OPINION

by Prof. Dr. Magdalena Sabeva Mitkova

regarding the dissertation work of Master Eng. Ivan Petrov Petrov

author of a dissertation on the topic: "Impact of hydrocracking process of heavy vacuum gas oil H-Oil on the action of other oil refining processes in a modern oil refinery (Lukoil Neftohim Burgas AD)"

According to order No. UD-258 of 27.09.2022 of the rector of the University "Prof. Dr. Asen Zlatarov" I have been designated as a member of the scientific jury, and according to order No. UD-283 of 18.10.2022, allocating the activities of the scientific jury, it is necessary to prepare an opinion on the dissertation work presented by the master engineer Ivan Petrov Petrov on obtaining an educational and scientific degree "doctor" in the scientific specialty "Technology of natural and synthetic fuels", code 02.10.23, professional qualification 5.10. Chemical technologies, field of higher education 5. Technical sciences on the topic " Impact of hydrocracking process of heavy vacuum gas oil H-Oil on the action of other oil refining processes in a modern oil refinery (Lukoil Neftohim Burgas AD)"

The set of documents presented by the master engineer Ivan Petrov Petrov is in accordance with Article 30 (1) of the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria and Article 42 of the Regulations for the Terms and Procedures for Acquiring Scientific Degrees and occupying academic positions at the University "Prof. Dr. Asen Zlatarov", Burgas.

The dissertation contains 169 pages, 66 figures and 39 tables. 315 literary sources are indicated.

The topic of the dissertation work is related to the adaptation of technological processes existing in a refinery to the new quantities and qualities of the products produced by a new technological process for the production of final products that meet world quality standards. Hydrocracking of heavy, residual fractions is established as the process that provides the highest conversion of residual petroleum to light petroleum products compared to all other technologies for converting heavy residual petroleum fractions.

The aim of the dissertation is to assess the impact of the heavy vacuum gas oil H-Oil on the hydrocracking process, included in the oil processing scheme of the

refinery of "Lukoil Neftohim, Burgas" in the second half of 2015, on the action of the other processes involved in the technological scheme of the refinery. The following tasks were set: to investigate the action of the hydrocracking process of heavy vacuum gas oil H-Oil with a catalyst in a pseudo-fluidized bed under different operating modes and when processing raw materials of different quality, as well as to determine the distribution of products; to conduct laboratory studies on the effect of different catalysts in catalytic cracking on raw materials of different composition; to investigate and evaluate the influence of the different types of oil processed in the refinery on the operation of the industrial catalytic cracking plant; to investigate how the improvement of the hydrocracking process affects the cetane number of the motor diesel fuel produced in the refinery; to investigate the possibility of controlling the sodium level in the hydrocracking of heavy vacuum gas feedstock coming from the primary oil processing; to evaluate how replacing NaOH with an organic reagent used in the primary oil refinery affects the performance of the catalytic reforming process.

As a result of a precise, extensive and long-term laboratory and industrial experiment, it was found that the properties of the unconverted residue from the hydrocracking process of heavy vacuum gas oil H-Oil with a pseudo-fluidized bed catalyst correlate with Kw - a characteristic factor of the mixed feedstock. At the same time, the Kw - characteristic factor of the mixed raw material increases with the Kw - characteristic factor of the heavy vacuum gas oil processed in the refinery and with the decrease in the amount of sludge from the catalytic cracking and the decrease in the amount of recycle of blended boiler fuel.

Kw – the characteristic factor of the vacuum gas oil from the process of hydrocracking of heavy vacuum gas oil with a fluidized bed catalyst increases with the amount of processed feedstock and lowering the reaction temperature, the amount of sludge from catalytic cracking and recycle of partially blended boiler fuel in the mixed feedstock for the process of hydrocracking of tars. The cetane index of the diesel fraction from the hydrocracking process of heavy vacuum gas oil in a pseudo-fluidized bed of the catalyst increases with the increase in the amount of processed feedstock, with the decrease in the reaction temperature and the amount of sludge from the catalytic cracking of the mixed feedstock. The amount of vacuum gas oil from the fluidized bed catalyst of heavy vacuum gas oil hydrocracking process that enters the catalytic cracking feedstock greatly affects the conversion of the industrial catalytic cracking plant and the economic efficiency of a modern refinery. Catalysts with the highest rare earth content are the most active and most coke-selective in the

processing of vacuum gas oils containing vacuum gasoil from pseudo-fluidized bed of heavy vacuum gas oil hydrocracking. In a study of various catalysts, it was found that catalysts based on catalyst D in an industrial catalytic cracking plant could improve its performance in processing a larger amount of low-grade vacuum gas oil from pseudo-fluidized bed catalyst of heavy vacuum gas oil hydrocracking. The most active and selective Δ coke catalyst provides higher conversion in the industrial catalytic cracking plant. The replacement of NaOH with alkaline organic nitrogen compounds in the primary petroleum distillation unit has been found to cause poisoning of a Catalytic Reforming plant, deactivate the catalyst and lower the octane number of the reformer. The Na content above 20 ppm in the heavy vacuum gas oil accelerates the deactivation of the solid catalyst and prevents the use of liquid nano-dispersed HCAT in the hydrocracking process of heavy vacuum gas oil with a pseudo-fluidized bed catalyst. Its removal depends on the operation of the crude oil desalination unit.

The presented dissertation has scientific and outstanding applied contributions, expressed in the following:

- ✓ The operation of the oil desalination and dehydration unit has been improved and the sodium content in the heavy vacuum gas oil has been minimized.
- ✓ The use of an expensive caustic replacement chemical in the oil desalination and dewatering unit to reduce sodium in the heavy vacuum gas oil below 20 ppm has been discontinued.
- ✓ The octane number of the reform has been increased due to the discontinuation of the organic base compound replacing the sodium base in the primary oil processing plant.
- ✓ 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 heavy vacuum gas oil in a pseudo fluidized bed of the catalyst.
- ✓ Scheduling of the cetane-enhancing additive has been optimized to produce stock diesel fuel meeting the EN 590 specification for a cetane number not lower than 51.

On the dissertation work, 8 articles with Impact Factor were published, 9 citations were noticed.

The abstract is compiled according to the requirements.

In conclusion, I can summarize that the presented doctoral work contains scientific and scientific-applied results, the candidate acquired in the course of the work in-depth theoretical knowledge of the specialty and the ability for independent scientific research, as well as for team work, which allows me to vote with conviction FOR awarding the educational and scientific degree "doctor" to master engineer Ivan Petrov Petrov.

November 18, 2022

Signature:

Подпис заличен
Чл.2 от ЗЗЛД

(Prof. Dr. Magdalena Mitkova)