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CONTRIBUTIONS TO THE RESEARCH AND TESTING OF MODERN DIESEL ENGINES FOR CERTIFICATION AND HOMOLOGATION OF PERFORMANCES AND EMISSIONS

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Summary. In the current age, pollutant emissions reduction and fuel consumption is less an alternative or secondary option but rather some categorical imperative to be treated with all seriousness. We have to do so with a set of priorities. In addition to designing environmentally friendly engines, which will consume and pollute less if possible even at all, there have to be taken into account also the existing and running engines until this time, and the performance level, which hasn't been designed taking into account the latest criteria in the field.

In the present work it is discussed the problem of testing brand new engines and systems, and also of analyzing or, if one can say so, of investigating the existing systems, but with some significant improvements which have to satisfy the actual requirements of less pollution and low consumption. Reviewing and carefully

studying the power of existing diesel engines in use today may lead to a series of constructive solutions and ways of optimizing the injection system so as the pollutant emissions and fuel consumption to be reduced, while engine power performance increases.

Key words: Automotive, Diesel, Engine, Exhaust, Performances, Pollution.

INTRODUCTION

Compression ignition engine is one of the efficient solutions for equipping the automotive sector and the present day tractors [1, 2]; or at least was considered in such manner till recently (that was before international Dieselgate scandal). In the last weeks it was all over in the global media the problem of pollutant emissions related to the Diesel engine installed on the VW motor vehicles, beginning with a series of tests developed in USA and continuing with investigations and criminal allegations inclusively in the European economic and industrial core (Germany), in Braunschweig and Wolfsburg where in fact is situated the production center of the auto maker. These events bring out from any anonymity the compression ignited engine and maintain the automotive industry in the first positions of the list with fields in the public and media attention. Besides the variations on the capital market, beside the diminishing or altering value of stock market and beyond the enormous financial losses generated simultaneously with the outlining and highlighting the information related to the manipulation of federal tests in USA by the European based vehicle production company and even beyond the political divorce of European Commission president (CE) Jean-Claude Juncker (during a visit at Passau, in south Germany) from the american president Barack Obama, it is very important that the general public and scientific community must understand the technical significations of developed tests in automotive engineering field, as well as the effects upon pollution and health.

The Volkswagen scandal has already raised questions in Europe about the accuracy of emissions testing, putting other automakers on the defensive position. Environmental groups have long complained that existing tests understate the amount of pollution that cars generate under real driving conditions [4, 6].

In this paper it is presented an innovative procedure for real time testing [3, 5] of the motor vehicles' emissions in road operating conditions by using portable equipment and latest state of the art wireless and Bluetooth telecommunication technologies in order to scan and read the sensors signals provided with the vehicle's electronic systems.

MATERIAL AND METHODS

Measuring method is based on the connection of digital equipment to the vehicle's electronic system interface in order to determinate the analogic parameters. Among the useful equipment for the development of experimental determinations were used the Torque acquisition system with a specific interface and a middle class passenger car (type model Dacia Logan with K9K engine euro 4 and euro 5).

The connection through the electronic telecommunication interface has the purpose of allowing an external evaluator (researcher, inspector etc.) to establish a scanning protocol of parameters in which the electronic system of the motor vehicle, also the engine, operates and manages the operating processes during some experimental tests, as it is shown in figure 1.

Fig. 1. Setting the protocol for communication, transfer and displaying available data from ECU. 1-Test track configuration, 1a-Start/stop location, 1b-Track sector, 1c-Tested vehicle, 2-Injection pump, 2a-Temperature sensor, 2b-Fuel flow actuator, 2c-High pressure output, 2d-Injection unit, 3-Digital phonometer, 3a-Graphic display, 3b-Analogic display, 3c-Digital operation key, 3d-Digital display, 4-Digital label, 5-Analogic interface, 6-Electronic device, 7-OBD connection, 7a-OBD interface, 7b-OBD socket inside vehicle., 8-Portable gas analyzer, 8a-Digital display, 8b-Operation panel, 9-aquisition terminal, 10-Delphi injector, 10a-Nozzle, 10b-Electric connection, 10c-Injector return, 10d-high pressure connection.

For realizing the experimental tests are used different applications and specialized equipment. On the basis these programs have complex mathematical systems. Fundamental programs, from which it is started, are using the values measured by the sensors. With the technological evolution testing strategies become more and more complicated and the problems which appeared in the older systems are now eliminated.

RESULTS AND DISCUSSIONS

There have been developed a series of comparative experimental tests, concerning the engine's output performance level at different operating regimes and in the situation of many parameters took into account, namely the consumptions, pollutants and specific conditions of mixture formation. All of these having the aim of determining the influence upon engine's economy and pollution level. Experimental measuring highlight the particular results, first from the phase of applicative research concerning the Euro 5 compression ignition engine with Common Rail fuel direct injection in the combustion chamber, and secondly in comparison with a Euro 4 C.I.E supplied through Common Rail direct injection, in order to outline the substantial differences concerning the performances and operational peculiarities.

The variation of accelerator pedal position for loading control through the engine's management system registers high values at high engine speeds. With the increase of accelerator pedal displacement angle initially increases the quantity of injected fuel, influencing by the means of turbocharger also the air quantity introduced in engine's cylinder a fact that leads to a better combustion and to the higher engine speed.

Through emissions monitoring with the gas analyzer were outlined the nitrogen oxides values (Fig. 2) especially their increased level when the injected fuel volume in the cylinder is small (lean air-fuel mixture), at the engine operation in higher gear ratios and lower engine speeds. As long as the motor vehicle operates at middle range speeds and lower engine speeds, due to the air quantity and high temperatures, the mixture is influenced and the processes take place in the context of nitrogen oxidation reactions.

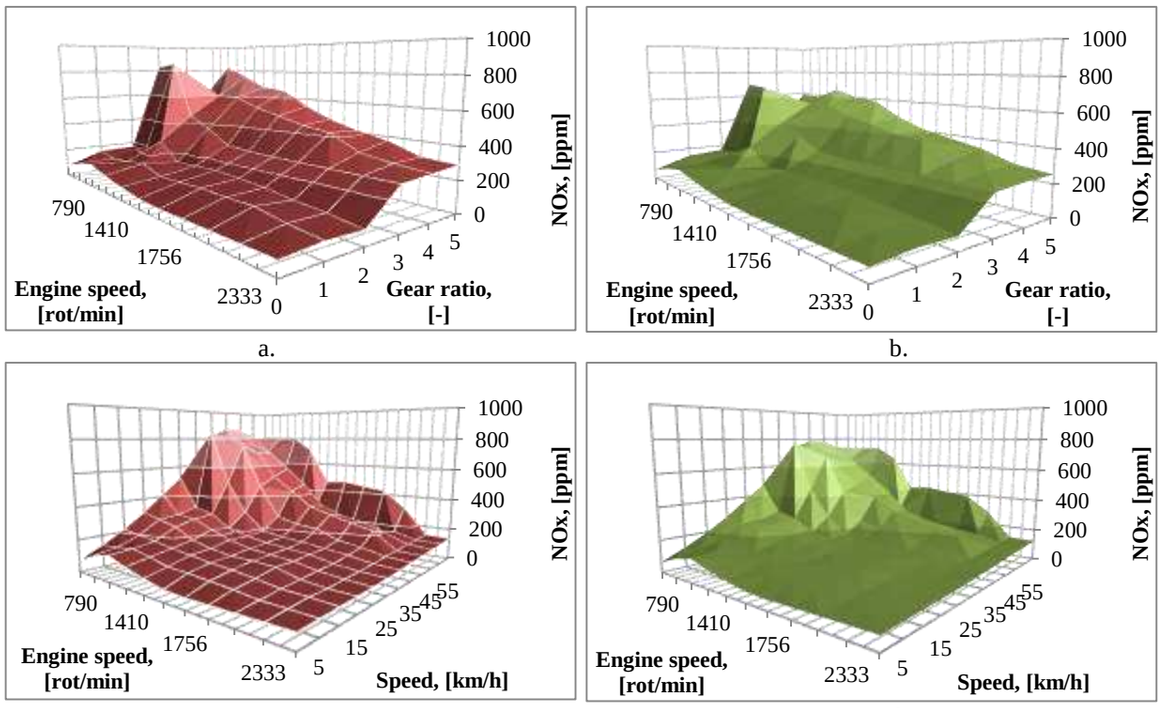

Fig. 2. Nitrogen oxide emissions during the dynamic tests of C.I. engine with Delphi injection system. a. NO_x during the tests with Euro 4 Delphi injection; b. NO_x during the tests with Euro 5 Delphi injection; c. NO_x during the tests with Euro 4; d. NO_x during the tests with Euro 5.

N_2O is a gas with significant greenhouse effects. In comparison with carbon dioxide (CO_2), the N_2O pollutant compound retains 250 times more thermal energy. Nitrogen oxides react with the ozone layer from stratosphere. A proper way for diminishing the formation mechanism of nitrogen oxides is by adjusting the air quantity and pressure in the intake manifold in order to reach the stoichiometric level in all situations in which the default supercharging systems do not operate at the corresponding or demanded performance level (higher altitudes, dynamic and starting efforts).

In figure 3 are represented the variation curves for average consumption and of brake specific fuel consumption (BSFC) at different operating regimes. For compared analyze of the results were represented the values experimentally determined in both configurations (Euro 4 and Euro 5). Thus it may be highlighted the difference concerning the output performances. Through comparative analyze of research results it is observed that the injection management contributes to the improving of mixture formation, which is an important step in optimizing the variation curve of air coefficient (lambda) in relation with the operating regime. An important difference it may be observed in the field of fuel consumption variation. Recording the average values of the fuel consumption it may be outline the fact that without the controlled interventions upon the engine supply system there is a negative influence of the operational regime and of air deficit upon economical performances concerning fuel consumption.

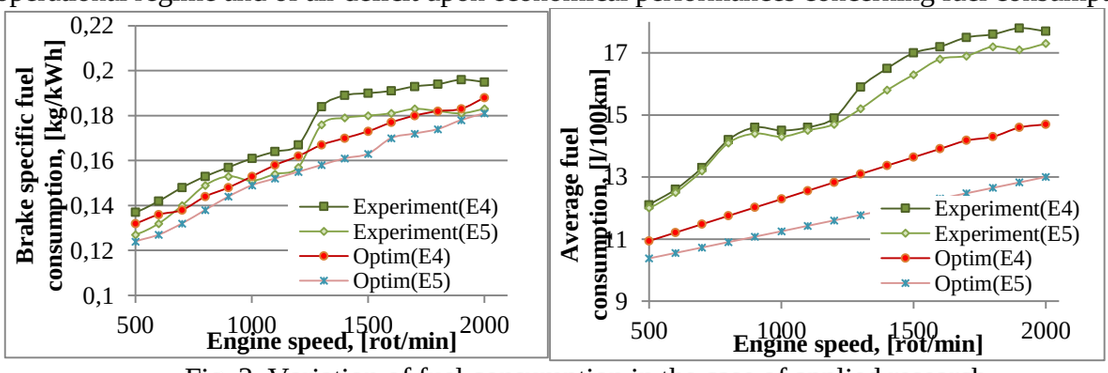

Fig. 3. Variation of fuel consumption in the case of applied research.

CONCLUSIONS

As an overview of the problem, the supply system influence on the engine economy may be affected by injection characteristics and also by each auxiliary system proper performance which may be monitored with the state of the art technologies that are available today.

This paper outlines the importance of linking the standard European testing procedure with experimental research implemented on a test-bed in science and engineering. The obtained results encourage the undertaking of new experimental research tasks concerning the engine's management and a proper designed fuel supply, in various restricted conditions – even by using ethanol and methanol fumigation maybe, a situation which may lead to a contribution at air-fuel mixture formation and to an improved energy efficiency as well as to a lower pollution. In other works, studies on thermal dynamics and fuel supply strategies (fumigation research) in the field of engine performances with higher energy efficiency will be much appreciated.

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