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RESEARCHES CONCERNING INDUSTRIAL LOGISTICS FOR AN INFORMATIC DEVICE USED FOR LUBRICANTS WEAR BEHAVIOR

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Abstract: *The present paper describes researches concerning industrial logistics used to obtain an informatics device for the lubricants wear behaviour. There are shown researches stages at national and international levels with used methods. Actual project develops a scientifically partnership, which brought a new idea of a method for a fast diagnosis of liquid lubricants (used for cars, air ships, sea ships, engines and different systems).*

Key words: *industrial, logistics, informatics device, lubricant, behavior*.

1. INTRODUCTION

The present paper describes researches concerning industrial logistics used to obtain an informatics device for the lubricants wear behaviour.

The beginning of the studies was given by the actual oil change method, which is before the completely use of lubricant; this is out-of-date, it has big economical waste and applying ecologically effects [1, 4]. Actual moment shows that the oil from the installation is changed based on oilcans recommendations, which are made by the producers (number of hours in good repair or number of distance covered in kilometers).

In Romania this instructions are not respected almost at all, the oil changes often, because the oil engine market was been invaded by the pirate products and the customers protection was almost zero.

In other countries (Western Europe, SUA or Japan) the oil is changed based on the instructions written on the oilcans, but at the minimal recommended (Fig. 1) covered distance (in fact for the combustion engine are used oils which are guarantee for an equivalent number of kilometers between two periodical revisions of the car).

The determination of the oil changing moment is different because it depends on difficult to control factors. According some cases the oil car is changed more frequently that is necessary, in order to be sure that its properties were not all vanished. This type of procedure is not dangerous, from theoretical point of view, but it is expensive. For the change of used oil, it cannot be establish a time of change available for all type of engines cars or for distance covered in a time interval. The degradation of "working" lubricant oil depends on many factors, but most important ones are the oxidation and the contamination.

For the appreciation of the stage of degradation and of the changing moment, there are made periodically physic-chemical oil analyses. The oil is considered damaged when its characteristics had touched some limit values, which are established for each type of engine. The contamination level and the "lifetime" of used oil depend on the exploitation conditions, the oil quality, the construction and the technical state of engine.

2. METHODS AND RESULTS AT INTERNATIONAL AND NATIONAL LEVELS

At international level, the main directions and orientations are guided into the preventive mentenability domain and they can be applied in any closed lubrication system (Fig. 2).

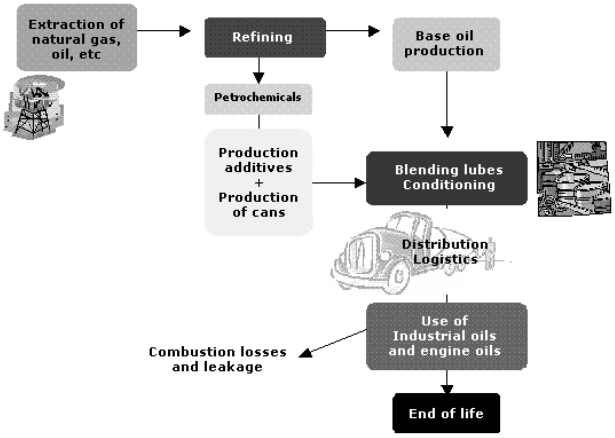

Fig. 1. Lubricant transformations.

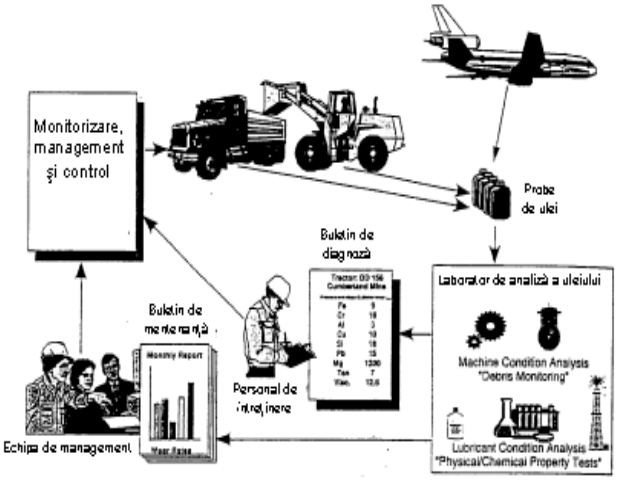

Fig. 2. A closed lubrication system.

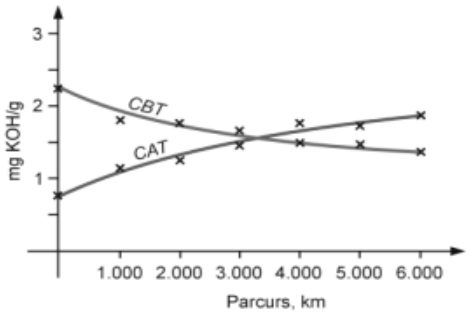

Fig. 3. The basicity analysis method [1].

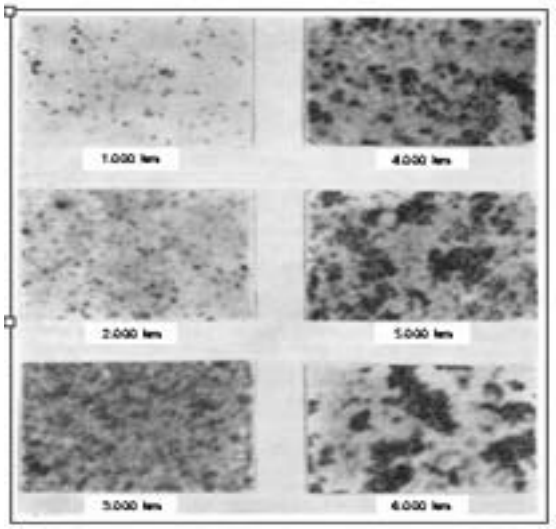

Fig. 4. The microscopic tests [2].

There were made applicative researches for oil determinations in exploitation time and for the establishment of the moment of its replacement. There are a few methods such as: the method of the intersection curve of acidity with the curve of alkalinity, which is used for alkaline oil (in special when it is used a fuel with sulphur), microscopic oil analysis and the method of oil spot. There were obtained some significant results in this domain:

- At the determination of the oil lifetime for engines trucks (firm MAN Germany) it was used the basicity analysis method (Fig. 3), which is applied for Mobil class oils [1].
- To determine the moment for the oil replacement, the firm Mercedes – Germany uses insoluble impurity in oil with microscopic tests, which is applied for class Shell oils (Fig. 4). The number and the size of particles in suspension are the indicators for the changing moment [2].
- The evaluation of the changing moment for the used oil from engine crankcase is made by using the method of oil spot (the ROMAN firm from Romania). This method is applied for Romanian oils made at Lubrifin Braşov (Fig. 5). It is a good and efficient method and it is based on the aspect of the spot made on a filter paper [3].
- The estimation of the oil changing moment (Fig. 6) uses the photoelectric method at the ROMAN firm from Romania and it is applied for Romanian oils made by Lubrifin Braşov [3].

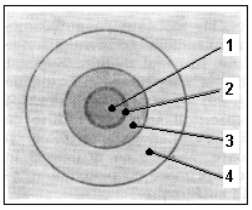

Fig. 5. The method of oil spot [3].

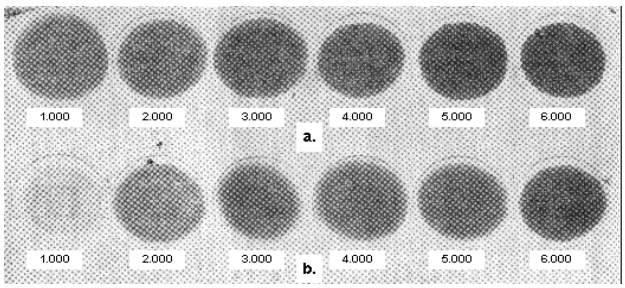

Fig. 6. The photoelectric method [3].

This method allows the establishment of used oil changing moment, according to the quantity of oil impurities.

Analyzing these application methods, it can be observed that it is necessary the endowment with performing laboratories, at high technical level. In addition, an accurate application of these methods involves a special attention from the technical staff and also practice experience.

In modeling and simulation domain considering virtual instrumentation, at international level was developed an important part of activity, which is orientated on collaborative projects between industrial and commercial companies: AEA Technology, Barkley's Bank, British Aerospace, British Gas, British Petroleum, Defence Research Agency, Ford Motor Company, Hydraulics Research, Inmos Ltd., Rolls Royce, Philips Research Laboratory, Sharp Laboratories of Europe [4, 5, 6].

There are a lot of Romanian firms and institutions interested in this domain, at educational level and also, between the lubricants users. "Politehnica" University from Bucharest and "Gheorghe Asachi" Technical University from Iaşi realized researches in this field, in order to determine rheological properties of the mixture of oil with polymers; it was emphasized their non-Newtonian tixotropic character.

Another partnership between "Politehnica" University from Bucharest and Bucharest – Măgurele physics platform analyzed the correlation of the lubricant destruction degree and its microscopic structure. The determination of lubricants impurities, from mechanical transmissions, uses the radioactive tracing points method.

Also, at "Transilvania" University from Braşov there were obtained interesting results in management direction of solid residues from lubricants, by using the ferografic analysis of used oils. Similar researches regarding lubricants durability, especially of consistent oils, were made in Romanian manufacturing bearing firms, such as RULMENTUL Braşov, TIMKEN Ploieşti or Koyo Alexandria. Their industrial laboratories had the opportunities to make physical-chemical standard tests and tribological ones (Timken stand, Amsler stand etc.).

3. METHODS AND RESULTS IN ACTUAL PROJECT

Actual project developed a scientifically partnership, who brought a new idea of a method for a fast diagnosis of liquid lubricants (used for cars, air ships, sea ships, engines and different systems). There were made researches in order to achieve a modeling and simulation instrument for the lubricants wear behavior. This device must give the oil changing moment, in a practically way, when it is completely used, not after theoretical suppliers recommendations.

Main idea of this device is to use a small quantity of lubricant for a determination, having low time of measurement and an adaptability character; these features represent essential advantages of these researches. Specialists from partnership achieved an informatics unit assembly, with complex and various actions: experimental data acquisition, extrusion curves tracing for fresh and used lubricants, etc.

First step was to obtain a theoretical model for squeeze curves specific to fresh and used lubricants, using LabVIEW software-graphic background program developed by National Instruments Corporation.

This program is useful in data acquisition, also for processing and presentation, control and command of industrial process, analyze for the dynamic behavior system. Using a graphic language in this environment, we could realize executable applications named virtual instruments, which can satisfy any direction of use present before [6].

There were made simulation tests for experimental data acquisition, which were accomplished for each lubricant type, using squeeze–film process through two parallel circular surfaces, with constant velocity. LabVIEW data acquisition process used constant geometry and extrusion velocity and varying the temperature of the lubricant film.

Another step in rheological properties determination for lubricants was the design and the execution of an experimental stand (Fig. 7), which conception was based on film lubricant squeezing through two parallel circular surfaces, with constant velocity. The experimental stand for rheological determinations is a modified rheogoniometer Weissenberg, which has as main elements: central unit (Fig. 8), motor drive for superior disk (Fig. 9), corresponding to friction coupling, electrical action system and motor command, pressure transducers, displacement transducer, data acquisition and processing system.

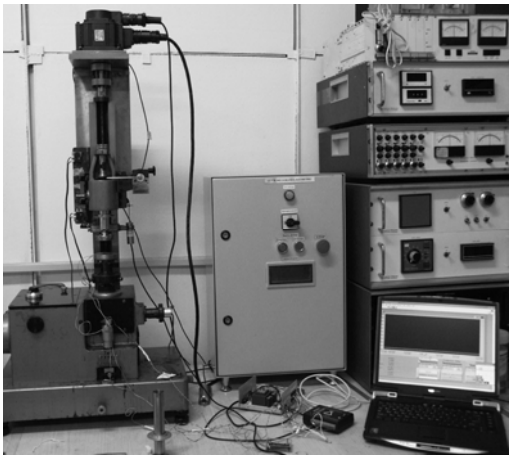

Fig. 7. Experimental installation for lubricants tests.

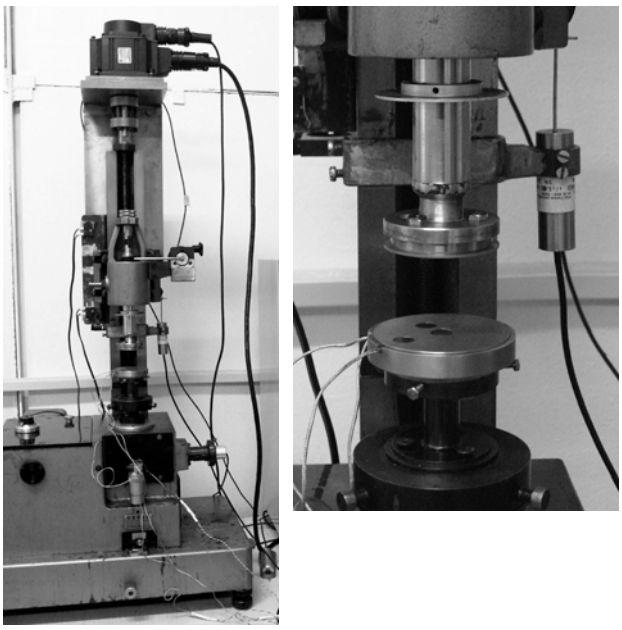

Fig. 8. Central unit and a detail of extrusion area.

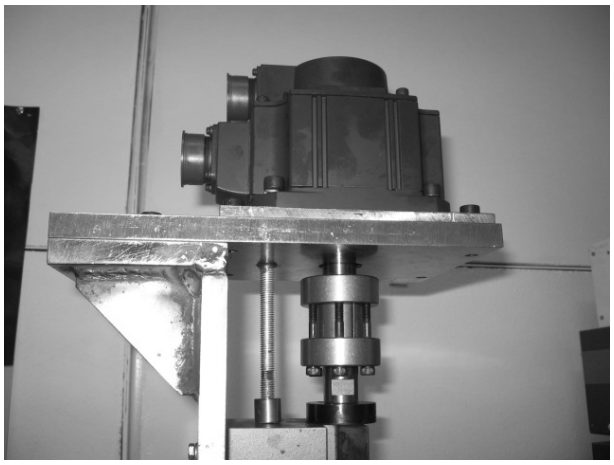

Fig. 9. Motor drive for superior disk.

Key-points were represented by the centralised data acquisition system and the automatization of servomotor working cycle. Using experimental data acquisition and processing program with LabVIEW there were obtained important information.

There were determined rheological parameters of fresh and used fluids, at different temperatures, using a specialised rheometer.

First step in the experimental data acquisition was to configure measurement system. Signals are taken from three pressure transducers and one displacement transducer. They are measured using a NI USB-6008 data acquisition board. This one is able to make 10.000 measurements by second, at 12 bits resolution.

Using Measurement&Automation Explorer software, it was defined a task, named REO (Fig. 10), which effects measurements for all four signals. Measurement gap of the board was established at ± 5 V and the board was configured for a continuous measurement of 2.000 values by second, for each chanel [6].

It was realized a virtual instrument for the calibration of three pressure transducers, which read 2.000 values from each channel and posts a medium value (Fig. 11).

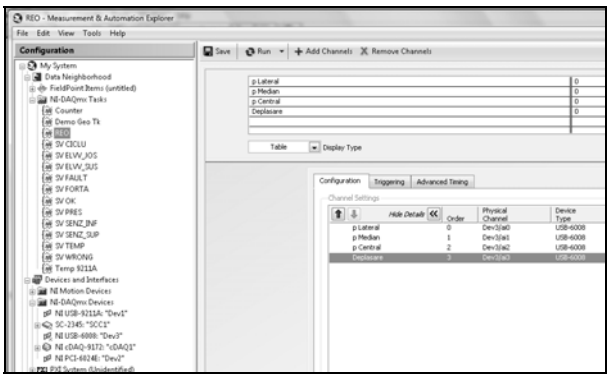

Fig. 10. REO- Measurement & Automation Explorer.

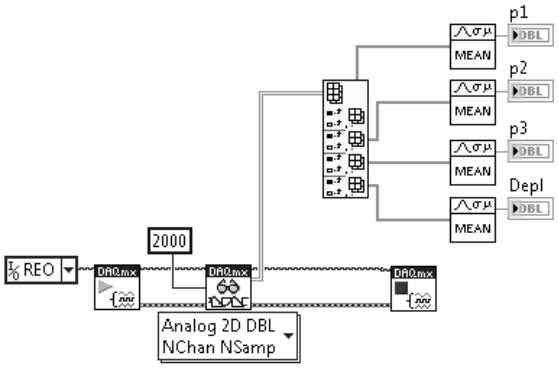

Fig. 11. The virtual instrument for calibration.

There were obtained relations for transformation of measured electrical voltage in measurement units for pressure. For the transformation of displacement transducer value it was another relation to transform electrical voltage value in length units. It was also created an instrument to measure pressure variations, during the determinations.

Obtained values were saved in a data file, by the virtual instrument which made also the measurements. After that, the saved values were taken over, they were scaled and graphical posted; finally, there were obtained graphical representations (Figs. 12 and 13).

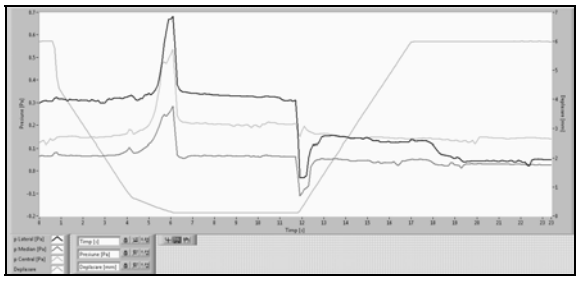

Fig. 12. Fresh HLP46 oil at 0,25 mm/s velocity.

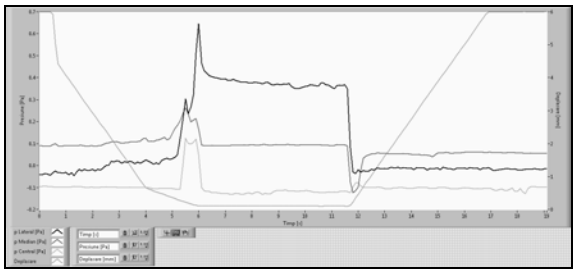

Fig. 13. Used HLP46 oil at 0,25 mm/s velocity.

4. CONCLUSIONS

Researches indicated significant differences between fresh and used fluids viscosity, which are due to the changing of their physical-chemical properties. It is an obvious conclusion and a valid assumption that lubricants' aging is directly connected to lubricants viscosity decrease.

There were realized extrusion tests in order to compare fresh and used lubricants behaviour; it was concluded that it is a direct connection between pressures distribution and lubricants wear degree. The more lubricants are used, the more maximal film pressures are lower, relative to fresh ones. Also, the accuracy degree of dynamic answer which is obtained is lower, relative to fresh fluids.

Experimental installation is quite simple and easy to use; it offers the possibility to obtain a large range of values for influence parameters of friction and wear.

Practically application of tested method offers important data concerning wear process evolution and about lubricants influence on durability, at high precision. The method may be applied in many practical situations, having economical conditions. The achievement of a modeling and simulation instrument of the lubricants wear behavior has the advantage of a fast diagnose method, with minimal investments and a high precision level, easy to use. This device may be available by many users, in research and didactic domain and, also, in small product units and exploitation units.

The principal result of these researches is a new, efficient, performed and ecological methodology, for the evaluation and quantification of lubricants wear degree.

It is important to obtain a new complex device for the "life reserve" diagnosis of lubricants oils, to assure a modern laboratory and to create new premise to develop new directions of approach for the lubricants durability problems.

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