



REVIEW

by assoc. prof. dr. eng. Veselin Todorov Mihaylov

Technical University of Varna

on the dissertation for obtaining the educational and scientific degree "Doctor"

of eng. Velichka Rosenova Georgieva

Topic of the dissertation: "Study of the influence of the type of fuel on the working process of a diesel engine"

1. Actuality of the problem in the dissertation

The environmental impact of engines has long been a leading aspect in their development. The main advantages of diesel engines are their high efficiency and low carbon emissions. In recent years, legislation in the European Union has strongly promoted electric propulsion as a solution to the problem of pollution. Although it has potential, electric propulsion still has disadvantages both environmentally and economically. Despite the initial idea of stopping internal combustion engines from 2035, it is very likely that they will continue to be used after that.

One of the ways to reduce the carbon footprint of internal combustion engines is the use of biofuels. The plants from which biofuels are produced absorb carbon dioxide during their growth and this provides significant greenhouse savings compared to the use of petroleum diesel fuel. The future development of internal combustion engines is going through the use of increasing concentrations of biofuel-fossil fuel mixtures. It should be borne in mind that even if we switch to higher concentrations, a significant number of vehicles remain in operation that are designed to run on pure diesel fuel or mixtures with up to 10% bioadditive. At the same time, from a scientific point of view, it is interesting how the workflow and environmental performance of modern diesel engines with electronic fuel supply and a common rail battery fuel system develop at high concentrations. From this point of view, I consider the current dissertation to be up-to-date.



2. Brief biographical data about the PhD student

Doctoral student eng. Velichka Rosenova Georgieva graduated in Transport Engineering and Technologies, Bachelor and subsequently Master at the Technical University of Varna in 2015. She was enrolled in full-time doctoral studies by order of the Rector No. 250/20.04.2016, in the doctoral program "Internal Combustion Engines". She was expelled with the right of defense by order of the Rector No. 336/14.07.2020. She has been working as an assistant at the Department of Transport Engineering and Technologies since October 2024. I have very good personal impressions of the work of the PhD student.

3. Knowing the status of the problem

In the first chapter, a review and analysis of technical literature on the problem under development is made - the PhD student has used a total of 57 literature sources, of which 28 in Cyrillic and 29 in Latin. The different types of biofuels, their properties, production technologies, features of their use as fuel for internal combustion engines are considered. Modern research by various authors' teams on the subject is indicated, from which some contradictory results can be seen, mainly in terms of emissions (NO_x). As a result of the review of the technical literature, the purpose and objectives of the dissertation are logically formulated.

4. Methodology of the study

For theoretical research, a commercial software product DIESEL-RK was used. This product is designed for thermodynamic and thermal calculation, analysis and study of the working process in four-stroke diesel engines with atmospheric and forced filling. The parameters of the engine used in the experimental studies were set and the parameters of the working process were obtained.

An experimental study of a modern diesel engine with a battery fuel system on a dynamometer has been carried out. Parameters of the working process, harmful components in the exhaust gases and characteristic parameters of the engine with diesel fuel B0 and mixtures with biodiesel fuel B10, B30 and B50 have been studied. 2000 min⁻¹, 2500 min⁻¹, 3000 min⁻¹, 3500 min⁻¹ and a resistance torque of 50 Nm, 75 Nm, 100 Nm and 125 Nm.



5. Assessment of the credibility of the material on which the dissertation contributions are based

I can accept the data from the conducted research as reliable. The equipment used, the measurement errors, and the methodology for conducting the tests are described in detail. The experimental studies were conducted jointly by a team from the Technical University of Varna and the University of Ruse, who have many years of experience in testing engines, which further confirms the reliability of the results obtained.

6. Contributions of the dissertation

The applied and applied scientific contributions presented in the dissertation are in accordance with the research. The contributions are indicated on page 128 of the dissertation – five scientific and applied contributions and two applied ones. I can accept the above contributions from the PhD student and refer them to the groups: proving by new means a significant new side of already existing scientific fields, problems, etc.; obtaining and proving new facts and values.

Scientific-applied contributions:

1. A mathematical model for calculating the parameters of the workflow from recorded indicator diagrams has been improved. The model takes into account the change in pressure in the engine cylinder every 0.1 degrees from the rotation of the crankshaft and takes into account many parameters of the operating process of the engine under study.

2. A detailed analysis of the possibilities for mixing biodiesel fuel to diesel fuel has been made. The permissible concentrations of biodiesel fuel to diesel fuel have been determined and their impact on the power-economic and environmental indicators of the engine has been determined.

3. A model for calculating the parameters of the working process of a diesel engine with a high degree of reliability has been developed.

4. The influence of the power-economic, environmental, indicator, effective indicators and parameters of the work process in the operation of a diesel engine with an electronic fuel injection



system under different mixtures of diesel and biodiesel fuels has been established and determined.

5. A database has been created with the indicators and parameters of the work process in different operating modes of a diesel engine with an electronic fuel injection system for different mixtures of diesel and biodiesel fuels. The data are applicable for benchmarking, modeling and validation of simulation calculations.

Applied contributions:

1. A comparative analysis of the influence of different concentrations of biodiesel fuel on the power-economic, environmental, indicator and efficiency indicators is made, as well as the change in the parameters of the working process of a diesel engine with an electronic fuel injection system for different mixtures of diesel and biodiesel fuels is investigated and determined.

2. An experimental system for indicating a diesel engine with a modern fuel injection system has been improved, which makes it possible to record rapidly changing values during engine operation in established and transient modes.

7. Assessment of the degree of participation of the PhD student in the development of the dissertation and contributions

I know the work of the PhD student and I believe that the doctoral dissertation and its contributions are largely the result of the independent work of Eng. Velichka Georgieva, which is supported by the published scientific papers related to the study. The PhD student has been actively involved in conducting experimental research, in processing and analyzing the results.

I believe that the PhD student has developed his work independently, under the methodological guidance of his supervisors.

8. Evaluation of the publications on the dissertation

A total of five publications on the dissertation have been presented, one of which is independent. All publications are presented and published in non-refereed editions of Bulgarian scientific forums. There is no information about open citations of these scientific works. The publications are on the subject of the dissertation.



9. Use of research results in scientific and social practice

The dissertation presents results of scientific and applied value. Despite the lack of implementation documents or evidence of significant scientific achievements, the data obtained show the potential to achieve significant socio-economic benefits in the use of bioadditive fuels.

10. Implementation of the research results

There is no data for the implementation of the research results in the dissertation. Still, the results of the dissertation are useful for science and practice, in assessing environmental indicators, power indicators, the need for structural changes when working with high concentrations of dietary supplements.

11. Evaluation of the abstract

The abstract has a volume of 42 pages, reflects the main provisions of the dissertation, meets the requirements of the Technical University of Varna for the preparation of an abstract and of the Law on the Preparation of an Abstract.

12. Notes and recommendations

I have no significant remarks on the dissertation. However, I would recommend the PhD student to pay more attention to the graphical presentation of the results. Figures 4.2÷4.13 are represented only with trend lines, with no experimental points - there is no information about the deviations of the experimental data from the trend lines.

13. Conclusion

I give a positive assessment of the work of the PhD student, considering that he has fulfilled the requirements under the Academic Staff Development Act, the Regulations for its implementation and the procedural rules of the Technical University of Varna for the preparation of a dissertation.

I recommend the honorable members of the Scientific Jury to vote for the award to eng. Velichka Rosenova Georgieva the educational and scientific degree "Doctor" in the field of higher education 5. Technical Sciences, professional field 5.1. Mechanical Engineering, scientific



TECHNICAL UNIVERSITY OF VARNA
DEPARTMENT OF TRANSPORT ENGINEERING AND TECHNOLOGIES



specialty "Internal Combustion Engines".

10.06.2025
Varna

Reviewer:.....
/assoc. prof. dr. eng. V. Mihaylov/