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THE WEAR OF THE COGENERATION GROUP TYPE EQUIPMENT

Marius Augustin CHIȘ, Gheorghe ACHIMAȘ

Abstract: Cogeneration groups have an increasingly important role in the simultaneous generation of electric and thermal energy. Their operation at the designed parameters is a continuous concern of the specialists, knowing that they still offer enough assets that can be worthwhile. At the same time, in order to ensure good quality operation and longer service life, in parallel with full capacity utilization, it is necessary to ensure a strict maintenance and repair conditions. Within the limit of the space granted and at a very accessible level, the paper presents the most important data on maintenance and technologies for re-conditioning of some parts from the cogeneration groups for the simultaneous production of electric and thermal energy.

***Key words*:** maintenance, re-conditioning, cogeneration group, oil analysis.

1. GENERALITIES

The working conditions of internal combustion engines belonging to cogeneration groups imply the existence of a lubricating system in the constructive assembly which ensures the presence of a determined quantity of oil between the surfaces of elements being in relative movement. Immediate effect results in reduced friction, thus mechanical losses and wear are reduced; at the same time, the oil also has a corrosion protection effect. At the same time, the oil absorbs some of the heat from friction, contributing to the cooling of various elements, especially those whose cooling cannot be obtained by other means. Together with the piston – rings – cylinder assembly, lubricating oil contributes to the sealing of the combustion chamber.

2. OIL SAMPLING

The oil sample must be taken while the engine is running and heated.

Before the oil sample is taken, the residual oil will flow into the sampling plant where the sampling takes place.

The samples must be clearly marked and contain the following minimum information: user, engine type, engine series, the lubricating oil producer, lubricating oil denomination, date when the sample was taken, engine operating hours, lubricating oil functioning hours, lubricating oil fill / lubricating oil consumption, total lubricating oil volume.

3. OIL ANALYSIS

The user must ensure that the analytical values needed to establish the oil exchange intervals are made available on time. The first oil analysis will be performed after 100 hours of operation.

The variation of the analytical values over a longer period is observed by the trend analysis, so that the individual values of the analysis will be entered in the tables or graphs.

4. OIL CHANGE

When changing oil, always the full amount of oil must be replaced. The quantity of oil remained in the engine and in the mounting elements must be reduced as much as possible. Oil change will be performed if one of the following criteria is met: when approaching the admissible limit values, after admission of the coolant in the lubrication system, after maintenance work at the level of the lubrication system, at least once a year.

The oil change intervals depend, in addition to the oil quality, on: the quality of the combustion gas, the environmental conditions, and the engine operating mode.

The oil change intervals will be set as follows (fig.1):

Example:

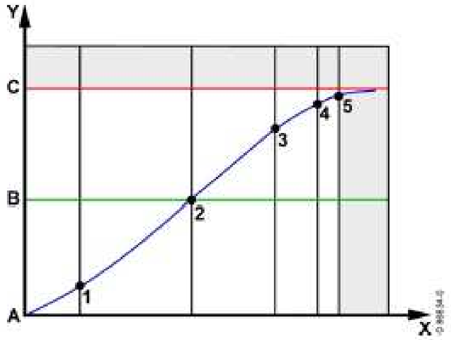

Fig.1 Oil change intervals

Axis X – Time interval
Axis Y – Value of the analysis result
A – Starting value
B – Limit semi – value
C – Limit value
Position 1-5 – Moment of the oil analysis
Position 5 – Moment of the next oil change

FIRST FILLING WITH LUBRICATING OIL

In case that the values of the analysis (position 1) are well under half of the admissible limit values (B), the time interval till the next lubricating oil change (position 2) can be doubled.

If some values of the analysis reach half the admissible limit value (B), the time to the next analysis (position 3) will be reduced.

When approaching the admissible limit value (C), the time intervals from one analysis to the next (positions 4 and 5) will be halved.

SECOND LUBRICATING OIL FILLING AND THE FOLLOWING FILLINGS

After establishing the time interval for the lubricating oil change, at the second filling can be used the first oil analysis of the lubricating oil after a greater interval (position 3).

If similar analysis results with that from the first lubricating oil filling come out, a second lubricating oil analysis will be carried out (position 4).

If the same analysis values are reached, the second oil change interval can be set as for the first filling with lubricating oil.

In case the operation conditions are unchanged, the analysis of lubricating oil for the next fillings with lubricating oil can be carried out at the same time interval (position 4).

If the results of the analysis differ to the previous, the lubricating oil change time intervals will be reset, until repeatable results are obtained.

5. OIL CONSUMPTION

The specific consumption of grease oil is understood the amount of lubricating oil that is consumed per unit of time at a certain capacity.

After the first operation hours (period of warming up) the oil consumption decreases. In the end, it will have to remain constantly low over a longer period of time. With a very long duration, the wear of the engine and the consumption of grease oil increases (fig. 2).

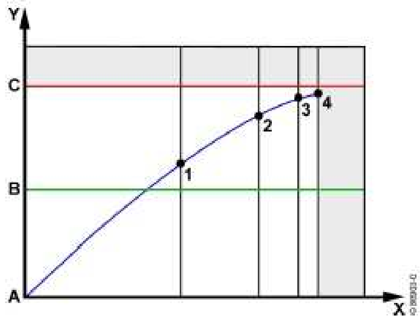

Fig. 2 Oil consumption according to the engine operating hours

Axis X – Operating time
Axis Y – Lubricating oil consumption
A area – Heating time
B area – Operating time
C area – Time of increased lubricating oil consumption due to the increased material wear

6. INTERPRETATION OF THE VALUES OF LUBRICATING OIL ANALYSIS

Viscosity – depending on temperature, increases by: oxidation, ash, evaporation of easy boiling components.

Total base number (TBN) – marks the alkaline reserve of lubricating oil and characterizes the chemical neutralization capacity. When working with flue gases that form acids (tailings depot gas, decanter gas and biogas), a rapid disintegration of TBN will be calculated.

Acid number (AN, former TAN) – neutralization figure (Nz) – contains strong acids (SAN) and weak acids. Oxidation and nitration processes can form weak organic acids. There is a strong link between the growth of AN, lubricating oil aging and its nitration

Establishing the connection between TBN and AN – While TBN decreases, AN increases. Because according to the list of limit values the AN must always be less than the TBN, in the area after the intersection of these values is no longer allowed to run the engine

Aging/oxidizing – is produced by reaction of base oil molecules and active substances with the oxygen, which leads to viscosity and AN increase.

Nitration – appears through the reaction of base oil molecules and active substances with the nitrogen oxide. There is a danger of corrosive reactions and strong alkaline reserve disaggregation.

i pH – serves to determine the pH of the lubricating oil. A super acidity of oil leads to wear through corrosion.

Water – in the lubricating oil causes an emulsion, which leads to increased wear and corrosion danger, increases the viscosity of lubricating oil.

Glycol – leads to reactions with lubricating oil substances and to and sludge formation and clogging of the filter.

Silicon – leads to abrasion wear. It results from the suction air and the combustion gases (gas from waste depot, decanting gas and biogas).

Natrium – the increased addition of sodium content in lubricating oil is a sign of contamination with coolant.

Aluminum – a typical wear and tear element of the pistons and radial sliding bearings.

Iron – a typical wear element of: cylinder, cam, push rod, shaft journals, piston rings, gears.

Chromium – a typical wear element of: piston rings, valve rods, cams, push rods and other elements form the engine from high alloyed steel.

Copper – a typical wear element of bearings and product of corrosion from the lubricating oil coolers and lubricating oil pipes.

Lead – a typical wear element of the radial sliding bearings.

Tin – typical wear element of the radial sliding bearings.

Molybdenum – component of the active substances of lubricating oil or different mounting parts.

Potassium and boron – typical element of substances for the corrosive protection in the coolant.

Calcium, zinc, phosphor, sulfur – typical elements of active substance in the lubricating oil.

Wear metal data are a helpful tool for assessing the engine. By doing so, engine state modifications can be discovered in advance. For appreciation, time concentration development for each wear metal will be observed by several lubricating oil analysis (trend analysis). Here is the wear rate for each value decisive, and not the absolute value of it. If a wear metal exceeds 50% of the values of the analysis given below, the time intervals for sampling will be halved (1).

<u>Example:</u> Calculation of wear speed

$$V_v = \frac{(c_1 - c_2)}{(t_1 - T_2)} \quad (1)$$

V_v= wear speed
c_1= mew concentration
c_2= old concentration
t_1= operating hours with new lubricating oil
t_2= operating hours with old lubricating oil

Six engine oil samples were analyzed on one engine. After the analysis number three of the lubricating oil $_{3=4}$ oil exchange took place. Before the last but one analysis of the lubricating oil t5 to the last t6, the concentration of the c6 wear metal increases much more than we expected from the previous lubricating oil analysis.

Since the last growth rate (Δc5,6 / Δt5,6) is above 50% of the limit value, the time interval until the next lubricating oil analysis must be halved.

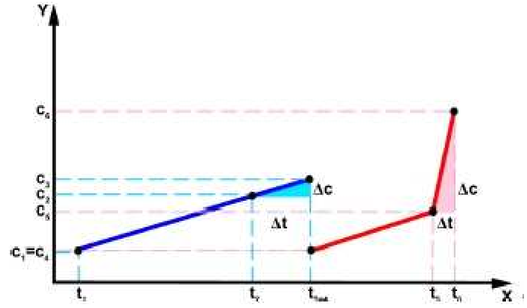

Fig. 3.Calculation of the moment of next oil sample taking

$$\frac{\Delta c_{5,6}}{\Delta t_{5,6}} = \frac{c_6 - c_5}{t_6 - t_5} \quad (2)$$

Axis X: Time interval

Axis Y: Value of the analysis result

$t_{3=4}$ Moment of lubricating oil change

$c_1=c_4$ Concentration in the new lubricating oil

7. CONCLUSIONS

Maintenance activities are intended to ensure the availability of the object to which are applied, and include all the interventions and operations necessary to achieve this purpose.

Cogeneration group's maintenance is efficient because:

- Increases the operation efficiency of the equipment;
- The cogeneration group standstill time is reduced;
- Increases the useful life of the cogeneration group;
- The spare parts replacement costs are reduced.

The activity of maintenance must be considered an investment in the future.

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UZURA ECHIPAMENTELOR DE TIP GRUP DE COGENERARE

Rezumat: Grupurile de cogenerare deţin un loc tot mai important în producerea simultană a energiei electrice şi termice.Exploatarea lor la parametrii proiectaţi, constituie o preocupare continuă a specialiştilor, ştiut fiind faptul că acestea oferă încă suficiente disponibilităţi ce se pot pune în valoare. În acelaşi timp, pentru a se asigura o funcţionare de bună calitate, şi durate de serviciu tot mai lungi, în paralel cu exploatarea la întreaga capacitate, este necesar să se asigure un regim strict de întreţinere şi reparare. În limita spaţiului acordat şi la un nivel accesibil, în lucrare sunt prezentate cele mai importante date privind mentenanţa şi tehnologiile de recondiţionare a unor repere din componenţa grupurilor de cogenerare pentru producerea simultană a energiei electrice şi termice.

Marius Augustin CHIŞ, PhD Student, Eng.: Technical University of Cluj – Napoca, Department of Manufacturing Engineering, 103 – 105 Muncii Blvd. 400641 Cluj – Napoca,
E-mail: marius_chis@yahoo.com, Phone: 0040-758 026 626.

Gheorghe ACHIMAŞ, Prof. PhD, Eng.: Technical University of Cluj – Napoca, Department of Manufacturing Engineering, 103 – 105 Muncii Blvd. 400641 Cluj – Napoca,
E-mail: Gheorghe.Achimaş@tcm.utcluj.ro, Phone: 0040-264 401 731.