# OPINION

by assoc. prof. PhD eng. Blagovesta Nikolaeva Midyurova

Department of "Ecology and Environmental Protection", Faculty of Natural Sciences,
"Prof. Dr. Asen Zlatarov" University - Burgas

of a dissertation for awarding the educational and scientific degree **"Doctor"**

Scientific field: **5. Technical sciences**

Professional field: **5.10 Chemical technologies**

Scientific specialty: **Water purification technology, 02.22.02**

*Author of a dissertation* **mag. eng. Maya Bogdanova Stancheva**, full-time doctoral student, "Prof. Dr. Asen Zlatarov" University - Burgas

Scientific supervisors: Prof . PhD Valentine Nenov and Assoc . prof. PhD Husein Yemendzhiev

*Dissertation topic*: **"Technological possibilities for recovery of resources from waste streams"**

*Reason:* member of a scientific jury for the procedure for the defense of a dissertation work for the acquisition of the Doctoral Degree, according to Order No. UD - 28/26.01.23 of the Rector of the University "Prof. Dr. Asen Zlatarov" - Burgas

## 1. Topic and topicality of the dissertation

Population growth and modern lifestyles have led to intensive growth in the livestock sector, which creates serious concerns about the impact on the environment due to the accumulation of huge volumes of waste streams characterized by high levels of organic and mineral pollutants, incl. in the form of nitrogen and phosphorus compounds.

Dissertation examines the technological possibilities for the utilization of waste streams rich in nitrogen and phosphorus and the assessment of the possibilities for their treatment in a way that can achieve the extraction of nutrients in a form suitable for their reuse.

I believe that the discussed topic is extremely relevant, and the set goals and tasks have been fulfilled to the required extent.

## 2. Overview of the cited literature

The dissertation contains a total of 8 chapters, developed on 143 pages and includes 45 figures, 30 tables and a total of 243 cited literary sources. Over thirty of the cited literary sources were published after 2016. The references are directly related to the topic of the study and show that mag. Eng. Maya Stancheva knows perfectly the nature of the problem, both theoretically and practically. On the basis of the literature review, the unsolved problems were clearly identified, the research approach was defined, and the purpose and tasks of the dissertation work were clearly formulated.

## 3. Research methodology

The experimental studies carried out by the author were carried out using different methods. Anaerobic degradation was applied as an approach for primary treatment of waste streams and increasing the concentration of chemically accessible forms of nitrogen and phosphorus. They are used anaerobic fermenter and laboratory ultrafiltration system EAUF-600. Spectrophotometric analyses, Kjeldahl method for determining total nitrogen in water were carried out and in WWTP sludge, inductively coupled plasma mass spectrometry, gas chromatography, etc. Using Visual MINTEQ 3.1 software, the trend of precipitation or dissolution of a solid in an aqueous solution was identified. The variability of the parameters due to the different characteristics of the treated wastewater, which obviously influence the formation of struvite , was evaluated .
The above is evidence of the author's good theoretical training and his good research skills for choosing research methods and tools.

## 4. Dissertation Contributions

I evaluate the contributions in the dissertation work as scientific and applied. The author formulated them as follows:

- For the first time, the potential of waste streams from animal husbandry and the milk processing industry as a potential source for phosphorus recovery has been investigated in detail. Anaerobic degradation has been researched and analyzed as a process for processing and stabilizing waste streams to improve their performance as substrates for struvite precipitation, and also to recover part of the energy through methanation and obtaining biogas from organic impurities.
- The behavior of the different starting substrates during the anaerobic degradation process was clarified, as well as the dynamics of the target ammonium and phosphate ions were followed. It has been established that waste streams from pig farms are not suitable for carrying out a full-fledged methanization process and are not subject to effective anaerobic stabilization.
- An approach was applied to mobilize additional potential in terms of phosphates available for precipitation by treating the substrates with acids with high efficiency achieved. It has been established that ultrafiltration is an effective method for further purification of working fluids in terms of organic impurities, while at the same time a significant part of the phosphate, ammonium and magnesium ions are preserved in the process.
- Data from experiments with real waste streams have been obtained, which are a solid basis for the creation of hybrid technologies for the simultaneous treatment of livestock wastewater and the recovery of resources from it.

## 5. Publications and citations for the dissertation work

For the dissertation, the author presents a total of six scientific publications, one of them referenced in Scopus. The results of the scientific research work have been reported and discussed at various international and national forums in the country and abroad. 1 citation was noted on one of the publications.

**6. Abstract and author reference**

After my acquaintance with the abstract, I believe that the most essential part of the dissertation work is sufficiently presented in its limited volume, which allows to assess the relevance and the proposed technological possibilities for the recovery of resources from waste streams.

From the presented author reference is evident that the candidate exceeds the minimum national requirements under the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for the conditions and procedures for acquiring scientific degrees and holding academic ones positions at the University "Prof. Dr. Assen Zlatarov " – Burgas.

**7. Dissertation notes**

I have essentially no comments on the dissertation work. I noticed a few grammatical and technical errors.

**Conclusion**

I believe that the dissertation meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Implementation, as well as the Regulations for the Terms and Conditions for Acquiring Scientific Degrees and Holding Academic Positions at the University "Prof. Dr. Asen Zlatarov" – Burgas .

In accordance with the achieved results, their precise interpretation and the derived scientific and scientific - applied contributions, I give **a positive assessment** of the dissertation work on the topic " *Technological possibilities for the recovery of resources from waste streams*". I propose to the honorable Scientific Jury to award the educational and scientific degree **"Doctor"** to **mag. eng. Maya Bogdanova Stancheva** in the scientific field - 5. Technical sciences, Professional field - 5.10 Chemical technologies, Scientific specialty - "Water purification technology".

Подпис заличен
Чл.2 от ЗЗЛД

Burgas
02.02.2023

Signature:
/ assoc. prof. PhD eng. B. Midyurova /