finland the content of hydrogen sulphide amounts to about 600 ppm. (In comparison: according to standard the share in natural gas must not exceed 10 ppm.) This is a perfect challenge for **ADDINOL Gas engine oil MG 40-Extra Plus**. Acid components, which arise during combustion, can be neutralised reliably thanks to the engine oil's powerful alkaline reserve. The four special gas engines TCG-2032 V16 manufactured by MWM have been in safe, trouble-free operation with ADDINOL Gas engine oil MG 40-Extra Plus since 2010 – it masters the high content of hydrogen sulphide without any difficulties.

Another lubricant perfectly suited for operations with loaded landfill gas as well as biogas is **ADDINOL Gas Engine Oil LG 40**. It has been developed specifically for GE Jenbacher engines series 4 and 6 and possesses highest oxidation stability.

Low ash – not only for engines operated with natural gas

The combustion process of natural gas and cleaned special gases is cleaner than the combustion of usual special gases – therefore a lower alkaline reserve is required of the engine oil. However, the combustion of natural gas reaches considerably higher temperatures in comparison. Besides, engines nowadays often are equipped with catalytic converters for controlling exhaust emissions. These applications demand gas engine oils of a lower sulphated ash content.

The mineral oil based **ADDINOL Gas engine oil MG 40-Extra LA** possesses distinguished low ash characteristics. Thanks to its high thermal-oxidative stability it ensures a stable lubricating film and a superior ageing stability also at extreme temperatures. It slows oxidation as well as ageing and controls the viscosity increase which is accelerated by oxidation in turn. Lubrication points are reliably provided with oil and the lubricating film is not interrupted.

Furthermore, oxidation would encourage the formation of organic acids which can cause considerable damage in the engines as corrosive reaction products – by slowing oxidation, the formation of organic acids is clearly diminished as well. At the same time, the oils prevent the formation of deposits and ensure full functionality of valves, pistons, rings and liners. Thus, ADDINOL Gas engine oil MG 40-Extra LA achieves considerably longer oil drain intervals.

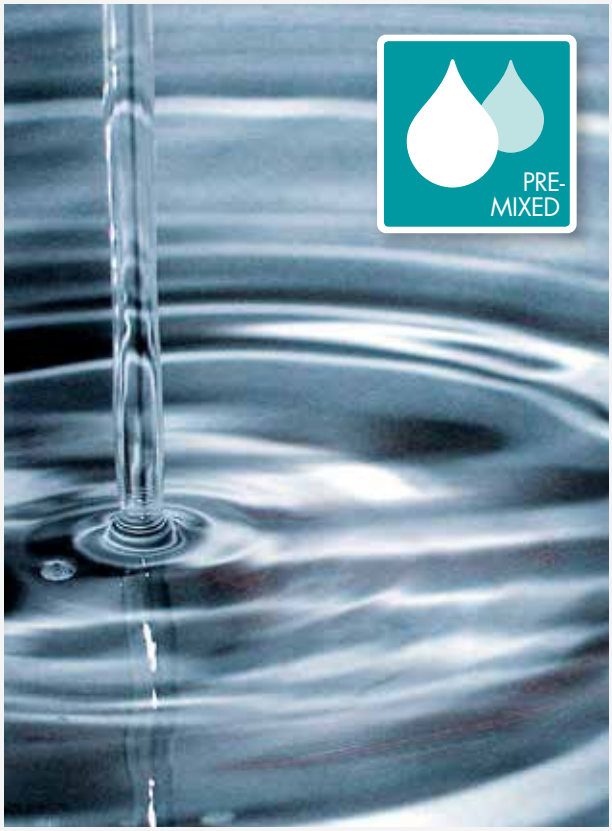
ADDINOL Gas Engine Oil NG 40 is a refinement of our proven and tested ADDINOL Gas engine oil MG 40-Extra LA. Highest thermal-oxidative stability for reliable lubrication also at increased temperatures and for all operating conditions, best wear protection and highest engine cleanliness characterise this mineral-oil based high-performance engine oil. ADDINOL Gas Engine Oil NG 40 is preferred for engines of the manufacturers GE Jenbacher, MWM and Caterpillar operated with natural gas in all performance ranges and with cleaned gases at the use of catalytic converters.

Long-distance runners – 108,000 operating hours in 15 years

Between 1999 and 2014 the association for sewage treatment Parthe near Leipzig has operated two MWM gas engines of type 226 with a nominal output of 70 kW each. **ADDINOL Gas engine oil MG 40-Extra Plus**, which is tailored to turbo-charged engines operated with special gases, and the continuous monitoring within the ADDINOL analyses service have allowed an impressive operating life of 108,000 operating hours over 15 years – in spite of heavy loads on the sewage gas in the form of silicon compounds. In the engine of a passenger car this equals about 5,400,000 km! And the long-distance runners were still equipped with their first main shaft and camshaft even!

Extra Tip for service: ADDINOL cooler protection

Apart from the reliable lubrication of the engine, the optimum heat exchange is of particular importance for a safe operation. The use of a high-grade cooler-protecting agent guarantees optimum heat exchange and reliable protection against freezing, cavitation and corrosion at the same time. The cooler-protecting agent ADDINOL Antifreeze Extra 4060 is pre-mixed with special water – this way it can be used without much effort or preparation and at stable quality. Therefore it is perfectly suited for service companies servicing various plants with different water qualities. Especially for unfavourable water qualities on the spot (e.g. very hard mixing water) the use of Antifreeze Extra 4060 is of benefit. The combination of additives and special mixing water reduces the formation of coatings and achieves highest cleanliness both in the cooling unit and in the heating circuit – this way Antifreeze Extra 4060 ensures an excellent heat transfer. The formation of foam is prevented efficiently. ADDINOL Antifreeze Extra 4060 is approved by leading manufacturers and has been tried and tested in practical applications many a time.



Large and small alike – ADDINOL gas engine oils for small cogeneration units

The decentral energy supply of private households by the help of small cogeneration units is gaining more and more importance. The parallel generation of electricity and heat allows the optimum conversion of the energy input (mainly natural gas). These micro CHP* plants reach utilisation degrees of more than 80 %. However, because of the heat- or power-led operation with frequent starts and stops the engines are exposed to extreme conditions. **ADDINOL Gas engine oil MG 40 PowerSynth** is perfectly suited for compact micro CHP units operated with natural gas. These units achieve optimum performance even at small oil volumes and the maintenance effort is reduced to a minimum.

* combined heat and power

Approved by leading engine manufacturers

ADDINOL Gas engine oils		MG 40-Extra Plus	MG 40-Extra LA	MG 40 PowerSynth	Gas Engine Oil LG 40	Gas Engine Oil NG 40
Base oil		mineral	mineral	synthetic	mineral	mineral
Ash content		high ash	low ash	low ash	low ash	low ash
Natural gas			✓	✓		✓
Special gases*		✓	✓		✓	✓
Special gases* of qualities similar to natural gas		✓	✓	✓	✓	✓
Special gas* operations with catalytic converter		✓	✓	✓	✓	✓
GE Jenbacher TA 1000-1109	Series 2/3: class A		+			+
	Series 2/3: class B	+	+		+	+
	Series 2/3: class C	+			+	
	Series 2/3: catalytic converters		+			
	Series 4/6: class A		+			+
	Series 4/6: class B		+		+	+
	Series 4/6: class C				+	
	Series 4/6: catalytic converters		+			
MWM TR 0199-99-2105	SuA 0.5-1.0 Ma%	+				
	SuA up to 0.5 Ma%		+			+
Caterpillar CG Series TR 0199-99-12105	SuA 0.5-1.0 Ma%	+				
	SuA up to 0.5 Ma%		+			+
MAN	M 3271-4 special gas	+				
	M 3271-2 natural gas		+			
MTU Onsite Energy	Series 400 natural gas (MDE BR 28xx/ 30xx)		+			
	Series 400 special gas (MDE BR 28xx/ 30xx)	+				
	Series 4000 special gas	+	+			
Tedom	61-0-0281.1 (L, B, S)	+				
Micro CHP plants				+		
recommended for		Caterpillar, Liebherr, Tedom, Wärtsilä, Waukesha, RollsRoyce, Perkins, MTU, MDE, Deutz, fuel injection engines				

* Special gases = biogas, mine gas, landfill gas, sewage gas
+ = approved, Ma% = weight percent
Individual use depends on the respectice OEM specifications, please contact our technical service for more information!

The secret of success behind the gas engine oils of ADDINOL

The composition of gas engine oils is a particular challenge. On the one hand, the manufacturers of the units place very complex requirements on the lubricants, on the other hand the applications are manifold and each plant needs to be looked at individually.

Research & Development make up a vital part of our core competence. In the development of our gas engine oils we have been co-operating closely with leading OEM for many years. After all, today engine oils are design elements and the safe and stable operation is only possible with the fitting lubricant.

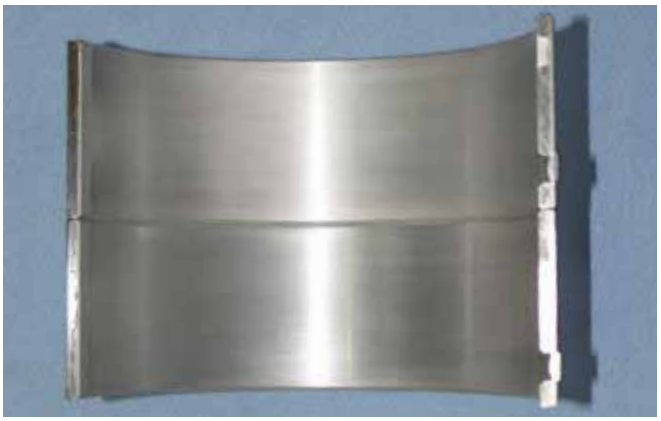
In the first step, the base oil and additive components need to be selected carefully and tested at our laboratory. Before a new gas engine oil is applied in the field tests of the single manufacturers it is subjected to comprehensive analyses at our in-house laboratory. Each manufacturer places individual requirements on the load tests in its units – these differ concerning duration, test criteria and key aspects. The runtime required varies from manufacturer to manufacturer and can amount to up to 16,000 operating hours. Achieving an approval entails a practical test phase in one or two engines. Each field test ends with an appraisal – here the engines are disassembled for checking the single components. Over the time we have acquired many years of field test experience and more than 800,000 analytical values, every year about 80,000 to 100,000 values are added.

Sven Köhler, responsible product manager for ADDINOL gas engine oils, explains: “Our in-house matrix is based on results obtained in field tests and on the limiting values defined by the OEM. By the help of this matrix and based on the analyses results on the spot we can make a recommendation on the oil operating life. For most operators this information is very valuable – it does not only allow the reliable monitoring of oil and plant, but at the same time it permits the planning of oil changes and maintenance. The limiting values defined by the single OEM must be kept by any means. If only one value is exceeded, the warranty claim is put at risk. By the help of our matrix we guarantee that all the values are met, the operator does not need to take care of anything but regular oil analyses and carrying out oil changes at the given intervals.“

Highest engine cleanliness, reliable wear protection

ADDINOL Gas engine oils achieve operating lives which are up to 50 % longer than the operating lives of conventional gas engine oils. Their oil change intervals are determined individually. Operating lives and the condition of the gas engine oil can be described by the help of specific values. However, the exact state of engine cleanliness and possible wear can only be ascertained by an examination with a borescope or by disassembling the engine. Within comprehensive field tests of up to 16,000 operating hours various gas engines have been subjected to an appraisal. The pictures of the components speak for themselves!

The engines operated with ADDINOL Gas engine oils possess a superior cleanliness and show almost no signs of wear! This means they ensure the full performance of the engine components and their long lifetimes. Valve train, piston skirts, bearings and cylinder liners are free of deposits. The engines can unfold their full potential.



Bearing shells – GE Jenbacher J 412 V12

Piston with ring grooves – MWM TCG 2016 V12

Piston with ring grooves – MAN E 2842 LE 302 V12

Sparking plugs – GE Jenbacher J 312 V12

Valve train – MWM TCG 2016 V12

Inlet and exhaust valve – MTU Onsite Energy AB 3066 L4 V6

The most important criterion for operators of CHP plants:

Oil change interval

- Oil quality
- Oil volume
- Gas quality
- Operating conditions

Reliable operation as well as optimum and tailored oil change intervals thanks to the ADDINOL analyses service

Regular checks of the oil condition and oil changes carried out in defined intervals are the precondition for the stable and lucrative operation of a cogeneration unit. This demand is posed by all gas engine manufacturers and all insurance providers. Therefore, we accompany the use of ADDINOL gas engine oils with our analyses service. An independent laboratory analyses the condition of your oil filling by the help of the following parameters, among others: viscosity and viscosity increase, oxidation, nitration, TBN* and TAN*. Wear elements and contaminants are determined as well. Apart from the i-pH-value*, the relation between TBN and TAN is highly important especially for sewage and landfill gases. These parameters indicate the loading of the oil with corrosive acids.

On the footing of our special matrix, which is based on the limit values defined by the manufacturers as well as on values obtained in field tests and practical applications, we identify the individual oil change interval for your plant, tailored to the respective conditions on the spot and the condition of both oil and engine.

However, the oil change interval is no fixed factor. It is influenced by the engine's operating conditions, gas quality, oil volume and oil quality. As the parameters can be subject to variation, the constant monitoring is highly important. The optimum oil change interval is the precondition for an efficient operation and maximum engine lifetimes.

For our service we only require the specifications of your engine. For obtaining the correct results, it is of utmost importance to record all data carefully. With each lab report you receive an overview of your parameters both in table form and in graphs including a trend analysis and information on the oil operating life, i.e. whether the interval can be kept or extended even or possibly should be shortened.

Minimum effort for you:

1.) Sampling with the prepared set.
2.) Dispatch of sample bottle and sample form to the OELCHECK laboratory in Brannenburg/Germany.
3.) 24 hours (on working days) after receipt of your sample at OELCHECK you receive your own individual recommendation concerning the oil's operating life, where necessary an additional comment on the condition of oil and/or plant plus a recommendation on the next date for analysis.

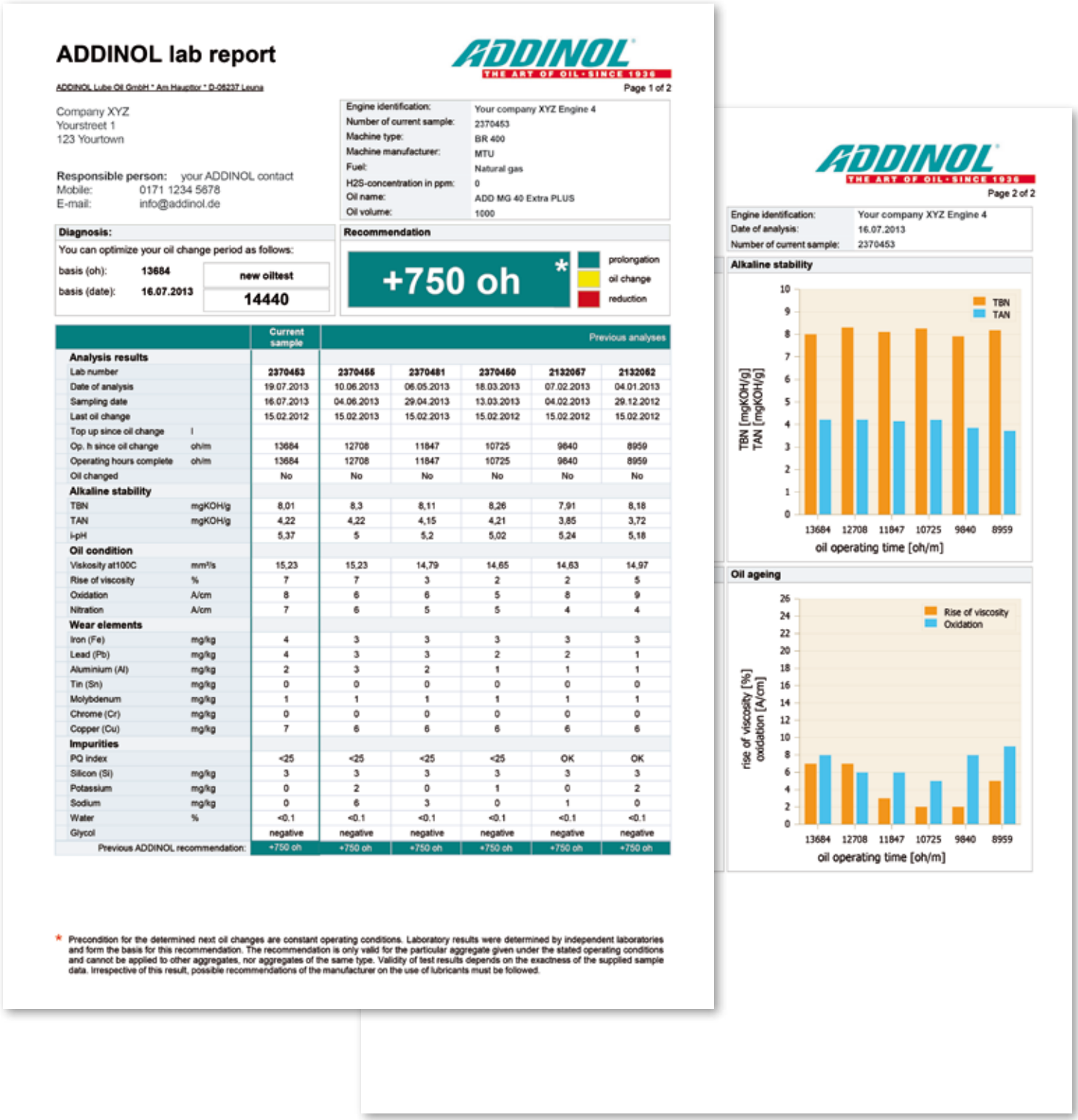
Extra tip! For plants filled for the first time with or changed over to one of the ADDINOL gas engine oils we pay the costs for up to two analyses within our starter kit!

The benefits for the operator at a glance:

- condition monitoring of oil and engine
- risk minimisation › increase of operational safety
- resource conservation
- optimised cost control
- improved planning of maintenance and oil changes
- compliance with warranty conditions of OEM and conditions of machinery breakdown insurance
- competent support provided by ADDINOL Application Technology.

*TBN: Total Base Number = alkaline reserve
*TAN: Total Acid Number = acidification of the oil
*i-pH-value: initial pH-value = indicator for free acids in the combustion gas

With our lab report you receive all important information on the condition of your gas engine oil. This way you can plan operation, maintenance and oil change without much effort. By the help of our analyses, the potential of your oil filling is utilised perfectly and at maximum safety for your engine. Thanks to optimum monitoring and trend analyses a considerable extension of the oil change intervals can be achieved within manufacturer specifications.



ADDINOL lab report

ADDINOL Lube Oil GmbH * Am Haupttor * D-06237 Leuna

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Company XYZ
Yourstreet 1
123 Yourtown

Responsible person: your ADDINOL contact
Mobile: 0171 1234 5678
E-mail: info@addinol.de

Engine identification:	Your company XYZ Engine 4
Number of current sample:	2370453
Machine type:	BR 400
Machine manufacturer:	MTU
Fuel:	Natural gas
H2S-concentration in ppm:	0
Oil name:	ADD MG 40 Extra PLUS
Oil volume:	1000

Diagnosis:

You can optimize your oil change period as follows:

basis (oh): 13684
basis (date): 16.07.2013

new oiltest
14440

Recommendation

+750 oh *

prolongation
oil change
reduction

		Current sample	Previous analyses				
Analysis results							
Lab number		2370453	2370455	2370481	2370460	2132067	2132062
Date of analysis		19.07.2013	10.06.2013	06.05.2013	18.03.2013	07.02.2013	04.01.2013
Sampling date		16.07.2013	04.06.2013	29.04.2013	13.03.2013	04.02.2013	29.12.2012
Last oil change		15.02.2012	15.02.2013	15.02.2013	15.02.2012	15.02.2012	15.02.2012
Top up since oil change	l						
Op. h since oil change	oh/m	13684	12708	11847	10725	9840	8959
Operating hours complete	oh/m	13684	12708	11847	10725	9840	8959
Oil changed		No	No	No	No	No	No
Alkaline stability							
TBN	mgKOH/g	8,01	8,3	8,11	8,26	7,91	8,18
TAN	mgKOH/g	4,22	4,22	4,15	4,21	3,85	3,72
i-pH		5,37	5	5,2	5,02	5,24	5,18
Oil condition							
Viskosity at100C	mm²/s	15,23	15,23	14,79	14,65	14,63	14,97
Rise of viscosity	%	7	7	3	2	2	5
Oxidation	A/cm	8	6	6	5	8	9
Nitration	A/cm	7	6	5	5	4	4
Wear elements							
Iron (Fe)	mg/kg	4	3	3	3	3	3
Lead (Pb)	mg/kg	4	3	3	2	2	1
Aluminium (Al)	mg/kg	2	3	2	1	1	1
Tin (Sn)	mg/kg	0	0	0	0	0	0
Molybdenum	mg/kg	1	1	1	1	1	1
Chrome (Cr)	mg/kg	0	0	0	0	0	0
Copper (Cu)	mg/kg	7	6	6	6	6	6
Impurities							
PQ index		<25	<25	<25	<25	OK	OK
Silicon (Si)	mg/kg	3	3	3	3	3	3
Potassium	mg/kg	0	2	0	1	0	2
Sodium	mg/kg	0	6	3	0	1	0
Water	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Glycol		negative	negative	negative	negative	negative	negative
Previous ADDINOL recommendation:		+750 oh	+750 oh	+750 oh	+750 oh	+750 oh	+750 oh

* Precondition for the determined next oil changes are constant operating conditions. Laboratory results were determined by independent laboratories and form the basis for this recommendation. The recommendation is only valid for the particular aggregate given under the stated operating conditions and cannot be applied to other aggregates, nor aggregates of the same type. Validity of test results depends on the exactness of the supplied sample data. Irrespective of this result, possible recommendations of the manufacturer on the use of lubricants must be followed.

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Engine identification:	Your company XYZ Engine 4
Date of analysis:	16.07.2013
Number of current sample:	2370453

Alkaline stability

Oil ageing

Please note: the picture shows a complete laboratory report. The recommendation is valid only for the given unit under the given operating conditions. The determined values cannot be applied to any other aggregate, not even to units of the same type.

ADDINOL®

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ADDINOL high-performance lubricants in more than 90 countries and on all continents.

handed over by:

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