

## OPINION

By Prof. Dr. Silvia Zivova Todorova, Institute of Catalysis - Bulgarian Academy of Sciences

Regarding the PhD thesis presented by Eng. Ivan Petrov Petrov  
field of higher education "Technical Sciences",  
professional field 5.10. "Chemical technologies",  
doctoral program 02.10.23 "Technology of natural and synthetic fuels"

**Author:** Eng. Ivan Petrov Petrov

**Topic :** *IMPACT OF THE HYDROCRACKING PROCESS OF VACUUM RESIDUE H-OIL  
ON THE PERFORMANCE OF OTHER OIL REFINING PROCESSES IN A MODERN OIL  
REFINERY*

*(LUKOIL NEFTOCHEM BURGAS AD).*

### **Scientific supervisors:**

*Associate Professor Dr. Dobromir Yordanov*

*Prof. Dr. Dicho Stratiev, LUKOIL NEFTOCHEM BURGAS AD*

The author of the PhD thesis is Ivan Petrov Petrov - PhD student at the University "Prof. Dr. Asen Zlatarov" Burgas at the Faculty of Social Sciences, Department of "Industrial Technologies and Management", with supervisors Assoc Prof. Dobromir Yordanov, Ph.D., and Prof. DS Dicho Stratiev.

The set of materials submitted by Ivan Petrov Petrov are in accordance with the Regulations for the conditions and order for acquiring scientific degrees and occupying of academic positions in University "Prof. Dr. Asen Zlatarov, Burgas. The PhD student presented 8 publications - 2 publications in Q 2, four in Q 3 and one in Q 4. Ivan Petrov is first author in one paper, third author in three papers, fourth author in three papers and fifth in one. This shows that the contribution of PhD student to research is significant. Eng. Ivan Petrov has participated with in the competition "Best scientific and technical development" in "LUKOIL Neftohim Burgas" JSC, once he was ranked first; there times he was ranked on the second place and two times in third place.

The documents are submitted on time and are well formatted.

The dissertation contains 6 chapters and is based on a review of 315 literary sources, contains 169 pages, includes 66 figures and 39 tables.

The dissertation is clearly structured with logically connected chapters. The presented figures, tables and diagrams are designed strictly and precisely and allow a very quick reading of the information. The topic of the dissertation fully corresponds to the scientific specialty. Scientific results have scientific and scientific-applied value and have been achieved through appropriate methods and approaches.

Based on the in-depth analysis of the data in the literature, the purpose of the thesis was formulated and several specific tasks were defined.

The conversion of heavy residual oil fractions into light petroleum products is a major way to improve the economics of oil refining. Among all the processing technologies of residual oil fractions, hydrocracking is emerging as the process that provides the highest conversion to light petroleum products. Therefore, this process is gaining increasing application in modern oil refining.

There are very few data in the literature regarding the relationship between the quality of the products obtained from the process of hydrocracking of heavy residual oil fractions and the quality of the raw material, the properties of the catalyst and the applied operating conditions of the process. These data, together with the data on the amount of products produced, are extremely important for evaluating the impact of the hydrocracking process of residual oil fractions on the other processes involved in the technological scheme of an oil refinery. The level of conversion of the residual oil fractions and the selectivity to the production of light have an influence on the technological processes used for the processing of the products of the hydrocracking process of vacuum residue. Therefore, the goal set by the thesis is to assess the impact of the hydrocracking process of vacuum residue H-Oil, included in the oil processing scheme in the refinery of "LUKOIL Neftohim Burgas" AD (LNB) on the action of the other processes involved in the technological scheme of the refinery of "LUKOIL Neftohim Burgas" JSC. Several tasks have been formulated to achieve the goal.

1. Determination of the dependence of the distribution of products and their quality in the process of hydrocracking of vacuum residue with a pseudo fluidized bed of catalyst, on the mode and quality of the raw material.

2. Conducting laboratory experiments with the aim of determining the influence of different types of catalysts on the hydrocracking process of raw materials containing different quantities and quality of vacuum gas oils.

3. To investigate and evaluate the influence of the structure of the various types of oil processed in the "LUKOIL Neftohim Burgas" refinery, the properties of the catalysts and the properties of the vacuum gas oils from the hydrocracking process of vacuum residue with a pseudo fluidized bed catalyst on the operation of the industrial installation for

4. To investigate the influence of the improved action of the hydrocracking process of vacuum residue with a pseudo fluidized bed of the catalyst on the cetane number of the motor diesel fuel produced in the LUKOIL Neftohim Burgas refinery.

5. To investigate the possibilities of controlling the level of sodium in the raw material for the hydrocracking process of vacuum residue in a pseudo fluidized bed of the catalyst during the primary oil refining process.

6. To evaluate how the replacement of NaOH with an organic neutralization agent used in the primary oil processing plant, in order to achieve a low level of Na in the vacuum residue (a requirement imposed by the application of the nano-catalyst HCAT in H-Oil and lowering of the poisoning of the solid catalyst with Na) affects the performance of the catalytic reforming process.

To realize the set tasks, the research conducted both in laboratory and also used data from industrial installations, which makes the achieved results particularly valuable because they can be directly used in practice.

The conclusions in the dissertation correspond to the set goal and clearly and correctly reflect the achieved results. It should be noted that the contributions of the dissertation are essential in both fundamental scientific and scientific applied terms and represent further development and enrichment of knowledge in the field. The main takeaways from the dissertation work are defined as follows:

1. Minimized the sodium content of the vacuum residue from 40 to below 20 ppm.
2. The use of an expensive chemical replacing caustic soda in the oil desalination and dewatering unit has been discontinued.
3. The octane number of the reformer has been increased due to the discontinuation of the organic base compound replacing NaOH in the primary oil processing plant.
4. The composition and properties of the catalyst for catalytic cracking were optimized when processing raw material with different quantity and quality of vacuum gas oil from hydrocracking of vacuum residue in a pseudo-fluidized bed of the catalyst.
5. The planning of a cetane-increasing additive for the production of commodity diesel fuel fulfilling the specification of EN 590 for a cetane number not lower than 51 has been optimized.

The presented abstract reflects objectively the structure and content of the dissertation work. The abstract was prepared in accordance with the requirements of ZRAS, the Rules for its application.

The dissertation is written in good language and technical errors are few enough. The dissertation reads with ease. The presented figures and tables are designed strictly and precisely and allow a very quick reading of the information. I have no principled objection to the material in the dissertation.

### CONCLUSION

The PhD thesis *contains scientific, scientific-applied and applied results, which represent an original contribution in science* and practice and **meet all** the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB and **University "Prof. Dr. Asen Zlatarov" Burgas** .

The thesis shows that the doctoral student Ivan Petrov Petrov **has** in-depth theoretical knowledge and professional skills in the scientific specialty "*Technology of natural and synthetic fuels*" . by **demonstrating** qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my *positive evaluation* of the conducted research presented by the above-reviewed dissertation work, abstract, achieved results and contributions. Therefore, I strongly recommend to the members of the Scientific Jury to award and scientific degree 'doctor' to Ivan Petrov Petrov in the field of higher education: "Technical Sciences", professional direction "*Chemical technologies*" doctoral program "*Technology of natural and synthetic fuels*" .

19. 12. 2022

Reviewer: .....

Подпис заличен  
Чл.2 от ЗЗЛД

... Prof. Dr. Silvia Todorova.