OPINION

regarding: **dissertation for awarding educational and scientific degree "Doctor"**
Author of the dissertation research: eng. **Maya Bogdanova Stancheva**
Dissertation research topic: **"Technological possibilities for recovery of resources from waste streams"**
Professional field: **„5.10. Chemical Technologies"**
Specialty: **"Water treatment technology" 02.22.02**
Member of the Scientific Jury: **assoc. prof. dipl. eng. Anna Kostadinova Simeonova, PhD**

General information of the dissertation

The opinion was prepared based on Order No. UD - 29 / 27.01.2023 of the Rector of the University "Prof. Dr. Asen Zlatarov" Burgas for the selection of a scientific jury.

The dissertation contains 145 pages, organized in the following sections: Introduction, Literature review, Aim and objectives, Materials and methods, Results and discussion, Main conclusions, Contributions and Literature, following the structure of a scientific publication. It includes 30 tables and 45 figures. A list of 6 publications on the subject of the dissertation, 3 participations in national and international scientific forums is attached. The bibliography includes 240 literary sources, all in English.

The dissertation is in the required sufficiency in terms of presented material, formulation of contributions and publication activity.

1. Relevance of the problem developed in the dissertation

Traditional wastewater management uses "end-of-pipe" approaches to remove pollutants in wastewater before discharge. Although effective in protection, this approach of removal and disposal requires a high investment of energy and materials and overlooks the values of the key nutrients in wastewater such as phosphorus and nirogen. Phosphorus enters wastewater as an end product of its anthropogenic cycle, which would lead to the depletion of phosphorus rocks and a global food crisis. In this regard, the issue of nutrient recovery from wastewater is a more effective strategy, and the wastewater treatment sector should be better integrated into the circular economy. On the other hand, the urban wastewater collection and treatment sector is responsible for around 0.86% of all greenhouse gas emissions in the EU as a whole. Almost a third of these emissions could be avoided by improving the treatment process, making better use of sludge and increasing energy efficiency, which are not yet at the required level.

The European Commission's proposal on 26 October 2022 to revise the Urban Waste Water Treatment Directive (UWWTD) places much more emphasis on the recycling and reuse of treated wastewater and sludge. According to some requirements of the Directive, an obligation will be introduced for WWTPs and sewerage systems of 10.000 p.e. and more to carry out an energy audit on energy efficiency, including the identification and cost-effective use of biogas production while reducing methane emissions.

In the presented dissertation, solutions are sought for the uptake of nutrients from waste streams, related to their recovery and reuse, as well as biogas recovery, which is related to the new challenges of waste water management. This defines the dissertation as particularly relevant and of great importance.

2. Scientific and scientific-applied contributions of the dissertation

Seven contributions are declared in the dissertation, which are not assigned to the following groups - scientific, scientific-applied or applied contributions. I consider that the contributions can be referred to the scientific-applied contributions. I accept essentially

author-defined contributions that are well-formulated, motivated in the dissertation, and validated by appropriate experimental research.

The specified contributions can be assigned to solving existing problems by new means, as well as creating new methods of research. The nature of the contributions can refer to the enrichment of existing knowledge and the application of scientific achievements in practice. The dissertation in general can be defined as a scientific result achieved through justified and proven solutions to private tasks. A new scientific field is not formulated, but scientific prerequisites for further development are created.

The results presented in the dissertation are included in 6 scientific publications, all in English and co-authored, as in three of them the PhD student is the first author, which shows her personal contribution to the development of the research work. All publications are in peer-reviewed journals, including one publication with IF indexed in SCOPUS. Three participations in national and international scientific forums are also indicated. I believe that these publications sufficiently represent the main results in the dissertation and adequately present the achievements of the PhD student to the scientific community.

3. Critical remarks and recommendations

The dissertation of eng. Maya Bogdanova Stancheva is an in-depth theoretical summary and experimental study of a significant problem related to new possibilities for the utilization of waste water products, relevant to the challenges of the circular economy. An appropriate dissertation structure has been adopted, modern scientific methods have been used, and a vast amount of experimental work has been carried out. The dissertation has clearly expressed scientific and applied contributions.

In general, I have no significant remarks to the dissertation, only some recommendations, which in no way belittle the scientific work:

• In Chapter IV. "Materials and methods", applied analysis methods are described in too much detail, equating item 3. "Test methods" with an exercise manual. It is sufficient to indicate the method and standard that are applied.

• The purpose of the development is to investigate possibilities for extracting nutrients from waste streams to be reused. In this sense, I do not find appropriate the information included in chapter II. "Literature review", item 4 "Manure in the soil" and "Techniques for reducing excess phosphorus in the soil" - eg phytoremediation.

4. Summary assessment of the dissertation and conclusion

The dissertation is a thorough and extensive study with proven scientific-applied value and contributions. I believe that the set goals have been achieved and eng. Maya Bogdanova Stancheva has successfully coped with the tasks formulated in this study. The dissertation **fully covers the criteria** laid down in the *Law on the Development of the Academic Staff in the Republic of Bulgaria* and the *Regulations* for it simplementation.

Bearing in mind the undoubted significance of the dissertation, as a Member of the Scientific Jury, I give my positive assessment of the dissertation and consider that educational and scientific degree "Doctor" in professional field: „5.10. Chemical Technologies", specialty: "Water treatment technology" 02.22.02 can be awarded to eng. Maya Bogdanova Stancheva.

Подпис заличен
Чл.2 от ЗЗЛД

05.02. 2023 г.
Varna

Scientific Jury Member:..
/assoc. prof. Anna Simeonova, PhD/