

OPINION

of Assoc. Prof. Milena Petkova Dimitrova, PhD
Department of „Industrial Technologies and Management“,
Burgas State University "Prof. Dr. Asen Zlatarov",
member of the scientific jury, formed by order No. UD - 309 / 27.07.2026 of the Rector of
Burgas State University "Prof. Dr. Asen Zlatarov"

Subject: Dissertation work of Eng. Svetlin Petrov Vassilev on the topic *"MODELIZATION OF THE PROPERTIES OF PETROLEUM FLUIDS AND PROCESSES IN OIL REFINING"*, submitted for the acquisition of the educational scientific degree "DOCTOR" (PhD) in the field of higher education 5. Technical Sciences, professional field 5.10. Chemical Technologies.

1. Brief biographical data:

Svetlin Petrov Vassilev was born on 02.11.1976. He obtained the educational qualification degree "Master of Chemical Engineering", specialty "Engineering Chemistry", at the University "Prof. Dr. Asen Zlatarov" - Burgas (1994–1999). His professional experience is entirely in the field of oil refining and petrochemistry: he successively worked at Lukoil Neftochim Burgas, "Neftochimproject" (1999–2006) as a technologist-research associate, designer, head of the "Technological Calculations" group and chief designer; 2006–2017 he was a project manager, designer in the "Chemical Technology" part and a partner in "Neftgazengineering"; from 2017 to the present he has been working as a freelance designer at "Tersa". He has full design qualification at the Institute of Industrial Engineering, Technology Section, extensive practical experience with process simulators (ChemCAD, Pro/II, Design II, Aspen HYSYS/UniSim) and good command of English and Russian. The dissertation was developed under the scientific supervision of Prof. Dobromir Yordanov, PhD and Prof. Dicho Stratiev, PhD.

2. General characteristics of the presented dissertation:

The dissertation work submitted to me for preparation of an opinion consists of 284 standard typewritten pages, including Introduction, Aim and Objectives, five main chapters (Chapter I – Chapter V), Conclusions, Contributions and List of publications on the topic of the dissertation. The work is illustrated with 83 figures and 51 tables. The bibliography contains 647 literary sources, which shows a thorough study of the current state of the researched scientific field. The dissertation work was discussed and directed for defense by the department council of the Department of „Industrial Technologies and Management“ at Burgas State University "Prof. Dr. Asen Zlatarov".

3. Characteristics of the scientific issues in the dissertation work:

3.1. Relevance of the problem developed in the dissertation. The relevance of the topic developed in the dissertation arises from the following circumstances:

- 1) despite the growing role of renewable sources, oil and oil products remain the main source of energy for transport and industry and a key raw material for petrochemicals, which necessitates continuous improvement of the efficiency and economic feasibility of its processing processes;
- 2) the accurate characterization of crude oils and oil fractions is a fundamental stage in the simulation of technological processes in the petroleum industry, and the accuracy of predicting

the physicochemical properties of oil fractions is fundamental for the design, optimization and management of these processes;

3) there is a significant and poorly studied gap between the latest advances in oil fraction characterization and molecular reconstruction methods, on the one hand, and the methods implemented in widespread commercial process simulators, on the other hand;

4) imprecise forecasts resulting from outdated characterization methods lead to significant economic losses in oil refining, which makes the improvement of correlation dependencies and the introduction of modern analytical and computational approaches (nonlinear regression, intercriteria analysis, artificial neural networks) of direct practical importance.

3.2. Identifying and assessing the most significant contributions to the dissertation.

Object and subject of the research. *The object of research* in the dissertation work is petroleum fluids, petroleum fractions and the processes of their processing in oil refining installations. *The subject of the research* is the analytical techniques, correlation dependencies and molecular modeling methods used to characterize and predict key physicochemical properties of petroleum fluids (fractional composition, molecular mass, critical properties, viscosity) and for molecular reconstruction of oil and petroleum fractions.

The main goal of the study has been set and fulfilled, namely the study of available analytical techniques, correlation dependencies and methods for modeling the molecular composition of petroleum fluids in order to outline their limitations and determine the possibilities for improving their predictive ability.

The following five tasks were set and sequentially completed in the dissertation:

1. Validation of distillation methods for estimating the diesel fraction content in heavy oil fractions through an industrial experiment.
2. Development of improved correlations and an artificial neural network (ANN) model for predicting the molecular mass of petroleum fluids.
3. Development of new correlations and an artificial neural network model for predicting critical temperature and critical pressure.
4. Development of empirical correlations and an artificial neural network model for predicting the viscosity of mixtures of heavy oil fractions with diluents.
5. Evaluation of software libraries and methods with group constituents for predicting the properties of individual components used in molecular reconstruction of oil.

The results of the dissertation work have been published in 13 articles in journals, referenced and indexed in the world-famous databases Scopus and Web of Science, and in 3 articles in non-refereed publications/collections with scientific review, with a total of 6 of them directly presenting the results of the five main chapters of the dissertation. According to the attached reference for acquiring the educational scientific degree "Doctor" (PhD) in the professional field 5.10. Chemical Technologies, the doctoral student covers the required points in all groups of indicators, as for indicator G he received 82.68 points with a minimum of 30 points, and for indicator A - 50 points.

3.3. Main scientific and applied scientific contributions:

1. The superiority of gas chromatographic methods for simulant distillation (ASTM D 7169) over physical vacuum distillation methods in the characterization of heavy oil fractions has

been established, confirmed through industrial experiment and process simulation, with a documented economic effect of 7.2 million USD in annual additional profit for the refinery.

2. A new empirical correlation and artificial neural network model for predicting the molecular mass of petroleum fluids in an extended range (70–1685 g/mol) has been derived, outperforming the correlations published in the literature.

3. New correlations and artificial neural network models have been derived for predicting critical temperature and critical pressure of individual hydrocarbons and oil fractions with increased accuracy.

4. New correlations and an artificial neural network model for predicting the viscosity of mixtures of heavy oil fractions with diluents are proposed, including a correlation dependence taking into account different measurement temperatures.

5. A detailed comparison has been made between the methods available in the literature for molecular reconstruction of oil and oil fractions and the methods applied in commercial process simulators, with an analysis of the ways to overcome the discrepancy between them.

6. The predictive ability of group constituent methods (J&R, C&G, A&G) for the properties of individual components in the molecular libraries for gasoline and diesel fractions has been evaluated, and specific recommendations have been formulated for improving the input data for molecular reconstruction.

7. A direct economic effect of the application of the results of the dissertation work in a real industrial environment (LUKOIL Neftochim Burgas) has been demonstrated, which gives the study a pronounced scientific and applied focus.

The scope of scientific and applied scientific contributions has been proven through appropriate and correctly applied research methods: nonlinear regression analysis, artificial neural networks, inter-criteria analysis, statistical analysis of errors (standard error, relative standard error, mean absolute deviation), comparative analysis with correlations published in the literature, as well as conducting a real industrial experiment to validate the obtained results.

4. Critical notes on the presented work.

The critical remarks that I can make are rather of a recommendatory nature and do not diminish the value of the achieved results. It is desirable that in future studies the newly derived correlations and artificial neural network models be validated on a wider range of crude oils of different origins in order to confirm their universal applicability.

5. Reasons and a clearly formulated conclusion.

The motives and conclusion in the dissertation are clearly formulated, logically justified and in full accordance with the set goals and objectives.

The results indicated in the opinion of 1–5 points meet the requirements of Burgas State University "Prof. Dr. Asen Zlatarov" for the acquisition of the educational and scientific degree "Doctor" (PhD) in the professional field 5.10. Chemical Technologies.

This dissertation is in accordance with the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADRB) and the Regulations for its implementation at Burgas State University "Prof. Dr. Asen Zlatarov".

The abstract correctly reflects the main emphases and results of the dissertation work.

CONCLUSION

In conclusion of this opinion, I give my positive assessment of the peer-reviewed dissertation work of Eng. Svetlin Petrov Vassilev on the topic "Modeling the properties of petroleum fluids and processes in oil refining". The candidate for the educational and scientific degree "doctor" fully meets the requirements of the Act on the Development of Academic Staff in the Republic of Bulgaria and the Regulations for its implementation at Burgas State University " Prof. Dr. Asen Zlatarov". The doctoral student possesses in-depth theoretical knowledge and proven skills for independent conduct of scientific research, combined with a pronounced scientific and applied focus of the results obtained.

I recommend to the scientific jury to award Eng. Svetlin Petrov Vassilev the educational scientific degree "DOCTOR" (PhD) in the professional field 5.10. Chemical Technologies, according to the LAW ON THE DEVELOPMENT OF THE ACADEMIC STAFF IN THE REPUBLIC OF BULGARIA.

Burgas
31.08. 2026

Sincerely:
/ Assoc. Prof. Milena Petkova Dimitrova, PhD /