

REVIEW

on a competition for the academic position of "**associate professor**" in professional field **4.2.**

Chemical Sciences, scientific specialty "**Processes and apparatus in chemical and biochemical technology**" for the needs of the laboratory "Innovative processes and systems engineering" of the Institute of Engineering Chemistry at the Bulgarian Academy of Sciences, announced in the State Gazette, issue 77 of 10.09.2024.

Candidate: **Assist. Professor Dr. Eng. Rayka Kirilova Vladova**

Reviewer: **Assoc. Professor Dr. Stella Ivanova Minkovska, Institute of Catalysis – BAS**

1. Brief biographical data and description of the applicant's scientific interests.

Assistant Professor Dr. Rayka Kirilova Vladova is the only candidate in the competition for the academic position of "Associate Professor" for the needs of the Laboratory "Innovative Processes and Systems Engineering" of the Institute of Chemical Engineering in the professional field 4.2. Chemical Sciences, scientific specialty "Processes and Apparatus in Chemical and Biochemical Technology". Dr. Vladova graduated from the University of Chemical Technology and Metallurgy - Sofia in 2011 with a Bachelor's degree in "Biotechnology" and a Master's degree in "Engineering Ecology" in 2013. The following year she was enrolled as a full-time PhD student in the professional field 4.2. Chemical Sciences, scientific specialty "Processes and Apparatus in Chemical and Biochemical Technology" in the laboratory "Innovative Processes and Systems Engineering" of the Institute of Chemical Engineering at the Bulgarian Academy of Sciences. In 2017, she defends PhD thesis on the topic "Increasing the sustainability and energy efficiency of production systems with batch processes on the example of an Autothermal Thermophilic Aerobic Treatment (ATAD) system for wastewater". In the period 2017 - 2019, Dr. Vladova held the position of research assistant at the Institute of Chemical Engineering - BAS. In 2019, she was elected as an assistant professor at the same institute. Dr. Vladova's scientific interests are related to increasing the sustainability and energy efficiency of multi-purpose batch production systems, designing resource supply chains (RSCs) for the production of food and beverage products and biofuels, and new approaches to dealing with uncertainty regarding the environmental, economic and social indicators of RSCs through stochastic optimization. Research with an ecological focus is related to the development of systems for purification on household waste waters using the processes on autothermal thermophilic aerobic decomposition on sludge, increasing the sustainability of production systems and reducing environmental impact.

2. General description of the candidate's scientific research and applied scientific activities.

The scientific interests of Dr. Vladova are in multi-purpose periodic production systems; resource and security chains; household sewage treatment systems wastewater using processes autothermal thermophilic aerobic sludge decomposition; hydropiezothermoelectric intelligent nano composite structures; mathematical modeling; multi-criteria optimization; stochastic optimization; artificial neural networks; energy integration of processes; increasing the

Asst. Prof. Vladova is a co-author of a total of 37 scientific publications, 20 of which have been published in journals with an impact factor. The results obtained from the scientific research have been presented as 64 participations in national and international scientific forums.

Assistant Professor Dr. Vladova was the leader of two projects, one of which was under the National Program "Young Scientists and Postdoctoral Fellows" Module "Postdoctoral Fellows" "Mathematical Approach for Design and Reconstruction of Wastewater Treatment Plants to Increase Sustainability and Energy Efficiency", and the second one was funded under the

“Program for Holding International Scientific Forums” of the FNR-MES - Project for Co-financing an International Scientific Forum on the topic: “1-st International Scientific Conference on Cleaner Energy and Chemical Engineering for Sustainable Circular Economy: CLES-CE 2022”. Thanks to her good theoretical preparation and ability to work in a team, Dr. Vladova was a member of the teams of five projects funded by the Scientific Research Fund of the Ministry of Education and Science (FNI-MES), three of which under the competition for funding fundamental scientific research and two under the program “Competition for projects under bilateral cooperation programs - Bulgaria – Russia”.

Dr. Vladova has served as the chairperson of the Organizing and Scientific Committee of two international scientific forums, organized and conducted for the period 2022. – 2024, “1st International Scientific Conference on Cleaner Energy and Chemical Engineering for Sustainable Circular Economy”, held in Sofia and “A joint symposium of: “The 8th Sustainable Process Integration Laboratory (SPIL), Scientific Conference CAPE Forum 2024 Computer Aided Process Engineering, 2nd International Scientific Conference on Cleaner Energy and Chemical Engineering for Sustainable Circular Economy: CLES-CE 2024” , held in Brno, Czechoslovakia. Senior Assistant Professor Vladova has completed two successful specializations under the European COST Cooperation Program at the Sabanci University, Istanbul, Turkey and at the Faculty of Technical Sciences, Novi Sad, Serbia. The candidate is a member of three scientific research networks: MPNS COST ACTION MP1305 “Flowing matter”, Horizon 2020, European Commission, ICT COST ACTION TD1207 ”Mathematical Optimization in the Decision Support Systems for Efficient and Robust Energy Networks”, Horizon 2020 and CA COST Action CA15118 “Mathematical and Computer Science Methods for Food Science and Industry”, Horizon 2020, European Commission.

The candidate has performed expert work by preparing anonymous reviews and evaluations of publications for renowned journals: Chemical Engineering Transactions, Energy, Cleaner Energy Systems and Bulgarian Chemical Communications.

3. Evaluation of the submitted materials.

Assistant Professor Vladova is a co-author of 37 scientific publications, of which 20 have been published in refereed and indexed journals with an impact factor (ISI IF). The presented from Assistant Professor Rayka Vladova competition materials meet the minimum requirements national requirements for academic position “associate professor” according to The Rules for terms and conditions for implementation on academic positions (PURZAD) in Bulgarian academy of sciences and the Regulations for application on The law for development on academic composition in the Republic Bulgaria (PPZRASRB). They are united by groups indicators:

Indicator A: The diploma for the PhD degree, **50 points** (minimum required: 50).

Indicator B: 4. Habilitation work –6 publications in journals with an ISI Impact Factor and/or SJR, distributed across quartiles as follows: **1** in Q1, **1** in Q2, **3** in Q3 and **1** in Q4. Total points for Indicator B - **102 points** (minimum required: 100).

Indicator D: 14 publications in journals with an ISI Impact Factor and/or SJR, distributed across quartiles as follows: **2** in Q1, **8** in Q3, **2** in Q4, **2** in SJR, as well as two book chapters. Total points for Indicator **224 points** (minimum required: 220).

Indicator E: Citations in scientific publications referenced and indexed in world databases of scientific information (Web of Science and Scopus) – 33 citations. **Total points for Indicator E** 66 points (minimum required: 60).

Indicators	Content / Indicator	Number points on the candidate	Minimum required points for "associate professor"
A	1. Doctoral thesis of earning a Ph.D. degree	50	50
B		102	100 points
	4. Habilitation work – scientific publications in journals with an ISI Impact Factor and/or SJR (Web of Science and Scopus)	1-Q1 1-Q2 3-Q3 1-Q4	25 for published in Q1 20 for published in Q2 15 for published in Q3 12 for published in Q4 10 for published in edition with SJR without IF
G		244	220 points
	5. Published monograph , which not presented as a main habilitation thesis		30 points
	7. Scientific publication in publications , which are referenced and indexed in world-famous bases data with scientific information (Web of Science and Scopus), outside habilitation labor	2-Q1 8-Q3 2-Q4 2-SJR	25 for published in Q1 20 for published in Q2 15 for published in Q3 12 for published in Q4 10 for published in edition with SJR without IF
	8. Published head from book or collective monograph	2 x15	15
D		66	60 points
	11. Citations in scientific publications , monographs , collective volumes and patents , referenced and indexed in world-renowned bases scientific data information (Web of Science and Scopus)*	33 x 2	

In the presented habilitation thesis, summarizing the results of 6 publications (Q1 – 1, Q2 – 1, Q3–3 and Q4-1), the significant personal contribution of the candidate to the conducted research and the interpretation of the results can be noted. This is confirmed by the fact that Dr. Vladova is the first author of 3 and the second author of 2 of the 6 publications included in indicator B.

4. Main scientific and applied scientific contributions.

Based on the materials presented by the candidate, the scientific, applied science and applied contributions can be summarized as follows:

Scientific contributions:

1. A scheme for thermal integration of flows in a periodically operating Autothermal Thermophilic Aerobic Treatment (ATAD) is proposed and implemented, which is

- included in a stochastic optimization framework. A mathematical model is created and an analysis of the efficiency of energy integration in the limited stochastic space is made [Publications 1, 2, 3, 8, 14, 17] .
2. The main tasks of optimal reconstruction of an energy-integrated ATAD system to reduce the effects of stochastic parameters, dividing the set of variables into stages, reformulating the mathematical model of a heat-integrated ATAD system in terms of two-stage stochastic programming, and defining the expected objective function, including annual capital and operating costs and taking into account the presence of multiple scenarios, have been defined and solved [Publications 5, 6, 8, 14, 17, 18] .
 3. An approximate method for estimating the Flexibility Index of the obtained solutions of a stochastic optimization model with multiple scenarios for the reconstruction of a thermally integrated two-stage bioreactor ATAD system for domestic wastewater treatment operating under uncertainties has been proposed and implemented. The optimization problem for determining the Flexibility Index for the obtained solutions has been mathematically defined. It has been established that no always solutions with minimal annual expenses for reconstruction provide sustainable work of the ATAD system [Publications 10, 14, 18, 22, 23].
 4. Methods have been created for the optimal design of Resource Supply Chains (RSCs), including suppliers of raw materials, production complexes of plants and markets. Their application achieves both optimal allocation and consumption of resources to achieve economic goals - maximum production portfolio of the complex of plants, as well as environmental and social goals - optimal “green” production portfolio [Publications 4, 7, 11, 12, 14 , 29, 31, 32]
 5. Analytical two-dimensional solutions for the stresses and strains in a three-layer composite loaded mechanically or thermomechanically axially have been obtained, based on a two-dimensional “stress-functional” model. The optimal safe intervals of external influences and the optimal geometry of intelligent nanocomposite structures have been determined, so that there is no interfacial delamination in them. Models have been created to determine the zones of safe operation of intelligent nanocomposite structures. [Publications 19, 24, 25, 27, 30, 33]

Applied science contributions :

1. A new, sustainable, optimization approach has been proposed and implemented to address uncertainties in the environmental, economic and social indicators of the Resource Supply Chains (RSCs) for the production of dairy products using different technologies, taking into account all sustainability criteria [Publications 22, 23] .
2. A model of an industrial ATAD bioreactor has been created, allowing for the prediction of the depth of thermal shock, the expected temperature at the end of the process, and the degree of reduction of volatile solids, given given values of the input flow parameters. For this purpose, the Artificial Neural Networks approach was used [Publications 8, 9, 13, 14, 17] .

Applied contributions:

1. The proposed approach for optimal reconstruction of an energy-integrated ATAD system to reduce the impact of stochastic parameters and the proposed scheme for thermal integration of flows in an ATAD system have been simulated with real data and the effectiveness of thermal integration in the limited space of incomplete parametric determination has been proven. [Publications 1, 2, 3, 8, 14, 17].

2. ATAD system for a real existing site has been proven [Publications 10, 14, 18, 22, 23].

The contributions formulated in this way substantiate methods and apply models for solving real problems, which enrich existing knowledge and enable the application of scientific and applied contributions in practice. The implementation of the proposed solutions will lead to economic benefits and a social effect in the very important area of environmental protection.

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

There were 33 citations without self-citations in publications indexed in Web of Science and Scopus, which means that the points for indicator groups D are met. H index (according to Scopus or Web of Science) is 4.

6. Critical remarks and recommendations

I have no critical remarks about the candidate. The documents for participation in the competition are formatted according to the requirements and contain comprehensive information about the results achieved and the scientific and applied scientific contributions of the candidate.

CONCLUSION

The habilitation thesis and publications presented by Dr. Rayka Kirilova Vladova are on the topic of the competition and represent original scientific and applied developments with a significant contribution to the field of processes and devices in chemical and biochemical technologies. New fundamental results have been obtained with applications in a significant area such as environmental protection. They provide a solid basis for further research in this scientific field.

Documents and materials presented by **Assistant Professor Dr. Rayka Kirilova Vladova** fully meet all the requirements of the Law on the State of the Republic of Bulgaria, the Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and Holding Scientific Positions of the Bulgarian Academy of Sciences and the Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and Holding Scientific Positions of the Institute of Chemical Engineering-BAS, related to the procedure for holding the academic position of "associate professor".

Based on the attached documents, I propose to the esteemed Scientific Jury and of the Scientific Council of the Institute of Chemical Engineering, Bulgarian Academy of Sciences, to awarded the academic title of "**Associate Professor**" to **Assistant Professor Dr. Rayka Kirilova Vladova** in professional field **4.2. Chemical Sciences**, scientific specialty "**Processes and apparatus in chemical and biochemical technology**"

Sofia, 02.01.2025

Reviewer: 

/Assoc. Prof. Stela Minkovska, PhD/