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STUDIES AND RESEARCHES REGARDING THE INFLUENCE OF LUBRICATING OIL TEMPERATURE ON DIESEL ENGINES

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ABSTRACT: The thermal regime has an important role on the wear of the engine and it affects the good functioning (also influencing the functioning parameters). The lubrication system of the internal combustion engine has the important role of ensuring an oil film between the moving surfaces. This paper highlights the effect that the engine lubricating oil temperature has on a diesel single cylinder research engine, on some important parameters of the engine (fuel consumption, power and torque). Experimental investigations were conducted in TestEcoCel Laboratory, Technical University of Cluj-Napoca.
KEYWORDS: lubricant oil, fuel, power, torque

INTRODUCTION

The functioning cycle of an internal combustion engine is characterized by: speed, load and the thermal regime.

The thermal regime has an important role on the wear of the engine and it affects the good functioning (also influencing the functioning parameters). It is a known fact that the friction between the moving parts (for example the piston-piston rings-cylinder, connecting rod-crankshaft) is reduced with the lowering (within some limits) of the viscosity of the oil from within the lubrication system.

A high viscosity of the oil can cause some power losses - loses that determine the rise of the fuel consumption and a low viscosity adversely affects the component parts wear, so it also affects the durability of the engine. The lubrication system of the internal combustion engine has the important role of ensuring an oil film between the moving surfaces.

EXPERIMENTAL RESEARCH

The determination of the lubricant oil temperature influence on the diesel engine performance was made in the TestEcoCel Laboratory, a high performance laboratory that is specialized in testing, research and certification of internal combustion engine that work with different fuels (Figure 1.)

The used test-bed consists of a single cylinder research engine that is equipped with an endoscopic camera for observing the phenomena that occur inside the combustion chamber, an active dynamometer used to rotate the engine up to speed, but also used to simulate the load of the road (loading the engine with a torque), a conditioning system for the cooling liquid and for the lubricating oil, a ventilation system used to condition the temperature of the air inside the test cell, a gas analysis system capable of measuring the pollutants in the exhaust gas; and all the systems are controlled by an automation system.

Figure 1. TestEcoCel Laboratory

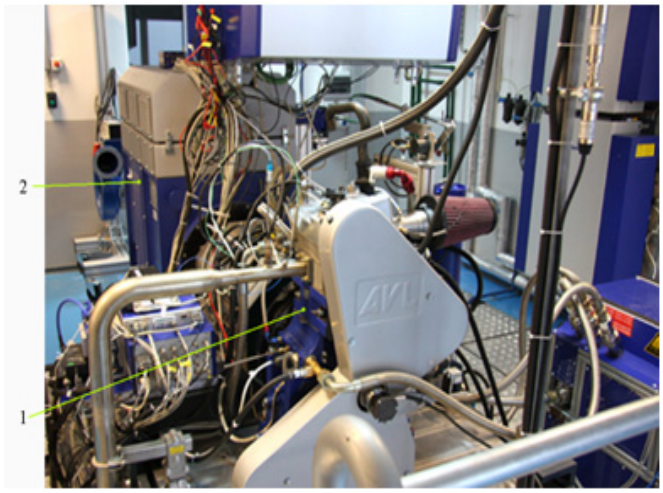

Figure 2. The test bed
1 - Single cylinder engine; 2- dynamometer

The tests were made at different temperatures of the lubricating oil, at constant speed, in order to exclude the influence of other factors that cannot be appreciated objectively.
Although the laboratory allows the use of different fuels, for this study, the only fuel that was used is classic: Diesel.

RESULTS

The measurements were made following some predefined steps, and materialized by getting a large number of results, some of which are presented in Table 1.

Table 1. Measurement results for the speed of 1000 rot/min

Lubricant oil temperature [°C]	Power [kW]	Torque [Nm]	Fuel consumption [kg/h]
30	1.55	15.9	0.75
35	1.76	18.0	0.70
40	1.85	18.7	0.66
45	1.96	19.1	0.64
50	2.05	19.4	0.60
55	2.13	20.3	0.58
60	2.21	21.2	0.55
65	2.35	22.6	0.53

The results from the measurements for the fuel consumption, power and torque, for the case where the speed was 1000 rot/min are transposed in figures 3, 4 and 5.

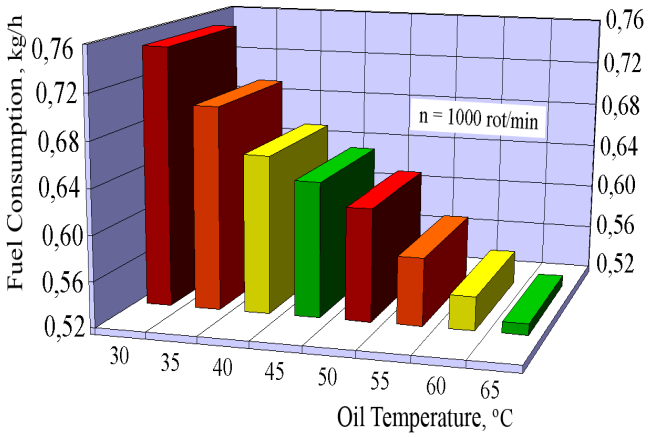

Figure 3. Fuel consumption variation depending on the lubricating oil temperature

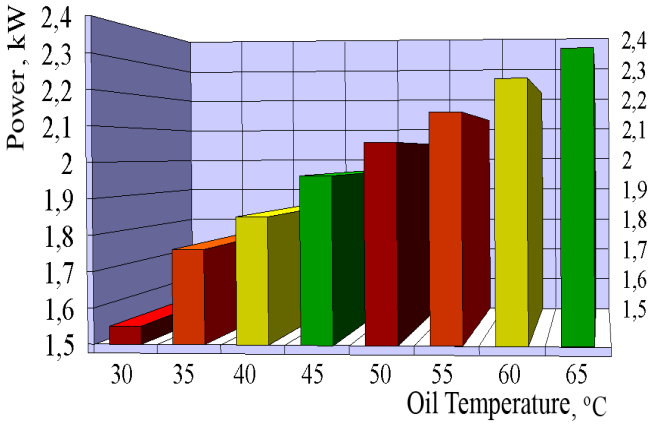

Figure 4. Power variation depending on the lubricating oil temperature

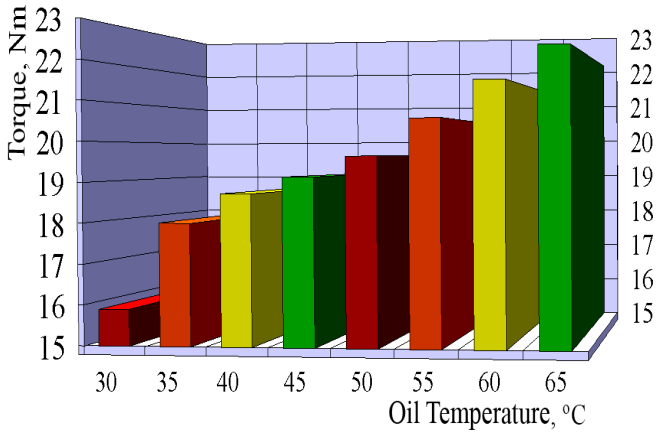

Figure 5. Engine torque variation depending on the lubricating oil temperature

In figure 6 the variation of the fuel consumption is presented, for the same engine, but for the speed of 2000 rot/min, and in figure 7 the specific fuel consumption is presented.
Effective power and torque variation depending on engine speed, for different temperatures of the lubricating oil are presented in figures 8 and 9.

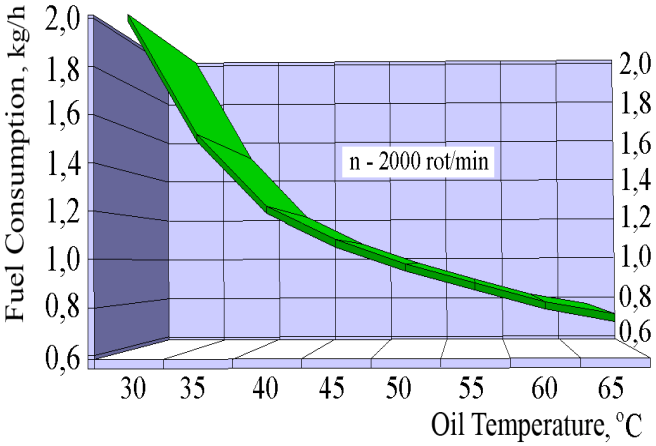

Figure 6. Fuel Consumption variation depending on the lubricating oil temperature, for the speed of 2000 rot/min

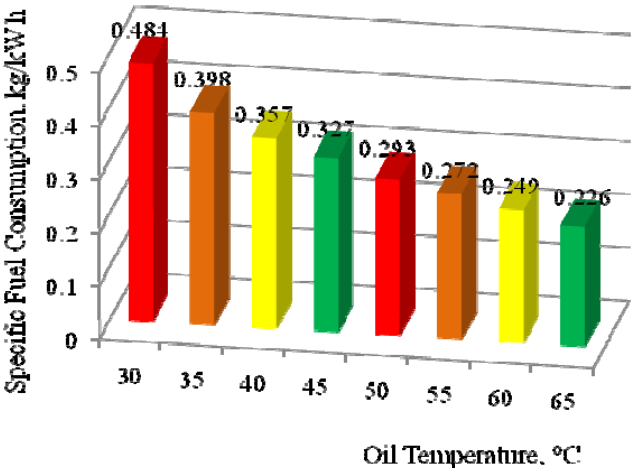

Figure 7. Specific Fuel Consumption variation depending on the lubricating oil temperature, for the speed of 2000 rot/min

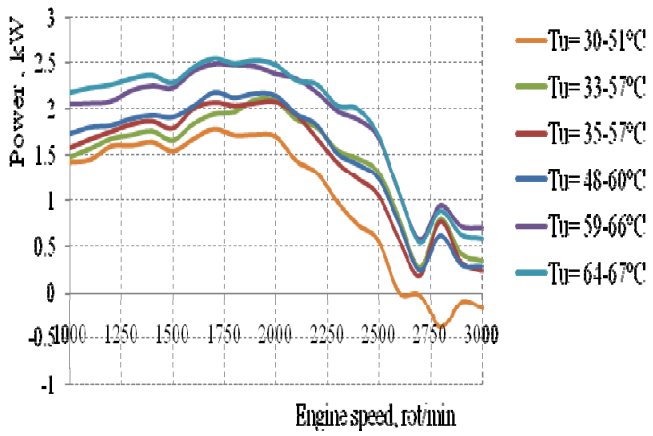

Figure 8. Engine power variation depending on the lubricating oil temperature,

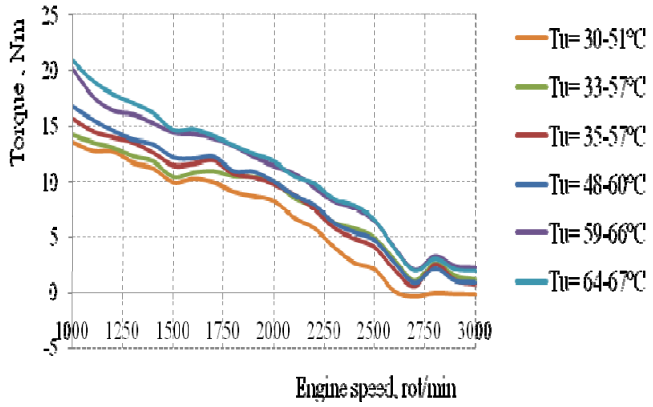

Figure 9. Engine torque variation depending on the lubricating oil temperature

CONCLUSIONS

The temperature inside the combustion chamber (determined also by the temperature of the lubricating oil) is the one that significantly influences the ignition delay. But the ignition delay (during which the fuel suffers important physical and chemical transformations), is a decisive factor when starting the engine, and also influence the functional parameters, the quietness and the durability of the engine.

From the present results, the conclusions are that the lubricating oil temperature (which causes its viscosity reduction) reduces fuel consumption and improves power and torque performance resulting explained by reducing friction between parts in relative motion (both from lubrication oil viscosity reduction and because at higher temperatures the clearance between the moving parts is smaller).

From figure 8, it can be seen that for a variation of the oil temperature from 30 to 51°C, at engine speeds of over 2600 rot/min, the effective power of the engine has negative values, which indicates that the engine is no longer rotating the dynamometer, but the dynamometer rotates the engine, which is allowed due to the measurement control method (the used method was speed/alpha, meaning that the speed is controlled by the dynamometer and for the engine, throttle position is controlled, in this case of measurements, it was 50%)

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