



## OPINION

By **Adriana Asenova Georgieva, Associate Professor, PhD Eng.** -  
internal member of a Scientific Jury, appointed by order No. UD-255/15.07.2024  
of the Rector of the University "Prof. Dr. Asen Zlatarov" - Burgas

**for the dissertation work of a full-time doctoral student**

**Master Eng. Ivan Atanasov Ilchev**

for the acquisition of an educational and scientific degree "PhD",  
in the doctoral program "Technology of natural and synthetic fuels",  
Professional direction 5.10. "Chemical Technologies",  
Field of higher education 5. "Technical Sciences"

**Dissertation topic:**

**"Improving the effect of the hydrocracking process of tar in LUKOIL  
Neftohim Burgas"**

**Scientific supervisors:**

- 1. Prof. Dobromir Ivanov Yordanov, PhD**
- 2. Prof. Dicho Stoyanov Stratiev, PhD**

As a member of the Scientific Jury, I have received in electronic form all the necessary documents for the preparation of the opinion, namely:

- Order No. UD-255/15.07.2024, No. UD-270/23.07.2024 of the Rector of the University "Prof. Dr. Asen Zlatarov" - Burgas - Prof. Dr. Hristo Bozov, MD;
- Dissertation of Master Eng. Ivan Atanasov Ilchev;
- Abstract of the dissertation work;
- Copies of the dissertation publications;
- CV.

**A brief biographical reference for the PhD student**

Master Eng. Ivan Atanasov Ilchev was born on June 11, 1991. He completed his secondary education at "Dr. Petar Beron" Secondary School, Svilengrad. He obtained his higher education at the University "Prof. Dr. Asen Zlatarov" - Burgas. He has a bachelor's degree in "Industrial Management", a master's degree in engineering - in the specialty "Industrial design in oil refining and petrochemicals". Since January 2020, he has been a full-time doctoral student in the doctoral program "Technology of Natural and Synthetic Fuels" under Professional Direction 5.10 "Chemical Technologies". He has worked successively as: administrator at Atlantis Bulgaria, designer-technologist at Himproekt, Devnya, refinery operator at Lukoil Neftohim Burgas AD, designer-technologist at Promproekt Varna EOOD and is currently a specialist in the supply of petroleum products for export at "Lukoil Neftohim Burgas - AD".

### **Dissertation review and analysis of results**

The dissertation work presented to me for opinion is 149 pages long, including 42 figures, 28 tables and a bibliography of 154 literary sources. The structure of the dissertation follows the generally accepted norms: introduction, literature review, experimental part, results and discussion, conclusions, contributions and used literature.

The aim of the dissertation work is to improve the performance of the hydrocracking process of tar in order to obtain a hydrocracked unconverted vacuum residue with indicators suitable for the production of road bitumen.

The literature review is comprehensive, with well and appropriately selected literary sources. Based on it, after analysis, the goals and tasks of the dissertation work are formulated, mainly aimed at:

- Study of the incorporation of atactic polypropylene (aPP) and elemental sulfur to improve the quality of the finished product with maximum incorporation of vacuum residues of secondary origin;

- Investigating the application of H-OIL VTB and FCC SLO in different percentage ratios (oxidized and non-oxidized) and adding sulfur in the production of road bitumen and comparing their quality indicators to obtain an optimal commodity product;

- Study of the optimal percentage of VTB that can be added for the production of bitumen without interfering with the standardization of the product according to BDS, consistent with the constantly changing blended oils processed in the refinery of "Lukoil Neftohim Burgas - AD" and the optimal regime in operation of the installation for hydrocracking of tar.

They are in tune with modern research trends and the development of knowledge in this area and would provide answers to a number of questions on the researched issues.

In the Experimental part, the possibility of increasing the share of unconverted vacuum gas oil from the existing process by oxidizing the mixtures in a laboratory reactor, semi-industrial, and also in an industrial installation for the production of bitumen in "Lukoil Neftohim Burgas - AD" is considered. Appropriate, modern methods of analysis, approaches and apparatus were used in conducting the experimental studies. The tested bituminous mixtures were analyzed for penetration at 25°C (according to EN 1426), softening temperature (EN 1427) and Fraass breaking point (EN 12593). Durability, expressed by resistance to hardening at 163°C (EN 12607-1), was evaluated. Density was measured according to the procedure in which dilution with toluene was used. The distillation characteristics of the studied samples were determined by gas chromatography simulation at high temperature distillation according to ASTM D-7169. A laboratory and industrial study of the production of road bitumen from mixtures of direct distilled and hydrocracked tar in various ratios is described. An experiment was

conducted to find the optimal parameters for obtaining road bitumen brand 50/70 according to BDS EN12591&2009/NA&2017/1lonpaBKa 1:2017.

Based on the large volume of experimental work performed, both in laboratory and industrial conditions, and the results obtained, a thorough and correct analysis was made and four conclusions were drawn.

**The scientific and scientific-applied contributions are expressed in:**

1. The oxidation kinetics of the two residues SRVGO and VTB with air were investigated and a first-order reaction kinetics of the air oxidation process was assumed. Rate constants are derived.
2. Permanent implementation of VTB in the production of road bitumen in compliance with all production and state standards. In this way, the conversion of H-Oil is significantly increased and the operation process of the Hydrocracking of tar plant on the territory of LNHB is improved.
3. A scheme of work with the addition of non-oxidized VTB in the production of road bitumen has been successfully implemented. The low-value semi-product VTB without any further processing is added to the stock road bitumen and increases the bitumen yield.
4. A scheme of work with the addition of oxidized VTB in the production of road bitumen has been successfully implemented. This scheme of operation replaces part of the SRVGO, which instead of going to the production of road bitumen, goes to the production of light fuels of a much higher value in an H-Oil plant without disturbing the operation mode of a Bituminous plant.
5. Due to the seasonal nature of the production of bituminous products, a large part of the experiments were used by the production team to prepare the operating mode of the installation before start-up. This provided preliminary data according to the current types of oil being processed at the refinery, which scheme of operation would be most suitable for operation and would bring the most revenue to the company.

The contributions reflect with sufficient accuracy the essence of the dissertation work and the results of the researches and show that the doctoral student has mastered well and applied the material related to the topic and the set goals appropriately and accurately. On the basis of theoretical knowledge and practical experience accumulated in the work process, he has the ability to analyze and evaluate specific experimental results and situations and conduct independent scientific research.

**The attached abstract** correctly reflects the content of the dissertation work of Master Eng. Ivan Atanasov Ilchev.

There are 5 scientific publications. In one of them, the doctoral student is the sole author, in two of the articles he is in seventh place, in one in fourth place and in one in

fifth place. Three of the publications are in journals indexed in the SCOPUS database. This shows that there is a certain scientific interest in the developed topic and in the obtained experimental results.

Publications and reported scientific results correspond to the topic and content of the main elements of the doctoral work.

The quantitative requirements for groups of indicators for obtaining the educational and scientific degree "PhD" have been met, namely the sum of the points for indicators 1 and from 5 to 11 is 96.1 points out of the required 80 points.

### **Critical remarks**

I have no principled objections to the dissertation work. As remarks, I note noted technical errors. Also, the conclusions should be more specific and presented precisely in order to meet the purpose and main tasks of the dissertation work, to be in good agreement and to adequately illustrate the experimental research.

**The dissertation work** meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for the Terms and Conditions for the Acquisition of Scientific Degrees and the Occupancy of Academic Positions at the University "Prof. Dr. Asen Zlatarov" - Burgas.

### **CONCLUSION:**

Bearing in mind the contributions of the current dissertation work and the fact that the doctoral student has carried out a sufficient volume of experimental work, has accumulated specialized knowledge in the researched area and has developed as a thorough and good researcher, I give a positive assessment of the doctoral work and confidently offer to the Respected Scientific Jury to award to Master Eng. Ivan Atanasov Ilchev the educational and scientific degree "PhD" in the scientific specialty "Technology of natural and synthetic fuels", Professional direction 5.10. "Chemical technologies", Field of higher education 5. "Technical sciences".

September 30, 2024  
Burgas city

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Prepared the opinion: ..  
/Assoc. Prof. Adriana Asenova Georgieva, PhD/