

REVIEW

by competition for "Associate Professor" in the professional field 4.2. Chemical sciences (Processes and Devices in Chemical and Biochemical Technology) for the needs of the "Innovative Processes and Systems Engineering" laboratory at the Institute of Engineering Chemistry at the Bulgarian Academy of Sciences (BAS) - Sofia

announced in State Gazette No. 17 of 21.02.2023.

with candidate Ch. Assist. Prof. Dr Eng. Boyan Christov Boyadjiev

Reviewer: Prof. Dr. Eng. Kosta Petrov Boshnakov

1. Brief biographical data and description of the candidate's scientific interests. Ch. Assist. Boyan Boyadjiev graduated from secondary education in 1990 in the National Natural and Mathematical High School "Acad. Lyubomir Chakalov", Sofia, specialty "Mathematics". In 1995 graduated from Technical University - Sofia, in "Computer Sciences" and obtained the educational qualification degree "Master of Engineering". In 2020 acquired the educational and scientific degree "doctor". The topic of the dissertation work is "Computer modeling of processes in column apparatuses".

In the period 2019 - 2021 is a technologist at the Institute of Engineering Chemistry (ICHЕ) at the Bulgarian Academy of Sciences - Sofia, and from 2021 - until now he is the Chief Assistant at the same Institute with duties of programming, administration and participation in research projects. His computer skills are impressive, consisting of programming in the following programming languages: C, C++, C#, Assembler, Java, JavaScript, Pascal, Delphi, Basic, Visual Basic, Ada, Algol, Lisp, Fortran, PHP, R, Python, Perl, Lua, AHK, Matlab. He has competences in designing, building and administering computer networks.

2. General characteristics of the scientific-research and scientific-applied activity of the candidate. The scientific research work of Ch. Assist. Dr Boyadjiev is generally related to research, mathematical modeling and simulation of chemical and mass transfer processes in industrial column apparatuses and, in specific cases, research of the kinetics of transport processes in systems with intense interphase mass transfer, the non-stationary kinetics of evaporation, the radial non-uniformity in column apparatuses, mathematical models based on average concentration, etc.

In the scientific autobiography of the Ch. Assist. Dr. Boyan Boyadjiev contains the following information about the projects in which he participated:

2002–2003, Vrije Universiteit, Brussel, Dept. Human Ecology, Prof. L. Hens, "Environmental management for port areas"; 2017-2019, "Energy efficiency: Methodology, tools, modeling and optimization: 1. Heuristic methods for modeling composite structures subjected to the combined impact; 2. A new approach for modeling processes in column apparatus; 3. Phase equilibrium of multicomponent systems; 4. A systematic approach to the management of "green" resource-insurance chains; 5.

Increasing energy efficiency through integration and minimization of waste heat and emissions. Exergy analysis." For these two projects, there is no information about which institution financed them.

Projects financed by the Scientific Research Fund: 2019-2022, KP-06-RUSSIA-3, "Modeling and experimental study of interphase mass transfer in distillation, absorption, adsorption and catalytic processes in industrial column apparatus"; 2019-2023, KP-06-H37/11, "Integrated absorption-adsorption process for waste-free purification of sulfur dioxide gases"; 2021-2024, KP-06-H-57/3/2021, "Optimal safe load and geometry for layered nanocomposites under thermo-mechanical load".

The candidate is a co-author in one patent "Apparatus for the absorption of medium and highly soluble gases" and in three utility models: "Column reactor for conducting chemical processes", "Absorption-adsorption apparatus for purifying gases from sulfur dioxide" and "Column apparatus for intensive mass transfer in three-phase systems". The patent and utility models are protected by duly issued documents.

Ch. Assist. Dr. Boyan Boyadjiev was awarded a Gold Medal for a very good presentation of the developments "Absorption-Adsorption Apparatus" and "Method for Purification of Gases from Sulfur Dioxide" at the Tenth National Exhibition "Inventions, Transfer, Innovations" (ITI' 2017), November 1-3, 2017, Sofia.

As a member of a team from the Institute of Engineering Chemistry (IChE) - BAS, he was awarded an Honorary Diploma by the Innovation Council of the Bulgarian Chamber of Commerce and Industry (BCC) for ranking the team in 3rd place in the "Best Innovative Project" category for 2017 for the project "New absorption-adsorption method and apparatus for purification of waste gases from sulfur dioxide".

Based on the scientific autobiography of the Ch. Assist. Dr. Boyan Boyadjiev, conclusions can be drawn about his scientific and organizational activity, which is expressed in the following: Secretary of the organizing committee of the "16th Workshop on Transport Phenomena in Two-Phase Flow" (15.09.2020-18.09.2020); Member of the organizing committee of "Challenges in Chemical and Biochemical Technologies and Environmental Protection" (25.10.2021-27.10.2021); Member of the organizing committee of the "1st International Scientific Conference on Cleaner Energy and Chemical Engineering for Sustainable Circular Economy" (28.08.2022-31.08.2022); Secretary of the organizing committee of the "17th Workshop on Transport Phenomena in Two-Phase Flow" (22.09.2020-25.09.2020).

3.Evaluation of the presented materials. For participation in the competition, Ch. Assist. B. Boyadjiev submitted the following documents: an application for participation in the competition, a copy of the announcement for the competition for "Associate Professor" published in the State Gazette, No. 17 dated 21.02.2023 and on the website of IChE-BAS, scientific curriculum vitae, diploma for educational and scientific degree "doctor", official note from IChE - BAS for work experience in the specialty, list of scientific publications, reference of scientific contributions, list of noted citations, certificate of fulfillment of the

minimum National requirements for the occupation of the academic position "Associate Professor" according to the Regulations of the BAS, certificate of fulfillment of the minimum requirements for the occupation of the academic position "Associate Professor" according to the methodology for the growth of scientists at IChE - BAS, summaries of the articles, full text of the scientific publications, of one patent and three utility models, links to two collective monographs that are not presented as the main habilitation thesis and to two book chapters.

In the documents for participation in the competition for the academic position "Associate Professor" from the Ch. Assist. Dr. Boyan Boyadjiev, 15 scientific publications outside the dissertation work and 9 scientific publications included in the dissertation work are presented. The 15 scientific papers other than the dissertation, marked with numbers from 1 to 15 in the List of scientific publications, are accepted for review.

The analysis of the authorship of the scientific works submitted for participation in the competition shows that the candidate is in first place in 10 of the scientific works, in one - in second place and in four in third and subsequent places, which gives me the right to assume that he has made a significant contribution to the research conducted and the results obtained.

The implementation by the Ch. Assist. Dr. Boyan Boyadjiev on the minimum requirements of the BAS for the scientific and teaching activities of candidates for the acquisition of the academic position "Associate Professor" in the professional field 4.2. Chemical Sciences is presented in Table 1

Table 1

Group of indicators	Content	Minimum points required	Points achieved by the Ch. Assist. Dr. Boyan Boyadjiev
A	1. Dissertation work for awarding the educational and scientific degree "doctor"	50	50
B	4. Habilitation work - scientific publications in editions that are referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus)		3x25=75 1x20=20 1x12=12
	Points for indicator 4	100	107
G	5. Published monograph that is not presented as the main habilitation thesis		2x30=60
	7. Scientific publication in editions that are referenced and indexed in world-renowned scientific databases information (Web of Science and Scopus), outside the habilitation work.		3x12=36
	8. Published book chapter or collective monograph		2x15=30
	9. Invention, patent or utility model, for which a protective document has been issued in due order		4x25=100
	Sum of indicators from 5-10	220	226

D	11. Citations in scientific publications, referenced and indexed in world-renowned databases of scientific information, or in monographs and collective volumes		52x2=104
	The points in indicator 11	60	104
	Total points	430	487

The fulfillment of the additional criteria of IChE-BAS by the candidate for the academic position of "Associate Professor" is presented in Table 2

Table 2

No	Additional criteria of IChE	Achieved by Ch. Assist. Dr. Boyan Boyadjiev
1	A minimum of 15 (fifteen) publications, other than those presented for the acquisition of the educational and scientific degree "doctor".	15
2.1	The total number of publications of each candidate must be a minimum of 20 (twenty)	24
2.2	Of the total number of publications, 15 (fifteen) should be in refereed journals.	24
3	Of the publications under item 2, at least 5 (five) publications must be in journals with an impact factor or impact rank.	14
4	The total number of noticed citations on all the applicant's works must be a minimum of 20 (twenty).	65
5	Recommended Hirsch index 4.	Scopus h-index - 4 Google Scholar h-index - 7 h10-index - 5

4. Basic scientific and scientific-applied contributions. In the group of indicators B is presented Habilitation work (B.4.) – 5 scientific publications in editions those are referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus).

Of the five scientific publications, 3 are in quartile Q1 (in the International Journal of Heat and Mass Transfer, which for 2001, when one of the scientific papers was published, has IF=5.616, and for 2003, when two of the scientific papers were published, IF=5.575), one in Q4 (in the journal Bulgarian Chemical Communications, IF=0.153) and one in Q2 (in the Journal of Engineering Thermophysics, IF=0.881), as a result of which the group of indicators B achieved 107 points (Table 1).

The Habilitation thesis contains the following more important scientific and scientific-applied contributions:

1. On the basis of a comparative analysis, systems with intensive interphase mass exchange were studied for the cases of pure gases in stagnant liquids, as a result of which results were obtained that show that the rate of mass transfer depends on the equilibrium concentration of the gas at the interphase surface. Mathematical dependencies related to the mass transfer process are derived.

2. The cases of evaporation of liquids in inert gases were investigated and it was proved

that the increase in the rate of evaporation is the result of the instability of the natural convection flow. The process is unstable when the vapor is lighter than the gas. Software was developed to conduct the simulation studies

3. On the basis of experimental data, a theoretical analysis of the kinetics of non-stationary evaporation was made. The rate of mass transfer due to diffusion and convection differs from the rate of evaporation, which is explained by natural convection due to instability of the system

4. Based on the mechanics of continuous media, theoretical solutions are presented in the modeling of column apparatus in the cases of one, two and three phases. An iterative numerical algorithm for modeling unsteady processes in three-phase columns is developed.

5. A new approach has been developed for modeling the catalytic processes in column apparatus with a physico-chemical mechanism of adsorption. A numerical analysis was carried out, which shows the possibilities of using the mathematical model of average concentration.

The attached publications outside the Habilitation thesis contain the following scientific and scientific-applied contributions:

6. The influence of the radial non-uniformity of the velocity in column apparatuses was investigated and the possibilities of using the average concentration model were presented.

7. A theoretical analysis of the effect of "back mixing" in column chemical reactors was made. It was proved that the radial non-uniformity in the velocity distribution in the cross-sectional area of the column leads to a decrease in the average residence time of the column flow (chemical reaction time), an increase in the average mass flow at the column outlet and, as a result, a decrease in the conversion rate in the column.

8. A new approach is presented for modeling chemical and interphase mass transfer processes in industrial column apparatus using convection-diffusion and average concentration models. The new models are used to analyze various processes (simple and complex chemical reactions, absorption, adsorption and catalytic reactions) and make it possible to model sulfur dioxide gas purification processes.

9. A new approach for modeling industrial column absorbers is proposed. The average concentration model has been used to model various absorption processes in co-flow and counter-flow columns.

10. A new approach for modeling industrial column chemical reactors is presented. It is concluded that convective-diffusion model and average concentration models can be used in the cases of isothermal chemical reactions.

11. A theoretical analysis of the methods for modeling and simulation of industrial processes was made. A new approach for modeling industrial chemical and absorption processes in column apparatus based on convective-diffusion and average concentration models is presented.

12. A new approach for modeling chemical processes in industrial column apparatus is presented. The average concentration model can be applied to model chemical processes with different reaction rates.

13. A theoretical analysis of the simultaneous processes of mass and heat exchange in column reactors is made and a solution to the problem of intensification of column chemical reactors is presented

14. To conduct the simulation studies and evaluate parameters in mathematical models of the investigated processes, published in the scientific works of the candidate, specialized software products have been created, which are a necessary tool for achieving the formulated contributions.

The submitted documents for participation in the competition also contain the following applied contributions:

15. An absorption apparatus for highly and moderately soluble gases is proposed, in which, as a result of constructive innovations, the velocity of the dispersed medium increases. The proposal is protected by a patent.

16. Proposed are: Column reactor for conducting chemical processes, Absorption-adsorption apparatus for purifying gases from sulfur dioxide and Column apparatus for intensive mass transfer in three-phase systems, which are registered as utility models.

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

In the documents for participation in the competition, a list of noticed citations is presented, in which 65 citations of scientific works are published, with the participation of Ch. Assist. Dr Boyan Boyadjiev.

In the document entitled Reference for the implementation of the minimum requirements of the BAS in the group of indicators D.11. Cited in scientific publications, monographs, collective volumes and patents, referenced and indexed in world-renowned scientific information databases (Web of Science and Scopus) contain 52 citations.

The predominant part of the citations are in prestigious publications with an impact fact, such as International Journal of Heat and Mass Transfer, Progress in Energy and Combustion Science, Journal of Vacuum Science, Journal of Chemical Industry and Engineering (China), etc.

6. Critical notes and recommendations. I have no significant remarks and recommendations.

7. Personal impressions of the reviewer about the candidate. My personal impressions of the candidate are based solely on the attached documents for participation in the competition. I believe that he shows high professionalism in developing mathematical models and software products for conducting simulation studies and evaluating parameters in the mathematical models of the studied processes.

CONCLUSION

Table 1 shows the fulfillment of the minimum requirements for the occupation of the academic position "Associate Professor" at the BAS for the professional direction 4.2 Chemical sciences by the Ch. Assist. Dr. Eng. Boyan Christov Boyadjiev.

According to the group of indicators A, the candidate fulfilled the minimum required points, and according to the group of indicators B, G and D, the minimum required points were exceeded, which also applies to the total number of points.

Regarding the fulfillment of the requirements for occupying the academic position of "Associate Professor" at IChE-BAN (Table 2), according to criterion 1 - the requirements are met, according to the other criteria the minimum requirements are exceeded.

Ch. Assist. Dr Boyan Christov Boyadjiev, meets all the requirements of the ZRASRB, the Regulations for its implementation, the Regulations for the conditions and procedures for acquiring scientific degrees and holding academic positions at the BAS, as well as the requirements for holding the academic position of "Associate Professor" at IChE - BAS. My assessment of the candidate's overall activity is positive.

Everything stated in the review gives me reason to propose Ch. Assist. Prof. Dr Boyan Christov Boyadjiev, to take the academic position of "Associate Professor" in the professional direction 4.2. Chemical Sciences (Processes and Apparatus in Chemical and Biochemical Technology) at the Institute of Engineering Chemistry - Bulgarian Academy of Sciences.

Date: 12.06.2023r.

Reviewer:


/Prof. Dr. Eng. Kosta Boshnakov/