REVIEW

of documents submitted for participation in a competition for the academic position of "professor" in professional field 4.2. Chemical Sciences (Processes and Apparatusses in Chemical and Biochemical Technology) for the needs of the Laboratory "Transfer Processes in Multiphase Media" at the Institute of Chemical Engineering, Bulgarian Academy of Sciences, announced in State Journal No. 96/02.12.2022 with candidate Assoc. Prof. Daniela Boyanova Dzhonova-Atanassova

Reviewer Prof. DSc. George Angelov Nickolov

Short scientific biography of the candidate and area of scientific interest

Associate Professor Daniela Dzhonova graduated from Technical University-Sofia as a mechanical engineer in 1988, majoring in Heating Technology, after which she completed a 6-month postgraduate qualification in applied mathematics and informatics at the same university. After graduation, she became a PhD student and part-time teacher. In 1992, she defended her thesis on heat exchange processes in turbulent flows and obtained the degree "Candidate of Technical Sciences", equivalent to the current educational and scientific degree "doctor". From the beginning of 1994 to the present, she keeps working at the Institute of Chemical Engineering of the Bulgarian Academy of Sciences (ICE-BAS), holding the positions of technologist and research assistant until 2010. From 2011 to now, she is an associate professor at ICE. From 2014 she is the head of the laboratory "Transfer Processes in Multiphase Media". At the same time, from 2018 to 2022, she was the scientific secretary, and from 2022, she is the deputy director of ICE. In the period 2012 - 2013, she was an associate professor and lecturer at the European Polytechnic University-Pernik, where she led lectures and exercises in English on "Energy from the Ocean".

The scientific and applied activity of the candidate is in 3 main areas, which, arranged by volume of research and contributions, have the form:

- Studies on packed columns with the aim of obtaining information contributing to increasing the efficiency of the conducted heat and mass transfer processes;
- Integrated technologies with membrane processes;
- Thermal accumulators.

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General characteristics of the research activity

Assoc. Prof. Dzhonova's main scientific interests are primarily in the field of Chemical Engineering, more specifically theoretical and applied studies of various processes with an ecological

focus, e.g. heat and mass transfer processes for purification of liquids and gases, energy efficiency of technological processes with a view to energy saving, research on fluid hydrodynamics combined with applications in reactors with integration of filtration processes with a view to extraction and concentration of valuable products In addition, I can also note the activity in the field of heat accumulators for the utilization of waste heat and the use of renewable energy sources.

General evaluation of the presented materials

A total list of 65 publications is presented in the materials. Of these, 21 publications are from participation in a previous competition for the position "Associate Professor", which are not related to the current contest. The remaining 44 pcs. relate directly to this competition. They might be divided into 2 groups:

- According to the requirements of Law for Development of Academic Staff (LDAS) and the rules of BAS: 33 items are listed here. that are for the most part in quartile journals and book chapters;
- According to the rules of the ICE: An additional 11 publications are included here, which meet specific requirements for the number of publications and citations.

I note that the requirements of both rules have been met and even exceeded.

Out of 44 publications on the competition, 5 items have been printed in conference proceedings and one utility model has been registered. The candidate has co-authorship in 4 book chapters, and 34 items are articles in scientific periodicals. According to the rules of the BAS, priority is given to publication in journals with quartiles, and this is accepted as one of the indicators of the quality of the articles. The candidate has 27 articles in quartile journals. They account for 61% of all publications and 80% of journal articles. The distribution by quartiles is as follows: 7 publications in the highest category Q1 (26%), 2 items in Q2 (7.5%), 5 pcs. in Q3 (18.5%), 13 pcs. in Q4 (48%). In my judgment and according to my personal experience, publishing in Q1 journals is not a trivial task due to the high requirements of these journals and the strict and demanding reviewers. Therefore, I note and estimate the presence of 7 articles in Q1, which constitute more than 1/4 of the quartile publications. There are 7 publications in journals that do not fall into the quartiles. (16% of all posts).

As a general evaluation of the publication activity, it can be said that the candidate has a representation with publications in 4 important branches: journal articles, book chapters, conference proceedings and patents. Articles in periodicals with a high scientific reputation are predominant.

Ms. Dzhonova has been an associate professor for 12 years, and during this period she has 44 publications, which makes almost 4 publications per year, with a notable activity in 2020

when there are 14 publications. Quantitatively, I rate this performance as significant and rather intense.

Assoc. Prof. Dzhonova, almost continuously since joining the ICE, has participated in the research related to 14 national and 5 international projects. Additionally, since 2019, she is the head of 2 international projects.

The candidate's pedagogical activity began already during her PhD studies, as a parttime teacher at the Technical University - Sofia. Later, she was a lecturer at the European Polytechnic University - Pernik. Under her supervision are interns, graduate students, as well as PhD students. This complements the general picture of her activity, which can be characterized by the presence of a complex of research, organizational and teaching practice.

I positively evaluate the precise and careful preparation and arrangement of the materials for this competition, as well as the high linguistic and grammatical culture of the candidate.

Note to this section: It is related to the difficulty of tracking production by year, which impedes taking of statistical information. The list of publications is not chronological, which does not conform to the common practice and expected logic of arrangement. I explain this arrangement of the main list by grouping the publications in a way that is consistent with the structure of the BAS evaluation system. But in the additional list of 11 articles (34 - 44), which does not depend on *a priori* imposed schemes, an uneven arrangement is also found. For example, the first article in this list (34) chronologically should fall into the group of the same year publications 40 - 42.

Basic scientific and applied contributions

In the field of integrated membrane processes: 9 publications

Theoretical and experimental studies have been conducted, combining the use of fluid dynamics to modeling of nanofiltration processes in membranes or in membrane devices and experiments to establish the model adequacy. Different schemes of flow input to the membrane (tangential or perpendicular to the membrane) were investigated, and the impact of the flow parameters on the hydrodynamics in the device was established (eddy generation, influence of the flow rate on the fouling of the membrane and on the concentration polarization. It is found that better hydrodynamic conditions are those in which greater shear stresses are created on the membrane surface, which leads to a reduction in the effect of the concentration polarization layer and to less pronounced fouling processes and, accordingly, deactivation of the membrane. When studying bioreactors with cellular mass, the compromise conditions for minimal membrane fouling combined with admissible minimal damage to the biomass activity, which

decreases with excessively intense hydrodynamics of the flow in the apparatus, have been found.

The scientific contribution of this part of research is in elucidating the conditions that influence concentration polarization and membrane fouling. The applied contribution is in two directions: showing the possibility of integrating the extraction of valuable substances with their simultaneous production in a concentrated form, as well as in determining the operational range of conditions in which the limiting process of membrane filtration is more effective.

In the area of development of efficient thermal accumulators - 10 publications

This is an activity in the modern field of research on renewable energy. Here, the contributions are mainly applied and refer to research into the use of natural energy in residential buildings or drying installations.

An overview and analysis of the possibilities of thermal energy storage by using materials with a phase change has been made, and the main characteristics of economical and energy-efficient heat-accumulator structures have been shown. The approach is again a combination of computational fluid dynamics to analyze heat exchange processes in relation to physical flows, contributing to the optimization of the efficiency of heat storage processes.

The possibilities of coupling solar thermal accumulators to solar dryers using only the daytime solar energy have been studied. The contribution is in defining guidelines for cost-effective energy storage and improving the drying process through extended operation of the installation (outside of solar heating), which increases productivity. It has also been found that the use of stored latent heat shortens the drying time, which is a contribution to the intensification of this process.

The research also contributes to the large-scale thermal energy storage through underground borehole storage. Here, the experimental thermal evaluation of the heat accumulator is extended and improved by applying mathematical modeling to elucidate the influence of the design parameters on the heat storage efficiency.

Review of publications on packed column efficiency - 25 publications

This is the area with the most detailed and voluminous research.

Uneven distribution of liquid in packed columns negatively affects their efficiency. The research in this area is aimed at limiting this harmful phenomenon. Here I would note the developed methodology for determining an optimized design of a device for measuring the liquid distribution, which has been applied in experimental devices. It is based on a study of the influence of the collector geometry on the maldistribution factor. The contribution is very useful

from a research point of view, because it concerns the creation of a measuring device that provides reliable and trustworthy data on the liquid distribution, which is the basis of the assessment of the influence of various factors on the flow uniformity.

To limit the flow non-uniformity, detailed experimental studies have been carried out, which clarify the conditions for creating a uniform flow, such as the configuration of the sprinkler device, structural elements of the column, the method of feeding the flow (radial or axial), etc. Along with experimental studies, theoretical results are also available, such as equations for determining pressure drop and dynamic holding capacity, dispersion model for liquid distribution, wall flow modeling, etc.

Research has been conducted with random packed beds, which are widely used in industrial units due to their empirically established advantages, but are less studied. Here, the direction is to obtain missing information about this type of fillers. As a result of the research, different packings are ranked according to their effectiveness. Equations for determining pressure drop and retention capacity are obtained, which reflect the influence of packing geometry. In general, the contributions relate to the evaluation of packings and the development of a methodology for calculating their operational characteristics.

Research on structured packings is focused on the processes of formation of large-scale irregularities and their influence on the operation of large distillation columns. The obtained information is intended for the development and testing of a model for predicting mass transfer and separation efficiency in these units.

I note the works on a ceramic packing with an author's design, intended for absorption and heat exchange in column apparatuses. It has been thoroughly studied, and a sizing methodology has been developed. Due to its qualities (temperature and chemical resistance, low pressure drop and high efficiency), it has been implemented in a number of industrial devices for removal of hydrogen sulfide, for the utilization of waste heat, for reducing harmful emissions of nitrogen oxides in waste gases.

Reflection of scientific publications in Bulgarian and foreign literature

Citation of publications is another important criterion for evaluating their qualities, for their usefulness and implementation by the scientific community. According to this indicator, the candidate presents himself in a good light. Half of the participating publications (21 items) were cited 82 times, and the total number of citations on all works was 172. These figures significantly exceed the minimum requirements of the BAS (120 points, equivalent to 60 citations) and ICE (50 citations)).

Critical notes and recommendations

In the statement of main contributions, the aim of the research, the summarized results and conclusions representing the new knowledge should be briefly presented. There is sometimes redundant and ballast information here, such as technical details of conducting the study, number of computational grid cells, vapor velocity range, specific type of freon, etc. These are elements of a publication's summary but need not be included in the main contributions.

In the chapter "Main contributions", only publications from the main list 1 - 33 are commented. Neither summaries, nor comments on the additional list of 11 publications (34-44) are supplied.

Another remark refers to the lack of information about participation in scientific forums, which would give an idea about the activity of fast dissemination of current research information. But this is only a wishful recommendation, as it is not an official requirement. Based on my personal information and impressions (including the candidate's participation in organizing a number of scientific forums), I assume that this activity is also of appropriate intensity and has contributed to the popularization of the results of her activity.

My personal impressions for the candidate

I have known Assoc. Prof. Dzhonova since she joined ICE. My impression is of a sociable person who successfully adapts and integrates in a new environment. Her initial immediate impact in the laboratory was expressed in an increased English-language culture of her research group's publications, which was due to her knowledge of several languages and her secondary education, which included an English high school. Subsequently, I observed her growing role and competences in the conduct of collective research, which logically led to her professional growth. She is a friendly and responsive person, which is evident in her capacity as head of laboratory and scientific secretary of IIH. In these positions, she has demonstrated scientific organizational skills as well as abilities to establish research collaboration between members of different laboratories with a view to utilizing various complementary qualifications in more complex research. I have a high opinion of Ms. Dzhonova's public and collegial behavior, and after the detailed acquaintance with the presented documentation, it also extends to her qualities as a researcher and scientist.

CONCLUSION

In general, the research activity of Prof. Jonova is characterized by the presence of scientific, scientific-applied and real applied and innovative contributions. They lead to the improvement of the efficiency of various processes and apparatus used for chemical production and for the recovery of waste heat from combustion plants, as well as for the storage and use of non-traditional renewable energy, which is a contribution to energy efficiency. I also note the ecological direction of the research, expressed in the capture and removal of harmful substances and the implementation of processes with reduced emissions of harmful gases. The applicant's activity is purposeful and leads to useful results. I assess the scientific production as being of high quality and support this subjective assessment of mine with the objective presence of a number of publications in high-ranking journals, as well as with the presence of a large number of citations.

The minimum requirements of the Law for Development of the Academic Staff, also these of the Bulgarian Academy of Sciences and the Institute of Chemical Engineering have been met and exceeded.

Judging by the candidate's competences and the documented previous activity, my final conclusion is that Assoc. Prof. Dzhonova is completely suitable for the post, which is the subject of the current competition. I recommend to the other members of the jury to vote positively for awarding the academic position "professor" to the candidate.

08.03.2023

Reviewer:

/Prof. DSc. G. Angelov/