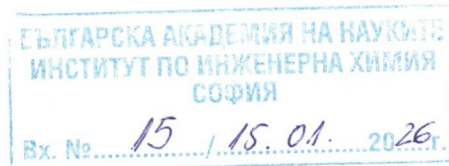


R E P O R T



Regarding the PhD thesis titled “CFD modeling of membrane separation by nanofiltration”

For the attainment of the educational and scientific degree of “Doctor”

Professional field: 4.2. Chemical sciences, specialty "Processes and apparatus in chemical and biochemical technology"

Author of the dissertation: Eng. Stela Plamenova Panyovska

Opinion author: Assoc. Prof. Petya Georgieva Popova-Krumova, Institute of Chemical Engineering, Bulgarian Academy of Sciences

1. Brief biographical information and description of the doctoral student's research interests and scientific activity.

Stela Panovska graduated from the University of Chemical Technology and Metallurgy in Sofia. In 2017, she received a master's degree in engineering from the University of Chemical Technology and Metallurgy, Sofia, with a master's degree in CAD/CAE and 3D Technologies in the professional field of Chemical Technologies.

In 2017, Eng. Stela Panovska joined the Institute of Chemical Engineering at the Bulgarian Academy of Sciences as a chemist. She has been an assistant since 2020.

Stela Panovska is a member of the Union of Chemists in Bulgaria, the European Association for Chemical and Molecular Sciences, and the Federation of Scientific and Technical Unions.

In 2021, Eng. Panyovska won the Ivan Evstratieff Geshov Award for Young Scientists in the scientific field of "Energy Resources and Energy Efficiency."

The scientific interests of Eng. Stela Panovska are in the field of chemical engineering and are focused on the experimental and theoretical study of extraction, distillation, absorption, and adsorption processes in chemical reactors.

During her research work, Eng. Panyovska has acquired knowledge in the field of chemical technologies related to hydrodynamic simulations of engineering processes in chemical apparatus using the ANSYS Fluent software package for computational fluid dynamics.

From the materials presented in connection with the dissertation, Eng. Panyovska has participated in six projects funded by the National Science Fund through competitions for funding fundamental

scientific research and bilateral cooperation, and has been the leader of two projects funded by the Ministry of Education and Science (FNI-MES).

Eng. Stela Panyovska exceeds the minimum national requirements, being a co-author of four scientific publications in refereed journals on the topic of the dissertation.

2. Significance of the problem addressed in the dissertation.

The problem addressed in the dissertation of Eng. Panyovska is undoubtedly relevant, as membrane separation by nanofiltration is a modern separation process that is becoming increasingly important in chemical engineering due to its high selectivity and energy efficiency and is establishing itself as an alternative to traditional separation methods - distillation and extraction.

The development of new membrane materials and modules, as well as the modeling and optimization of membrane processes, contribute to increasing the efficiency and reliability of nanofiltration. This makes the technology a key element in modern and future separation processes in industry.

3. Review of the dissertation and analysis of the results.

The dissertation is 151 pages long, and the material presented is systematized and illustrated with 62 figures. The bibliography used covers 169 literary sources. The text is written in a clear and precise academic style, and the presentation is logically structured, consistent, and thorough. The aim and objectives are clearly formulated.

4. Basic scientific and scientific-applied contributions.

The scientific and applied scientific contributions presented by Eng. Stela Panovska focus on membrane-integrated bioreactors. The main results presented in the dissertation were obtained by applying computational fluid dynamics methods.

A method has been developed for evaluating the efficiency of transport processes in a bioreactor with integrated membrane separation, based on CFD simulations and the relationship between the hydrodynamic characteristics in the reactor and the conditions for mass transfer through the membrane.

The scientific publications related to the dissertation show that the doctoral student has worked effectively with various scientific research teams, and the scientific research conducted by Eng. Panyovska exceeds the requirements for obtaining a Doctor of Science degree.

5. Description and evaluation of the submitted materials:

The materials presented by the doctoral student fully comply with the requirements of the Law on the Development of Academic Staff, the Regulations of the Bulgarian Academy of Sciences, and the internal criteria of the Institute of History and Archaeology at the Bulgarian Academy of Sciences for awarding the PhD degree.

6. Reflection of the candidate's scientific publications in Bulgarian and foreign literature.

The publications related to the dissertation are in peer-reviewed scientific journals, with three of the publications having an impact factor/impact rank: two publications in a Q3 journal and one publication in a Q1 journal. The total of 33 citations of publications related to the dissertation testify to the relevance of the research topic and the high scientific significance of the dissertation.

The results of the research have been reported at seven scientific forums, which is an indicator of active research activity and very good scientific training of the doctoral student.

7. Critical comments and recommendations on the candidate's scientific works.

The doctoral candidate's publications appear in renowned scientific journals indexed in world-famous scientific literature databases.

The list of references does not include the author's publications on which the dissertation is based.

The documents for participation in the competition are formatted according to the requirements and contain comprehensive information about the results achieved and the scientific contributions of the doctoral student.

8. The reviewer's personal impressions of the candidate.

I have known Ms. Panyovska since she joined the Institute of Chemical Engineering. Ms. Panyovska is a precise, ambitious, and dedicated researcher with excellent theoretical training. Over the years, she has established herself as a conscientious and competent specialist in her field of scientific interest. Ms. Panyovska demonstrates excellent organizational skills and the ability to work in a team on joint scientific projects and tasks.

CONCLUSION

I give a positive assessment of the dissertation and the personal contribution of Eng. Panyovska.

The materials presented by the doctoral student fully cover and satisfy the minimum requirements for obtaining the educational and scientific degree of "Doctor" in professional field 4.2. Chemical Sciences, in accordance with the Regulations on the conditions and procedures for acquiring scientific degrees and occupying academic positions at the Bulgarian Academy of Sciences, as well as the additional requirements of the Institute of Inorganic Chemistry at the Bulgarian Academy of Sciences.

The above allows me to confidently recommend that the esteemed Scientific Jury award the scientific degree of "Doctor" to Eng. Stela Plamenova Panyovska.

Date: 15. 01. 2026.

Signature:



/Assoc. Prof. Petya Popova-Krumova/