

REVIEW

On the competition for the acquirement of the academic position of PROFESSOR in the field of higher education, 5. Technical sciences, professional field 5.1. Machine engineering, scientific specialty „02.01.25 – Machines and equipment for chemical, oil, gas and oil refining industries

Announced in Sate gazette issue 45/17.06.2022 r.

With one candidate Assoc. prof. PhD Eng Dimitar Rusev Rusev

Reviewer: Prof. PhD.Eng. Magdalena Sabeva Mitkova

1. General information on the career development of the candidate

The candidate in the present competition Assoc. Prof. PhD Eng. Dimirat Rusev Rusev graduated his secondary education at the Technical school for electrical engineering "Konstantin Fotinov" – Burgas in 1976 , specialty "Controlling and measuring devices and automation".

He graduated the Moscow institute of chemical engineering (Moscow, Russia) in 1985, specialty "Design of machines and equipment for the chemical industry" with the educational degree of "master" and professional qualification of master-engineer designer.

In 1986, he was enrolled for regular PhD preparation at the University "Prof.Dr. Asen Zlatarov" – Burgas, Department of "Processes and apparatuses" with scientific tutor Prof.Dr. Dimitar Tomov Mitev.

In 1990, he successfully defended his PhD thesis before the specialized scientific council n "Basic processes, apparatuses and automation of the chemical and metallurgic industries" at the Higher attestation commission to obtain the educational and qualification degree of "Philosophy doctor" in the field of higher education, 5. Technical sciences, nprofessional field 5.1. Machine engineering, scientific specialty „02.01.25 – Machines and devices for the chemical, oil, gas and oil refining industries". The author's abstract entitled "Study on some essential problems of the performance of fluidized bed at pressure differing from atmospheric one" is within the scope of the present competition and describes a thorough in-depth research of high scientific level.

From 1990 to 1992 he was Research fellow III degree in Production and applied research laboratory "Fluidized bed" at the University "Prof.Dr. Asen Zlatarov" – Burgas.

From 1992 to 1995 he was Deputy director of ZMM - Burgas.

Since 1995, the candidate is a lecturer – Chief assistant (1995-2006)and associate professor since 2006 in the Department of "Electronics, electric engineering and machine engineering" at the University "Prof.Dr. Asen Zlatarov" – Burgas. During this period he was twice appointed Director of the Technical school at the University "Prof.Dr. Asen Zlatarov" – Burgas. (2008-2012 from 2020 till now).

Assoc.Prof. Dimitar Rusev is member of the editorial board of the international information and analytical journal „Crede Experto“, ISSN 2312 – 1327. The journal is indexed in the international databases: eLIBRARY.RU, Ulrichsweb, Pubicon Science Index, Scientific Indexing

Service, Research Bible, Inno Space, Journal Index, Universal Impact Factor, Scholarsteer, Academic Keys, Turk Egitim Indeksi, etc.

He has participated in 1 project financed by an European program, 1 project financed by the national scientific program EPLUS, 5 participations in national scientific projects supported by the Ministry of education and science, 3 projects financed by the Grant system for competitive project financing of scientific and artistic activities at the University "Prof.Dr. Asen Zlatarov" – Burgas and 4 projects financed by the Scientific research sector of the University "Prof.Dr. Asen Zlatarov" – Burgas. He was recognized as the author of 3 invention patents, he has 1 patent application and 1 application for useful model for which a decision for registration has been issued.

The autobiographic data presented indicate for active scientific research and applied research activities and show that the candidate works very successfully in a team.

2. General description of the provided materials

For the present competition for the position of "Professor", Assoc.Prof. PhD eng. Dimitar Rusev Rusev supplied all the information necessary for the estimation. The materials submitted for assessment are arranged according to the requirements of the LDASRB and the Regulation of the terms and conditions for acquirement of academic positions at the University "Prof.Dr. Asen Zlatarov" – Burgas. Their contents provide possibility to make clear estimation of the scientific research, applied research and lecturing activities of the candidate and fully cover the topic of the competition.

The materials submitted for reviewing are 1 monograph (Group G*8) and 66 scientific publications within the nomenclature specialty, among them:

- Author's abstract of dissertation thesis (Group A), not subject of reviewing;
- 10 publications in journals referred and indexed in world-known databases with scientific information - Scopus; Web of Science (group B);
- 6 publications in journals referred and indexed in world-known databases with scientific information - Scopus; Web of Science (group G7);
- 50 publications in non-referred journals with scientific reviewing or in redacted collective issues (group G8).

Among the provided scientific publications, 29 are published in proceedings from conferences and they are included in the National reference list of modern Bulgarian scientific issues with scientific reviewing (4 abroad and 25 at international and national conferences held in Bulgaria).

All this illustrates the competence accumulated in the field of consideration. The applicant presented also Protocols for equal contribution in the co-authored publications.

3. Analysis for compliance with the minimal requirements

The candidate has defended his PhD thesis, thus covering the requirement stated in **Group A, indicator 1**.

It was established that of the 10 scientific papers reviewed within "**Group B, indicator 4**" published in journals referred and indexed in world-known databases, in 9 papers the candidate is a co-author and he is the only author of 1 publication. The manuscripts are published mainly

in the following journals: Oxidation Communications - ISSN 0209-4541, Journal of Chemical Technology and Metallurgy - ISSN 1314-7471, Journal of the Balkan Tribological Association - ISSN 1310-4772.

The total number of points for group B Indicator 4 "scientific publications in journals referred and indexed in world-known databases with scientific information - Scopus; Web of Science" is 217 which exceeds the minimum number of 200 required by the University "Prof.Dr. Asen Zlatarov" – Burgas.

Considering the 56 scientific works reviewed in "group G", it was found that in "group G7" (scientific publications in journals referred and indexed in world-known databases with scientific information - Scopus; Web of Science) candidate provided 6 publications of which he is single author of 4 of them and co-author of 2 publications. The publications are mainly in the following journals: Journal of Chemical Technology and Metallurgy - ISSN 1314-7471, Journal of the Balkan Tribological Association - ISSN 1310-4772.

In "group G5" there is 1 published monograph and in "group G*8" (scientific publications in non-referred journals with scientific reviewing or in redacted collective works) the applicant provided 50 publications; among them 29 are published in proceedings from conferences and re included in the National reference list of modern Bulgarian scientific issues with scientific reviewing (4 abroad and 25 from international and national conferences held in Bulgaria).

The total number of points in "group G8" (scientific publications in non-referred journals with scientific reviewing or in redacted collective works) is 609,9 which is higher than the minimum number of 500 according to the requirements of the University "Prof.Dr. Asen Zlatarov" – Burgas.

In the information about the citations in "group D", the author submitted 65 noticed citations, as follows:

- Under indicator D*12 (citations or reviews in scientific journals referred and indexed in world-known databases with scientific information or in monographs and collective works (Scopus; Web of Science, etc.), the candidate provided 14 cited papers with a total of 59 citations.
- Under indicator D*14 (citations or reviews in non-referred journals with scientific reviewing) the candidate provided 5 cited papers with a total of 6 citations.

The total number of points in "group D" is 602 which is higher than the minimum number of 200 points according to the requirements of the University "Prof.Dr. Asen Zlatarov" – Burgas.

In "group E", the candidate provided certificate (Ref. № 1714/24.06.2022) to confirm that he has been the scientific tutor of 3 successfully defended PhD students.

In "group E18" (participation in national scientific or educational project) the candidate supplied the following:

- Participation in 1 project BG051PO001-3.1.09-0011 financed by the European social fund of the EU and the financial support of Operational program "Human resources development";
- 1 project (D01-214/2018-2022) financed by the National scientific program EPLUS;

- 5 participations in scientific projects of the Ministry of education and science – Scientific research fund, namely - ДО-02-192/2008-2012, ДО-02-110/2008-2012, ВУ-ТН-909/2006-2008, ДДВУ-02-106 /2010-2014, КП-06-Н27/2018-2022;
- 3 projects financed by the Grant system for competitive project financing of scientific and artistic activities at the University “Prof.Dr. Asen Zlatarov” – Burgas. - ОУФ-НИ-02/2008, ОУФ-НИ-05/2011, ОУФ-НИ-04/2008,;
- 4 projects financed by the Scientific research sector of the University “Prof.Dr. Asen Zlatarov” – Burgas, namely - НИХ-331/2014, НИХ-366/2016, НИХ-159/2008, НИХ-352/2015. He has been recognized as the author of 3 invention patents, 1 patent application and 1 application for useful model.

In “group E23” the candidate has published a textbook on “Technical documentation” (2013, ISBN 978-954-8422-91-8) and textbook on “Machines and equipment of the chemical industry” electronic edition (2021, ISBN 978-619-91760-0-9).

The materials provided in “group E25” (published application for patent or useful model) are as follows:

1 submitted patent application

- Reg. № BG/P/2022/113558 / 12.07.2022 „Technology and reservoir for storage of hydrogen in absorbed state“;

1 submitted application of useful model

- Reg. № BG/P/2022/5555 от 12.07.2022, „Reservoir for storage of hydrogen in absorbed state” with issued Decision of registration № 4308/22.08.2022.

In „group E26” the candidate has been acknowledged as the author of 3 invention patents:

- Reg. № 67400 B1/25.11.2021, „High voltage technology for preparation of graphene and its deposition as surface coating onto metal substrate“;
- Reg. № 66859 B1/29.03.2019, „Reactor for separation of emulsions using fractal systems“;
- Reg. № 67421 B1/15.03.2022, „Method for deposition of graphene coating onto polymer substrate by electric arc technique“.

The total number of points in “group E” is 350 which is higher than the minimum number of 200 according to the Requirements of the University “Prof.Dr. Asen Zlatarov” – Burgas.

4. General characteristics of the scientific research and applied research activities of the candidate

The main fields where the scientific and applied research activities of the candidate were focused are the design of machines and equipment, hydrodynamics, simulation studies of hydrodynamic and mechanical processes, deposition of surface coatings, energy efficiency and management, organization and optimization of the educational process.

The research work covers wide spectrum of interdisciplinary fields. The analysis shows that the main part of the studies is of experimental and simulation nature due to the complexity of the processes taking place in the systems studied. These studies are connected with the necessity for knowledge in various fields – machine engineering, processes and apparatuses, hydrodynamics, energetics, mechanics, physicochemistry, tribology, statistical processing and analysis of results, etc.

The information supplied in the provided summary of the contributions is very clearly and comprehensively structured and it is presented in six main fields:

1. Design of construction of machines and equipment and improvement of the energy efficiency and design turbines for ORC installations;
2. Hydromechanical studies and optimization of mechanical constructions;
3. Deposition and studies of the mechanical characteristics of surface coatings deposited onto metal and polymer materials;
4. Simulations studies and optimization of mechanical constructions and tensile properties of deposited coatings;
5. Synthesis of new materials;
6. Management, organization and optimization of the educational process.

The scientific research and applied research contributions in each field are described in detail.

5. Estimation of the pedagogical activity of the candidate

The candidate has had substantial pedagogical activity. It can be seen from the provided information about the lecturing activity of the applicant that for the educational year 2019-2020 he has had lectures and exercises with students from the educational and qualification degree (EQD) "Bachelor", "Professional bachelor" and "Master" totaling 461, 51 and 407 hours, respectively, for 2020-2021 – 551, 36 and 482 hours and for 2021-2022 – 491, 36 and 287 hours.

He has been the scientific tutor of 3 successfully defended PhD students and 12 diploma students from EQD "Master".

He elaborated 1 review of a diploma thesis, 1 review of a textbook of "machine engineering" and 1 review of "Handbook for solving problems in technical mechanics".

He developed 22 new curricula for EQD "Bachelor", regular and extramural forms of education on the disciplines: „Engineering graphics“, Computer technologies in transportation“, "Applied software", Machines and equipment in chemical industry“, "Introduction to AutoCAD“, "Applied software in engineering chemistry“, "Processes and equipment in chemical industry – I part“, "Processes and equipment in chemical industry – II part“.

The applicant developed 3 new curricula for EQD "Professional bachelor", regular and extramural forms of education for the disciplines: „Basics of design and CAD“, Applied CAD systems in electronics“, "Technical documentation“.

He developed 13 new curricula for the EQD "Master", regular and extramural forms of education, for the disciplines: „CAD technologies in transportation“, Automation of design“, "Computer methods in design“, "Reservoirs and containers under pressure“, " Computer graphical systems“, "Computer 3D design“, "Web design“, "Computer animation“, "Simulation design of electronic circuits“, "Computer design in electronics“, "Computer design of electric machines and equipment“, "Fluidized systems – technique and technology“.

The candidate developed also 12 lecture courses for EQD "Bachelor", regular and extramural forms of education, 5 lecture courses for EQD "Professional bachelor" and 12 lecture courses for EQD "Master".

He developed also 6 video lecture courses for the discipline "Engineering graphics" for EQD "Bachelor" regular and extramural forms of education, and 6 video exercises for the same discipline. The video lecture courses and exercises were made for the distant form of education of the students at the University.

Information is supplied certifying that the all these disciplines have been permanently incorporated in the educational plans of the University specialties which ensures the lecturing engagement of the candidate in this scientific specialty.

The candidate has been Chief assistant for 11 years and associate professor for 16 years. All the facts mentioned above reveal the substantial pedagogical activity of the candidate.

6. Main scientific and applied research contributions

The main scientific and applied research contributions of the applicant can be attributed to design of machines and equipment, study of hydrodynamic processes, simulation studies of hydrodynamic, heat- and mass transfer and mechanical processes, deposition of surface coatings, energy efficiency of ORC-installations and management, organization and optimization of the educational process. The supplied summary of the contributions contains detailed and clearly structured information which is arranged in six main fields. The scientific and applied research contributions in each of these fields are described in details.

I can shortly summarize the contributions of the studies, according to the scientific works supplied for the competition, as follows:

- ✓ Profound scientifically based studies have been carried out using modern computer systems for 3D design and simulation modelling and a method and mathematical model for description of the hydrodynamic processes in fluidized bed apparatuses were developed. New designs of meshes for granulation of finely dispersed materials were developed and the constructive characteristics of the device were optimized. New design of direct stream reverse vortex flow cyclone for cleaning the spent fluid was suggested (publications: B4(1,7), G7(2,3,4), G*8(8,10,16,17,18,42,44). Scientific research results obtained in this field have been implemented in practice..
- ✓ Reactor for separation of emulsions using fractal systems was designed and a mathematical model and method for description of the process of separation were developed (publications: B4(3), G*8(39)).
- ✓ New type of disintegrator-cavitation pump for fine grinding of solid state materials and their dispersion in liquid phase to obtain stable suspensions was developed (publication: G*8(32)).
- ✓ Scientifically based study of the performance of the ORC installations was carried out and the heat and hydrodynamic expansion processes in the turbine were optimized by computer modelling. New design of turbine working wheel blades was developed depending on the hydrodynamics and the Freon used. New type of turbine nozzle device was developed allowing polytropic expansion of Freon. Using simulation modelling, the performance of the shaft of generator turbine working with Freon was studied. Results were obtained about the distribution of the strain and deformations of the shaft and new

shaft design was suggested (publications: G5, G7(4), G*8(3,14,25,26,27,28,46,47)). Scientific research results obtained in this field have been implemented in practice.

- ✓ ➤ New approach towards the deposition of wear resistant coating of aluminium oxide Al₂O₃ onto polyamide structures Polipa®PA6 and Polikes®PA6G using fluidized bed was suggested. The coating structure was analyzed and specific optimal performance regimes were determined. It was proved that the substrate material has significant effect on the wear resistance and adhesion of the coating while the elastoplastic properties of the coating were affected by the technological conditions under which the coating was obtained (publications: B4(7), G7(5), G*8(35,50)).
- ✓ A new technology for formation of SiC (silicon carbide) based metal complexes within metal structure using electric arc technology was suggested and the possibilities for optimization of the deposition process were studied. The influence of the technological regimes of preparation of the coatings on some basic characteristics (adhesion, hardness, wear resistance) of the multicomponent system was established (publications: B4(5), G*8(22)).
- ✓ New approach for formation of metal matrix composites from stainless steels X2CrTi12, X5CrNi18-10 and X1NiCrMoCuN20-18-7 containing SiC and TiC was suggested, as well as the same steels with WC (tungsten carbide) and Stellite 6. The composites can be used in appliances with high wear resistance and they are especially suitable for the chemical industry since they have improved characteristics, e.g. microhardness, high elasticity modulus and high wear resistance compared to conventional metal alloys (publications: B4(6), G*8(23,30,31)).
- ✓ New method for deposition of copper nano-coating onto polymer material Polikes®PA6G by high voltage technology was suggested. The regimes of copper coating deposition were established experimentally. The morphology of the deposited coating was determined. Specific optimal regimes of high voltage sputtering of copper were developed which can successfully be used for deposition of copper coatings onto various polymeric materials (publications: G7.(1,), G*8(45)).
- ✓ New technology and optimal regimes for high voltage sputtering of graphene and deposition of graphene monolayer onto polymeric or metal substrate were developed aiming to obtain capacitive nano-coating. For this purpose, high voltage sputtering of graphite electrode in vacuum was employed to deposit the layer onto polymer material PS/SB793 shockproof and aluminium substrate. The optimal regimes of graphene coating deposition were experimentally studied and established (publications: B4(10), G*8(49)).
- ✓ New approach and method for simulation and prediction of the geometric, mechanical and tribological properties of the coating studied was suggested, as well as for optimization of the deposition regimes under certain selected main criteria: adhesion strength, microhardness and wear resistance. Simulations were carried out with complex external load of normal force, bending and torque applied on the system substrate-coating for which, after comparing to the physical experiments with coatings on X18H9T and Ti on PS/SB190 crystal, PS/SB793 shockproof **POLIPOM®POM**, the results obtained coincided very well. The methods allows shortening time and resources for experimental studies and determination of the desired thickness of the coating which is an expensive and quite long procedure (publications: B4(8), G*8(33,41)).

- ✓ Method for simulation structural modelling and analysis of the strain in orifices mounted in spherical bottoms of pressure reservoirs and analysis of the pressure in thin-wall containers. Modern computer technologies were used to create 3D model and physical model for simulation of the equivalent stresses arising in the walls of the spherical bottom for different values of the angle γ and container body, on the basis of the finite elements method. Software programs for investigation and optimization of the design were developed (publications: G*8(3,14,40)).
- ✓ Mathematical model for determination and prediction of ship viability after impact, where the possibilities for repairing the damaged systems are taken into account. Mathematical formulation for determination of the function of failure distribution is suggested, by which the probability of ship viability after impact can be assessed (publications: Г*8(11,24)).
- ✓ Research study was carried out and a technology for granulation of volatile coal ash – industrial waste from thermal power stations (TPS), to produce sintered granules which are good heat insulation material and have certain absorption properties and can be used for clearing petroleum spills. Technology for granulation of soot and preparation of granules of required shape, size and density was suggested, which can be used in rubber industry. Technologies were also suggested for preparation of highly porous ceramic materials having high dielectric constant on the basis of SiO_2 , Al_2O_3 , graphite, CaCO_3 and barium titanate. The kinetics of oxidation of copper pyrometallurgical iron silicate (fayalite) slag was studied by TG-DTA, XRD and SEM – EDS analyses. The technological regimes were optimized and a method for oxidation of fine iron silicates in high temperature fluidized bed was suggested. Technology for preparation of glass ceramics from natural materials was suggested, as well as from industrial wastes (ash from TPS, metallurgical slag, etc.) containing oxides. Technology for preparation of lightweight ceramic materials with clay matrix and biowaste fillers (rice husks, rye thatch, etc.) as pore-forming materials was suggested; the materials can be used in modern building construction. Research work was carried out and a technology for synthesis of wollastonite ceramics by two-stage technique was suggested. The initial materials used were $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ and $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$, as well as Na_2SiO_3 and CaCl_2 . The calcium silicate powders were synthesized by the method of chemical co-precipitation so they were very finely dispersed. Technology for preparation of graphite based electro-conductive paste (publications: B4(1,4,9), G7(6), G*8(6, 8, 9, 10, 12, 13, 18, 19, 20, 21, 36, 37, 38, 48)).
- ✓ Technology for preparation of glass microspheres sized from 100 to 50 μm in hydrodynamic flow of high temperature gas was developed. The initial material used was ground waste glass from households and industry. Technological scheme and installation design of the installation was elaborated. Mathematic apparatus and software product for optimization of the performance regimes were suggested (publications: B4(2), G*8(7)). The results obtained from the research work have been implemented in practice.
- ✓ Scientifically based research was carried out on the new requirements for the methods of teaching of students and a new educational system was implemented for the regular and extramural students in the disciplines Engineering graphics, Technical documentation and Mechanics. The system was made in accordance with the new requirements of BDS ISO and BDS EN ISO, modern means of remote education were also included (publications:

G*8(1,2,4,5,15,29).

The scientific research and applied research contributions in each of these fields are described in detail.

7. Critical remarks and recommendations

I have no critical remarks on the essence and the technical presentation of the materials for the competition; I would only recommend the candidate to take into account the following recommendations:

1. In the scientific papers, the conclusions should make more extensive analysis of the results obtained. The reader expects to more thoroughly understand the author's opinion about the processes and tendencies observed.

2. The key word in the publications should be carefully chosen. They should be meaningful and should be some of the most often found phrases in the text but, actually, they are scarce in the paper.

8. Personal impressions and opinion of the reviewer

I am impressed by the volume and the scope of the scientific production of the candidate. He works in perspective and interesting scientific and applied research fields; he has ideas and offers solutions. This defines him as an established and recognized scientist and specialist in his field, which is a prerequisite for his future development.

CONCLUSION

On the basis of the analysis of the candidate's scientific, applied research and pedagogical activities made I consider that **Assoc. Prof. PhD Eng. Dimitar Rusev Rusev** complies with the requirements of LDASRB, the Rules for its application and the Regulations for its application in the University "Prof.Dr. Asen Zlatarov" – Burgas for acquiring the academic position of "Professor".

In full confidence, I recommend the members of the honorable scientific jury to vote for **Assoc. Prof. PhD Eng. Dimitar Rusev Rusev** to take the academic position of "Professor".

4.11.2022
Burgas

REVIEWER : .
(Prof. PhD Eng. Magdalena Sabeva Mitkova)