ter their situation. Consequently, subjective ideas of inhabitants on current state of the environment in the districts of the CR are, in my assessment, almost identical with objective facts (Sedivy, 1989).

The strongest inward relation was found, by means of correlation analysis, between classification characteristics of sociodemographic anamnesis and variables concerning the cognition. By two-level classification of theoretically justified combinations of groups of variables, the influence on their random distribution (on the basis of statistically significant differences of frequency) was assessed. From this, heterogenizing influences were derived as follows:

- cognition on sensitivity component (in accordance with the phylogenetic theory of emotions which are considered to be the most original form of orientation in a unrecognisable environment with biological significance);
- influence of anamnesis classification characteristics on cognitive components;
- environmental awareness is further polarized by further cognitive variables and by sensitivity data;
- responsibility is heterogenized by anamnesis characteristics and by cognition variables;
- environment-friendly behaviour is differentiated by anamnesis data.

These foundings are undoubtedly of social psychological importance for the motivation and educational influence on awareness of environment and behaviour of people. It is clear to all of them that the cognitive component has an additive (+) and multiplicative (x) influence on all components of the hypothetical culture system. The emotive component at investigated boys of sixteen unambiguously predetermines their attitudes to environmental responsibility. In opposite, to them, the activating factors of sensitivity of adults can be regulated by the level of their knowledge and the ethic apparatus. Their responsibility is determined mostly by experience and regulated by legal norms. The emotional orientation in the environment is, with a high degree of probability, related to personality background whereas the sensitivity does influence interest as well a further cognitive efforts.

The cognitive and emotional components of awareness of environment activate the thought process the product of which are estimates and judgments. These should include statements concerning the responsibility formulated during successive integration of ethic attitudes. Environmental responsibility after individual selfreflection should manifest itself in the behaviour towards the environment which is also predetermined by anamnestic background.

The dynamics of environmental awareness is expressed in the contingent postdiction that modal attitude to environmental changes formerly manifested itself in form of unconscious indifference and inactivity as the result of dictated revolutionary acculturation of the so called socialistic way of life. The reason is the retardation of cognition of complicated phenomenon's behind simple phenomenon's (which is for the for sciences characteristic) as well as the retardation of synthesis behind analyses. The polarization of modal behaviour occurs (in consequence of increasing knowledge of detrimental effects of devastating factors and of ecology as a scientific discipline, i.e. during the process of filling up the information vacuum) both towards passive fear and substitute frustration activities inclusive the aggression, and towards reflected activity in the benefit of environment.

We shall carry out a modified type of such investigation at Czech forestry workers, i.e. students of high schools and universities and manual and technical workers of





forestry joint-stock companies. We want to verify the hypothetical assumption (derived from the results of a pilot probe) that the necessary but not sufficient condition of correct work with environment-friendly technologies is the reflected environmental perception of the working place – forest environment. We would like to participate in the international research, educational and cultural programme "Carpathians" that is being organized by several foreign corporations. On this occasion we would like to co-operate with Ukrainian colleagues who would find out the social and environmental perception of forest environment by Ukrainian forest workers. The results would be used for international comparisons. I openly offer the co-operation in the project to ready colleagues from Lviv and Transcarpathian Ukraine. I ask the organizators of the programme "Carpathians" if they would kindly give their approval to this co-operation.

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*Alois Skoupy, Radomir Klvac*

# BIODEGRADABLE OILS IN THE OPERATION OF PORTABLE FOREST MACHINES

Considerable amounts of oils used for the lubrication of portable forest machines, particularly power saws, get into the forest environment. The paper brings some new findings concerning the dispersion of oils used for the lubrication of cutting parts of machines and a possibility of replacing mineral motor oils with biodegradable oils. Original methods used made it possible to perform a precise measurement of oil dispersion and to study the service life of engines in portable machines. The paper aims at a contribution to the knowledge of the related negative effects of machines on the environment and on the health of machine operators.

## Introduction

Lubrication of chains in power saws at a loss contributes to the introduction of oils into the natural environment. Expressed in absolute values, the amounts are so large that they can be considered an important element with a possible negative impact on the forest ecosystem, particularly contaminating the surface and underground waters. Some studies report as much as up to 60% of oil used for the lubrication of chains in power saws getting into the water either directly or through soil infiltration.

Research projects in Germany, Austria, Sweden and later also in the Czech Republic were aimed at a substitution of mineral lubricants with substances of natural origin and led to the development of vegetable-based technical oils. However, if these oils are to become a full-value replacement of mineral oils, their technical parameters have to be at least so good as those of mineral oils. This is why a research task was started in 1992 in cooperation with the CR Ministry of Agriculture, concerning the substitution of

mineral oils with vegetable oils at the lubrication of two-stroke engines in portable machines. At the present time, the works continue within a Research Plan resolved at the Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry in Brno.

## Methods

A radioindicator method was developed to assess the dispersion of oils, which makes it possible to quantify the oil dispersion immediately after cutting. There were altogether 42 measured cross-cuts made on Norway spruce and beech trees of diameters ranging from 10 to 30 cm with the use of three oils of different viscosity. Parameters studied included the absolute amount of oil on the soil surface, in the sawdust and on the processed timber. Expressed were mutual relations. The concentration of oils was measured also on the soil surface under the point of cutting.

Service life tests of 100 operating hours were drafted in order to assess the applicability of motor oils provided that the speed characteristics of engines be measured at the beginning and at the end of the life test so that any possible changes caused by the test can be detected. Characteristics expressing the course of torque, fuel consumption, inlet air temperature, engine temperature beneath the heater plug and atmospheric pressure were measured both in the course of the speed tests and in the course of the service life tests.

Calculations were then made of the average concentrations of CO, $CO_2$ and HC in exhaust gases, average temperature of engine beneath the heater plug and the average torque for all speed regimes and the fuel mixture used. The average values were used to express individual quantities as in standard CSN 302008. The following data were supplemented by calculation: corrected torque $M_{t\,kor}$; net output $P_e$; corrected net output $P_{e\,kor}$; fuel consumption per hour $G_t$ and specific fuel consumption $g_e$.

The tests were made on a Husqvama 242 power saw.

At the beginning the testing was made with the use of a Schenck W 40 whirling electric brake which was later replaced with a DC dynamometer Type DS 446-2V whose torque sensor is less sensitive to the occurrence of torsion harmonic oscillations. After several repeatedly made attempts at a suitable mechanical connection of the engine crankshaft with the measuring instrument the best suited combination was that of a flywheel, two flexible couplings and an inserted shaft with arbour supports (Fig. 1).

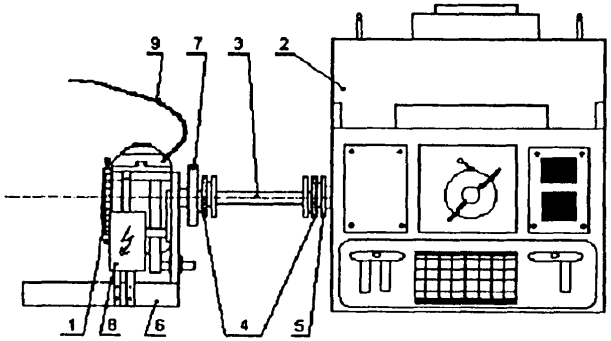


*Fig. 1. Diagramme of engine connection with the braking site: 1 – Engine of the Husqvama 242 petrol saw; 2 – DC dynamometer DS 446-2/V; 3 – Propeller shaft; 4 – Flexible coupling; 5 – Dynamometer flange; 6 – Cross table; 7 – Flywheel; 8 – Electromagnetic device to control the throttle disk; 9 – Fuel feed*





A device was designed for the service life test, which is capable of controlling the course of the life test to an inserted programme and to simultaneously record the measured values at all places where it is possible without any major problems. This is the way in which the throttle valve position was automatically controlled along with the speed of the braking site and moments for reading the following parameters: engine temperature, inlet air temperature, torque and rotations. The measured values were stored directly onto the computer hard disc.

The assessment of mechanical engine wear included the assessment of dimension changes, which can be affected by wear resulting from the use of different lubricating oils. The dimensions studied were as follows: some piston and cylinder diameters, piston ring joint backlash, spacing of heater plug electrodes, carbonization in the combustion space according to the methodology of Research Institute for Fuels and Lubricants (VUPM); the methodology is not the subject of this work (measurements were made by VUPM).

There were two oils gradually tested, each on a new engine of the Husqvama 242 power saw. In order to ensure comparable test conditions, one and the same carburetter was used for the two new engines, which was adjusted to manufacturer's instructions and sealed.

The measurements of speed characteristics were made in the range from 5 000 to 10 000 rpm with the individual measurements graduating by 500 rpm. The service life tests were arranged in such a way that the saw was operated at all times for 4 minutes at a full load of 8 500 rpm and then 2 minutes at 2 500 rpm. The oils evaluated were : OA M6A (mixture 1:25), BIO 2T/7 MIX (1:25), EUROL (1:66).

## Results

The oil dispersion studies indicated that 55% to 85% of oil are caught in the sawdust, 3% to 15% of oil remain on the surface of timber being cut, and 10% to 35% of oil get onto the soil surface with the relative amount of oil on the soil surface decreasing with the increasing diameter of the cut timber although the absolute amount is naturally increasing (see examples in diagrammes Figs. 2 and 3).

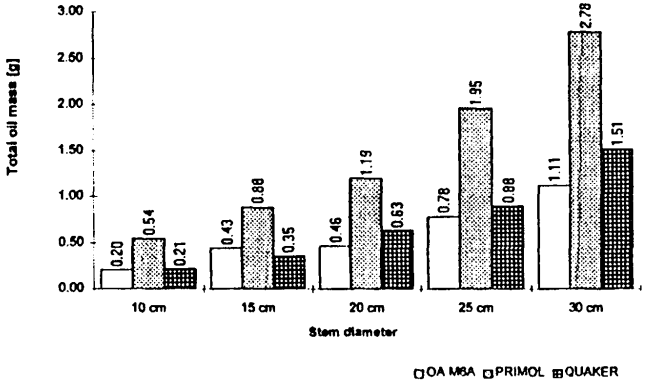


*Fig. 2. The dependence of oil amount on the diameter of a Norway spruce specimen being cut*

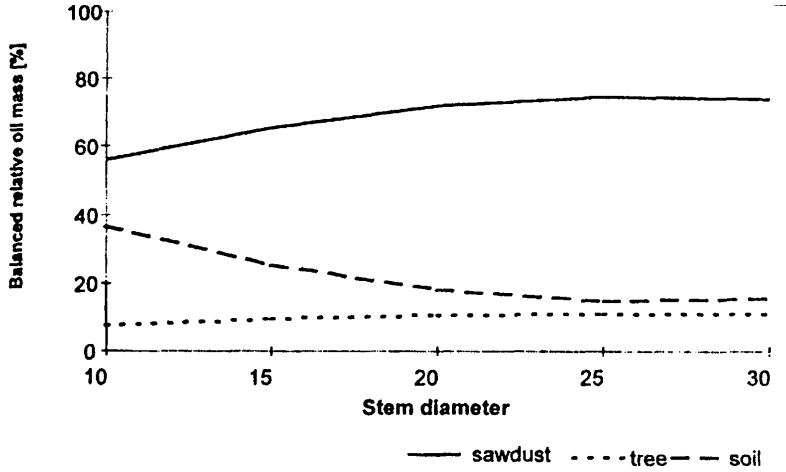


*Fig. 3. The relative distribution of OA M6A oil at cutting Norway spruce; oil supply 6 ml.min$^{-1}$*

The average soil surface oil concentrations increase with the increasing log diameters and reach the values ranging between 0.01–0.1 g.m$^{-2}$. The maximum oil concentrations beneath the cutting point range between 0.05 – 0.65 g.m$^{-2}$ with the oil spot area being max. several tens of cm$^2$. A typical oil stain including the measured concentrations is illustrated in Fig. 4 with the marked position of the cut specimen and the power saw position. Table I which precedes the Fig. 4 brings actual concentrations on individual measuring points within an area of 1 x 3 m.

*Table I.*

| | | | |
|---|---|---|---|
| Tree species | Norway spruce | Air temperature [°C] | 21 |
| Diameter [cm] | 29.5 | Wind speed [m.s$^{-1}$] | 0 |
| Humidity [%] | 41.8 | Wheather | half-clear |
| Oil type | OA M6A | Cutting time [s] | 10.2 |
| Oil pump adjustment | Degree 4 | Total oil consumption [g] | 0.241 |

Oil concentrations in g.m$^{-2}$

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 12 | 0.04638 | 0.05116 | 0.04712 | 0.04391 | 0.04292 | 0.04051 | 0.03247 |
| 11 | 0.05348 | 0.06269 | 0.06314 | 0.06534 | 0.06112 | 0.05618 | 0.04050 |
| 10 | 0.06913 | 0.08651 | 0.09193 | 0.09216 | 0.07533 | 0.06267 | 0.04827 |
| 9 | 0.08126 | 0.11622 | 0.12418 | 0.14955 | 0.09500 | 0.07732 | 0.05070 |
| 8 | 0.08998 | 0.15196 | 0.17915 | 0.17605 | 0.13730 | 0.09993 | 0.05980 |
| 7 | 0.09873 | 0.19293 | 0.25753 | 0.32054 | 0.18755 | 0.12780 | 0.06466 |
| 6 | 0.06800 | 0.14694 | 0.23346 | 0.57452 | 0.30119 | 0.21376 | 0.09481 |
| 5 | 0.08029 | 0.14137 | 0.18639 | 0.26962 | 0.20706 | 0.11675 | 0.06230 |
| 4 | 0.06173 | 0.08580 | 0.09931 | 0.10937 | 0.09148 | 0.07706 | 0.05017 |
| 3 | 0.05020 | 0.06710 | 0.06534 | 0.06472 | 0.06198 | 0.05474 | 0.04071 |
| 2 | 0.04426 | 0.05035 | 0.05355 | 0.05193 | 0.04911 | 0.04391 | 0.03727 |
| 1 | 0.03932 | 0.04529 | 0.04730 | 0.04978 | 0.04607 | 0.03835 | 0.03352 |

Table II presents the average and maximum oil concentrations found on the soil surface by oil types and tree species with the oil supply being set to Degree 2, ie. ca. 6 ml oil per minute.





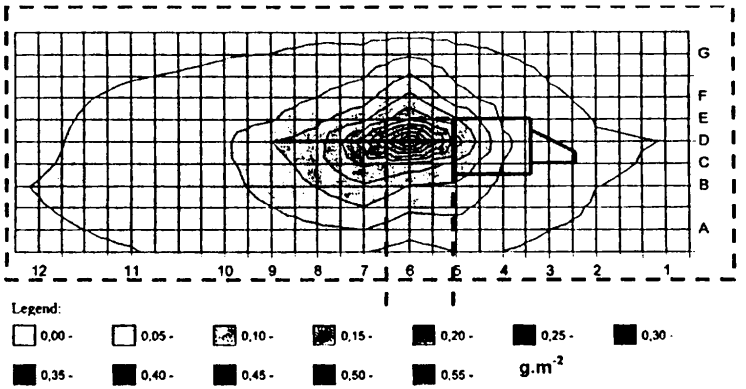


*Fig. 4. Soil surface oil concentration Table II: Average and maximum soil surface oil concentrations in g.cm$^{-2}$*

| Norway spruce | OA M6A | | PRIMOL | | QUAKER | |
|---|---|---|---|---|---|---|
| Diameter | Average | Max. | Average | Max. | Average | Max. |
| 10 cm | 0.024 | 0.186 | 0.061 | 0.351 | 0.015 | 0.110 |
| 15 cm | 0.039 | 0.301 | 0.061 | 0.408 | 0.021 | 0.114 |
| 20 cm | 0.022 | 0.109 | 0.107 | 0.539 | 0.024 | 0.173 |
| 25 cm | 0.044 | 0.237 | 0.083 | 0.458 | 0.024 | 0.146 |
| 30 cm | 0.054 | 0.352 | 0.099 | 0.669 | 0.055 | 0.292 |
| Beech | OA M6A | | PRIMOL | | QUAKER | |
| Diameter | Average | Max. | Average | Max. | Average | Max. |
| 10 cm | 0.012 | 0.060 | 0.059 | 0.429 | 0.025 | 0.181 |
| 15 cm | 0.022 | 0.191 | 0.061 | 0.410 | 0.030 | 0.142 |
| 20 cm | 0.044 | 0.281 | 0.088 | 0.379 | 0.025 | 0.169 |
| 25 cm | 0.041 | 0.383 | 0.088 | 0.629 | 0.029 | 0.191 |
| 30 cm | 0.069 | 0.614 | 0.072 | 0.368 | 0.036 | 0.288 |

The results of motor oil testing were processed into tables and diagrammes. With regard to the permitted extent of this contribution, it is only several examples that are presented here. One of them is illustrated in Fig. 5 with the course of outputs. It showed that the maximum engine performance always exhibited a drop in the course of the life test. The drop was most significant with Eurol whilst the BIO 2T/7 MIX results were comparable with those of the OA M6A.

The measurements did not reveal any substantial differences between the respective oils. The results of measuring the carbonization deposits were evaluated to Methodology CZ 125 (511, 516) and recorded in tables and diagrammes (Fig. 6). The higher points the better result. In contrast, viewed from the point of carbonization the best of oils appeared to be Eurol that is not inclined to clogging of the exhaust port or to piston ring sticking.

The evaluation seems inconsistent only at the very first sight since some effects which were not subjected to study in the given methodology appeared to be decisive in the course of the life test. For example, Eurol fouled the carburetter sieve so that the end of the life test saw a considerably poorer fuel mixture. In the comparison with the initial measurements, Diagramme 4 shows the performance decrease at the medium speed and the increased performance, in contrast, at the higher speed.

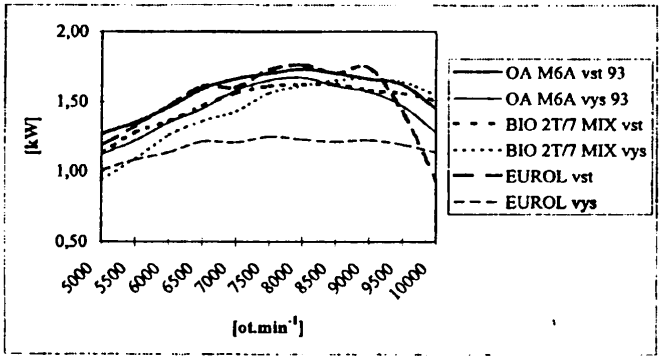


*Fig. 5. Graphic processing: An example (the course of effective output /Pe/)*

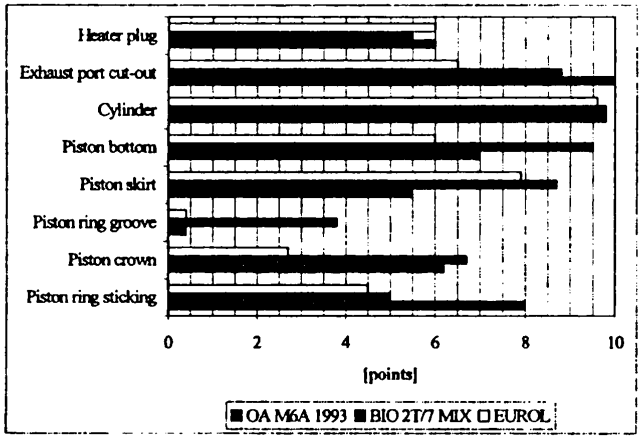


*Fig. 6. Illustration of the point evaluation of piston and cylinder carbonization deposits*

## Conclusions

A general statement can be made that during the current operation of a chain saw in the forest stand the oil concentrations on the forest soil surface cannot reach values that could have a negative influence on the soil flora and fauna. The impacts on the timber production cannot be spoken of at all. Also, any contamination of water, particularly the underground water, comes into consideration at these concentrations only on the condition of a massive oil leakage such as at oil spills. A more serious contamination of water can result only from working on water-logged soils or from cutting right above the water surface.

We assume, however, that it is useful to recommend the use of biologically degradable oil such as the vegetable oil for spring areas, spa forests and the like. In all other cases the requirement of the technical properties of biologically degradable oils being at least comparable with special mineral oils and their prices is logical. Only then the oils will be a real contribution.

Evaluating the engine oils we can claim that the biologically degradable oils can be a full-value substitution for mineral oils. Yet, there are still some problems at hand





that arise apparently due to the polymerization of these oils such as the clogging of carburetter sieve. In our opinion, the two methodologies are entirely original the statistic evaluation providing the repeatable results whose interpretation is a good basis for conclusions that can be used by manufacturers and users of oils as well as for farther research.

## Acknowledgement

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# FOREST ROADS ON GROUNDS OF LOW BEARING CAPACITY

## 1. Methods of opening-up the regions

### 1.1. The use of bark

Places characterized by grounds of poor bearing capacity which are permanently waterlogged and groundwater table is constantly at the level of soil surface can be passed only using the suitable type of a road with the corresponding type of roadway