



REVIEW

on the materials for participation in the competition for the academic position of "Professor", field of higher education 4. Natural Sciences, Mathematics and Informatics, Professional field 4.4. Earth Sciences, scientific speciality 'Ecology and Ecosystem Conservation', in the discipline 'Solid Waste Processing Technologies', announced by the University of Forestry in Official Gazette 100/16.12.2022, procedure code ELLAsP-1222-98 .

Candidate:

1. Assoc. Prof. Ph.D Eng. Ekaterina Ivanova Todorova

Reviewer: Assoc. Prof. Ph.D Petar Gospodinov Petrov, Professional field 4.4. Earth Sciences, University of Forestry

1. Brief biographical date about the candidate

Assoc. Prof. Ph.D Eng Ekaterina Ivanova Todorova, was born in the city of Sofia on December 28, 1961. In 1985, she graduated from the Institute of Chemical Technology in Sofia. He acquired his "patent specialist" certification from the Institute of Economics in Sofia in 1987. His doctoral thesis, "Distribution of contaminants and environmental concerns in the manufacturing of extractable phosphoric acid" was successfully defended in 1995. From 1981, she worked first as a patent specialist, then as a chemical engineer at the University of Chemical Technology and Metallurgy - Sofia and the University of Mining and Geology "St. Ivan Rilski". In 1995, Assoc. Prof. Ph.D Eng Ekaterina Todorova obtained the scientific degree "candidate of technical sciences" (now Ph.D). In 1999, she began her teaching and research career at the Forestry University - Sofia, as a chief assistant. In 2006, he acquired the academic position of "associate professor".

The candidate has several participations in projects as a manager and specialist in the industry in which he is seeking advancement, as can be seen from the CV that has been submitted.

She has good computer literacy, speaks English at a good level. It is evident that in the course of his work the candidate has developed good communication and management skills.

Assoc. Prof. Ph.D Eng Ekaterina Todorova, has been the Dean of the Forestry University's College of Ecology and Landscape Architecture since 2020.

2. Compliance of the candidate's submitted documents and materials with the requirements according to the Regulations for the development of the academic staff of the University of Forestry

The documents submitted by Assoc. Prof. Ph.D Eng Ekaterina Todorova, the only candidate, correspond to the requirements of the Regulations for the development of the academic staff of the University of Forestry. The materials are in accordance with the requirements of Art. 60 of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its Application. The documents are also in accordance with the Regulations for the terms and conditions for the acquisition of scientific degrees and for the occupation of academic positions at University of Forestry under field of higher education "4."Earth Sciences".

According to the minimum required points for Professional field 4.4. "Earth Sciences", the reference and assessment of compliance by indicators is as follows:

1. Indicator A - Dissertation work for the award of the educational and scientific degree "doctor". A copy of the diploma for the educational scientific degree "Ph.D" is presented. *The required 50 points have been completed.*
2. Indicator B.3 – A monograph with a volume of 170 pages has been submitted. *The required 100 items have been completed.*
3. Indicator Г.7. Articles and reports published in scientific publications, referenced, and indexed in world-famous databases with scientific information - 9 items.
4. Indicator Г.8. Scientific publication in non-refereed journals with scientific review or in edited collective volumes - 25 issues.

In total, 200 points are required for G7+G8, 308.1 points have been completed.

Copies of publications and abstracts are provided.

5. Indicator D.10 - Citations or reviews in scientific publications, referenced and indexed in world-famous databases with scientific information or in monographs and collective volumes - 156 items.

6. Indicator D.11 - Citations in monographs and collective volumes with scientific review - 6 items.

7. Indicator D.12 - Citations or reviews in non-refereed journals with scientific review - 26 items.

Out of the required 100 points for indicator D, the candidate has completed 850 points.

A list of citations by indicators is presented.

8. Indicator E.14 - Guidance of a successfully defended doctoral student – 2 successfully defended the doctoral student, under the independent guidance of the candidate.

9. Indicator E.15 - Participation in a national scientific or educational project - 18 items

10. Indicator E.16 - Participation in an international scientific or educational project - 3 items

11. Indicator E.17 - Guide to a national scientific or educational project - 15 copies

12. Indicator E.19 - Attracted funds for projects managed by the candidate – 1 project, with 144 points.

According to indicator E, the candidate has completed 764 points, out of the required 150, according to Regulations for the development of the academic staff.

By all indications, the Candidate has met the requirements, and in many cases, has gone above and beyond them.

In addition to the evidence of the complement ment of the minimum requirements for holding the position of "professor", Assoc. Prof. Ph.D Eng Ekaterina Todorova has presented: 2 publications that are not included in the list of scientific publications; 1 delivered and unpublished report on the topic "Specificity of the circular economy of biodegradable waste - opportunity, problems and sustainable management" at the VII International Scientific Conference - winter INDUSTRY 4.0, from 7 to 10.12.2022 in Borovets; proof of peer review of 5 scientific papers and publications.

All submitted additional materials are in the direction in which the candidate works and in which the current procedure is announced.

3. Evaluation of the educational and teaching activity of the candidate

Assoc. Prof. Ph.D Eng Ekaterina Todorova, conducts lectures and exercises in full-time and part-time form of education at:

Educational qualification degree "Bachelor" in the academic disciplines:

- "Solid waste processing technologies" (Ecology and environmental protection) (regular education: lectures 45 hours, exercises 45 hours and practice 6 hours and part-time education: lectures 24 hours, exercises 21 hours and practice 6 hours)
- "Fluid purification technologies" (Ecology and environmental protection) (regular education: lectures 45 hours, exercises 30 hours and practice 18 hours and part-time education: lectures 23 hours, exercises 15 hours and practice 6 hours)
- "Preventive activity for environmental protection" (Ecology and environmental protection) (regular education: lectures 30 hours and exercises 30 hours and part-time education: lectures 15 hours and exercises 15 hours)
- "Environmental management systems" (Ecology and environmental protection) (regular education: lectures 30 hours and exercises 15 hours and part-time education: lectures 15 hours and exercises 8 hours)
- "Chemical substances and environmental risk" (Ecology and environmental protection) (regular education: lectures 30 hours and exercises 15 hours and part-time education: lectures

15 hours and exercises 8 hours)

Educational qualification degree "Master" in the academic disciplines:

- "Household waste management" (Residential ecology) (regular education: lectures 45 hours and exercises 15 hours)
- "Waste" module from the discipline "Abiotic monitoring" (Environmental restoration and ecological monitoring) (regular education: lectures 30 hours and exercises 30 hours)
- "Application of remote methods for monitoring mining facilities" (Remote methods for monitoring and modeling in the environment) (regular education: lectures 15 hours and exercises 45 hours)
- "Circular and sustainable waste management" (Environmental engineering) (regular education: lectures 30 hours and exercises 30 hours and part-time education: lectures 15 hours and exercises 15 hours)

Assoc. Prof. Ph.D Eng Ekaterina Todorova is a teacher who successfully organizes and leads the learning process at a very high professional level. Achieves outstanding results in student motivation and the transmission of modern knowledge and skills.

Assoc. Prof. Ph.D Eng Ekaterina Todorova is the author of the curricula for the disciplines, having participated in their updating and revision in 2012, 2014, 2017 and 2022, when the curriculum of the Ecology major was also updated and environmental protection and the master's programs "Environmental Restoration and Ecological Monitoring", "Residential Ecology" and "Ecotourism".

In 2022 at University of Forestry, 2 new hybrid master's degrees are being launched at the Department of Environmental Impact Assessment - Remote Methods for Monitoring and Modeling in the Environment jointly with Moscow State University and Environmental Engineering jointly with Technical University Gabrovo. Assoc. Prof. Ph.D Eng Ekaterina Todorova is the main driver for their development and implementation.

Assoc. Prof. Ph.D Eng Ekaterina Todorova supervised 2 successfully defended doctoral students (in 2016 and 2020) and 1 dismissed with the right of defense. It should also be highly appreciated that both successfully defended doctoral students appeared in competitions for chief assistant (Ph.D Alexandrina Kostadinova) and assistant (Ph.D Savina Brankova) at University of Forestry and are currently successful teachers.

Assoc. Prof., Ph.D Eng. Ekaterina Todorova was a consultant to 1 doctoral student at University of Chemical Technology and Metallurgy, Department of "Engineering Ecology" on the scientific specialty "Technology for recovery and treatment of waste" and 4 specialists on an individual curriculum at University of Forestry in the field of waste, which fully corresponds to the candidate's qualifications and the subject of the current competition.

In the past ten years, Assoc. Prof. Ph.D Eng Ekaterina Todorova has served as the supervisor for 39 graduates, the majority of whom focused on topics related to the current competition. All graduates have successfully defended. She was a reviewer of 16 diploma theses. Actively participates in the organization and conduct of diploma defenses and state exams for students, specialty Ecology and environmental protection.

Assoc. Prof. Ph.D Eng Ekaterina Todorova (respectively a member and chairperson of the accreditation committee) made a significant contribution to the planning and execution of the three most recent accreditation procedures of the specialty while supplying as a teacher in the Department of Education and Training and Dean of Deputy Dean and Dean of the Faculty of Ecology and Landscape Architecture.

She has organized and participated in numerous practical and seminar trainings and classes in the field of waste management.

Assoc. Prof. Ph.D Eng Ekaterina Todorova participates as a member or is the chairperson of numerous committees in the Forestry University related to the organization and conduct of the educational process.

4. Evaluation of the candidate's scientific, applied scientific and publication activity

4.1. Participation in scientific, scientific-applied, and educational projects

For the period 2004 - 2022, Assoc. Prof. Ph.D Eng Ekaterina Todorova, participated in 18 national scientific and scientific-applied projects and in 3 international scientific and educational projects. She was the head of 15 national scientific projects and 2 scientific projects financed under international programs with national co-financing.

On behalf of LTU, she leads a scientific, infrastructural project for the construction of a Center of Competence "Clean technologies for a sustainable environment - water, waste, energy for a circular economy". Through the project, funds in the amount of BGN 723,068.42 were attracted for University of Forestry. In addition to the funds raised, another important result of the project led by Assoc. Prof. Ph.D Eng Ekaterina Todorova is the built waste management laboratory, to which she made a personal contribution.

Evidence is presented for the implementation of a technological scheme for composting green waste in the Municipality of Dobrich - ASEKOB reference with ex. No. 32/20.05.2013

All listed scientific, scientific-applied, and educational projects are within the scope of the announced competition and each one of them has contributed to the development of Assoc. Prof. Ph.D Eng Ekaterina Todorova as a highly qualified specialist in the field of growth, with a contribution to the development of science and application of scientific achievements in practice.

4.2. Characteristics of published scientific results

The candidate Assoc. Prof. Ph.D Eng Ekaterina Todorova has provided the following scientific production: 1. Habilitation work - monograph (B3); 2. Articles and reports published in scientific publications, referenced, and indexed in world-famous databases with scientific information - 9 (Г7); 3. Articles and reports published in non-refereed peer-reviewed journals or published in edited collective volumes - 25 (Г8).

In the presented Reference on the scientific and publication activity, it can be seen that Assoc. Prof. Ph.D Eng Ekaterina Todorova is the sole author of the monograph "Industrial symbiosis of biodegradable waste - a key element for its prevention", with a volume of 168 pages. In terms of quality and volume, the monograph fully meets the requirements of LAW on the development of the academic staff in the Republic Bulgaria for growth in an academic position. The subject of the monograph fully coincides with the field of competition for promotion to the academic position of professor.

The candidate's study on solid waste management, industrial symbiosis, and the circular economy is included in the monograph's content. In accordance with our nation's obligations to implement a circular economy, the monograph includes studies related to identifying opportunities for the realization of industrial symbiosis in Bulgaria for biodegradable waste, including sludge from wastewater treatment plants (WWTP), green biowaste, and food biowaste. The research's findings, which are the focus of the monograph, are rational, coherent, and make a substantial scientific contribution to the fields of solid waste processing technologies and the circular economy.

Publications of the candidate Assoc. Prof. Ph.D Eng Ekaterina Todorova in scientific publications referenced in global databases are 9 (26.5%), of which 4 publications (11.8%) have an impact factor. In Non-Refereed Publications with scientific review or in edited collective volumes, the candidate has 25 articles (73.5%), of which Journal Publications – 15 articles (44.1%), Publications in collections of scientific forums - 7 (20.6%) and edited collective volumes – 3 (8.8%).

The candidate has published 21 publications in English and 13 in Bulgarian.

The primary scientific fields that Assoc. Prof. Ph.D Eng Ekaterina Todorova's studies fall under are:

Minimization and utilization of waste as a raw material and energy resource, including through industrial symbiosis.

Studies in this direction are related to:

- Minimization of the amounts of waste obtained from sediment during wastewater treatment [№№44 (Г7.1), 69 (Г8.17), 59 (Г8.7)].
- Assessment, SWOT-analysis, and cost-benefit analysis of various solid waste treatment technologies based on the best available techniques [Nos. 44 (Г7.2), 52 (Г7.9), 54 (Г8.2), 55 (Г8.3), 57 (Г8.5), 58 (Г8.6), 62 (Г8.10); projects - WASTEKIT project, "CirCe" project].
- Assessment and analysis of quantities and composition of the available hazardous waste and the possibilities for their environmentally friendly treatment [Nos. 55 (Г8.3), 57 (Г8.5), 60 (Г8.8), 71 (Г8.19), 72 (Г8.20); projects -4, 5, 9, 10, 14].
- Assessment and analysis of the morphological composition of solid waste [Nos. 64 (Г8.12), 66 (Г8.14); projects – 5, 6, 7, WASTEKIT project, "CirCe" project].
- Development of technology and technological scheme for converting biodegradable waste into a raw material resource, incl. compost [№№ 75 (Г8.23), 77 (Г8.25); projects - HEI-ILCA project, "CirCe" project; project Center of Competence "Clean technologies for a sustainable environment - water, waste, energy for a circular economy" and an implemented technological scheme for composting green waste in the Municipality of Dobrich].

Environmental efficiency of waste treatment technologies

Studies in this direction are related to:

- a comparison of the regulatory requirements in the development of environmental impact assessments with the possibilities of applying the environmental efficiency standard ISO-14045 [№ 48 (Г7.5)].
- assessment of the ecological efficiency of various operating installations for composting and thermal treatment of bio-waste [№ 51 (Г7.8)].
- determination of quantitative values and calculation of the ecological efficiency of plasma-gasification methods for waste treatment [№ 70 (Г8.18)].
- calculation of the ecological efficiency of various methods of hazardous waste treatment based on the best available techniques and technologies [№ 70 (Г8.20), projects-Leading project with international financing and national co-financing on the topic "Clean technologies for sustainable environment-water, waste and energy for a circular economy" to build a Center of Competence with partner University of Forestry].

4. 3. Reflection of the candidate's scientific activity in the literature (citability)

A total of 188 citations of 24 publications were noted, for which Assoc. Prof. Ph.D Eng Ekaterina Todorova attached a list and evidence in documents submitted for the competition.

From the list presented, 156 citations of 13 scientific works are established in scientific publications, referenced, and indexed in world-famous databases with scientific information or in monographs and collective volumes, of which 17 citations in publications with an impact factor. Citations in monographs and peer-reviewed collective volumes of the candidate are 6 to 2 scientific papers. Citations or reviews in non-refereed peer-reviewed journals were found, a total of 26 cited on 9 scientific papers.

Provided reference on the citability of scientific output of Assoc. Prof. Ph.D Eng Ekaterina Todorova shows that 92% of the citations are in refereed and indexed scientific publications, proves the significance of the candidate's scientific research and her contribution to the development of science .

The total number of points that the candidate receives according to the indicators in group Д is 850, with 100 points required for the academic position "professor" for the professional field of Earth Sciences.

4.4. Contributions in the works of the candidate/s (scientific, scientific-applied, applied)

I accept the scientific and scientific-applied contributions formulated by the candidate, which include specific and multidisciplinary studies focused on waste management, circular economy, environmental efficiency, and industrial symbiosis. The studies cover different types of solid waste, incl. household, biodegradable, mining, etc.

The three directions in which the candidate's contributions are summarized are up to date, coincide with the search for scientific solutions to modern scientific problems in the field of waste management and show a thorough understanding of the problems in the direction for which the current competition is announced.

The contributions presented by Assoc. Prof. Ph.D Eng Ekaterina Todorova are summarized in 3 directions, as follows:

Research field 1: Minimization and utilization of waste as a raw material and energy resource, including through industrial symbiosis.

Scientific contributions:

- Opportunities for the realization of industrial symbiosis for biodegradable waste in Bulgaria are scientifically, technically, and technologically justified. (B1)
- For the first time, a connection has been made between the possibilities of minimizing and utilizing waste as a raw material and energy resource in settlement systems, different in size, number of population and represented industrial sectors, enabling the development of new industrial activity. (B1)
- Industrial symbiosis has been found to be realized in different ways depending on the classification of sewage sludge as hazardous or non-hazardous waste. (B1)
- It has been confirmed that industrial symbiosis can bring benefits to the environment, with successful implementation and functioning of the symbiotic relationships between the participants. (B1)

Scientific-applied contributions:

- Specific technological solutions are offered based on the quantitative and qualitative composition of biodegradable waste and its life cycle, in the context of industrial symbiosis. (B1)
- A scheme has been developed for the minimization and utilization of non-hazardous sludges from wastewater treatment plants by obtaining compost and lubricompost. (B1)
- It has been confirmed the need for the sludge to undergo an anaerobic biotechnological treatment process in order to use the energy capacity for energy production, after which the resulting fermentation product can be used in agriculture. (B1))
- A quantitative assessment of the generated waste from treatment plants was made and it was established that their classification as hazardous and non-hazardous predetermines their treatment. A scheme of industrial symbiosis of hazardous sludge from sewage treatment plants has been developed based on thermal methods for obtaining various chemical products that are an alternative to natural gas and oil. (Г8-17, Г8-18)
- The possibilities and conditions for achieving the ecological norms in the treatment of wastewater from the pulp and paper industry, as well as in the treatment of some heavy metals and metalloids from waste water in the production of copper, have been established (Г7-1; Г8-7).
- Hazardous waste at the national level has been identified quantitatively and by location, as well as the quantities of composite packaging waste by municipality, the problems with construction waste. It has been proven that the quantities of hazardous waste are decreasing, but through ecological efficiency, the appropriate methods of treatment and their conversion into an energy and raw material resource can be identified (Г7-9, Г8-3, Г8-5, Г8-8, Г8- 12, Д8-19, Д8-20).

- A modern household waste management system has been developed, which can ensure its transformation into a raw material and energy resource. It has been experimentally proven that the location of municipalities at the national level does not affect the morphological composition of household waste. A scheme for the treatment and utilization of the solid household waste generated in Sofia is proposed. (Г7.2; Г8.2; Г8.6; Г8-10, Г8-14)
- The starting quantities of the initial C/N ratio (30:1) of green and brown waste, their preliminary preparation, the sequence of loading into the compost heap, including its aeration, ensuring an optimal composting regime are determined. (Г8-23)

Research field 2: Environmentally friendly management of mining waste

Scientific contributions:

- It has been established that mining waste from the processing of copper and polymetallic ores containing gold and silver do not contain substances hazardous to the environment and human health, in concentrations leading to their classification as hazardous waste. (Г7-6, Г7-7, Г8-1, Г8-9, Г8-11)
- Mine tailings from cyanide gold mining have been confirmed to meet regulatory requirements and the concentration of weak acid decomposable cyanide at discharge points meets best available techniques (Г8-4).
- It has been proven that mining waste can be used in various sectors of industry and construction. They contain valuable substances that can be used as an alternative to natural materials. It has been proven that utilization of mining waste for backfilling of mine workings does not lead to additional leaching of the impurity elements contained in it. (Г8-13, Г8-15, Г8-16)
- A database has been created for the mineral substrate (mining waste), hydrological and hydrogeological profile of the Chelopech village area, surface and underground water quality, soil, and sediment analysis. It has been established that the mine waste from the embankments has no potential to neutralize acidic waters, this leads to the deterioration of plant nutrition conditions, suppressing their growth and inhibiting the metabolic processes of some microorganisms. (Г8-22, Г8-21)

Methodological contributions:

- A methodological approach has been developed for the classification of mining waste and its behavior in the environment by applying a static and kinetic leaching test. The leading criterion in the classification of mining waste is its origin and chemical composition, with complex application of legislation on mining waste and waste management (Г7-4, Г7-3).

Research field 3: Environmental efficiency of waste treatment technologies

Scientific and scientific-applied contributions

- It was found that in the evaluation of the ecological efficiency of various operating installations for composting and thermal treatment of bio-waste, based on the international standard ISO 14045:2012, the ecological efficiency depends to a different extent, both on the economic value and from the environmental impact that the technology has. The results of the evaluation confirm that the methods that utilize the energy and raw material potential of waste have a higher ecological efficiency.
- Using quantitative parameters, the ecological efficiency was calculated for various thermal methods of waste treatment, incl. plasma-gasification, and their environmental compatibility has been proven. Among the investigated installations, the installation for obtaining electrical energy has the highest efficiency, followed by the installations to produce ammonia and diesel.
- It was found that by calculating the ecological efficiency, the appropriate methods for treating hazardous waste can be identified, which is a prerequisite not only for reducing the

impact of this group of waste on the environment, but also for turning it into an energy and raw material resource.

- It has been proven that the environmental efficiency of waste recycling depends to a significant extent on the economic value of the process (respectively, the amount of recycled waste). Recycling, as part of the circular economy, has its financial side, but collecting and recycling one ton of recyclable materials is much more economical than landfilling one ton of waste. It has been found that as disposal costs increase, thermal methods will become more environmentally efficient.

Methodological contributions:

- A unified system for detailed, concrete, and reliable assessment of ecological efficiency is proposed through thirteen groups of indicators, each of which includes a different number of specific indicators for environmental protection, human health protection and sustainable development. This system can be used to evaluate investment proposals in terms of their impact on the environment.

5. Evaluation of the candidate's personal contribution

Among the 34 publications that were submitted for consideration, the candidate is the first author on 8 of them, the second author on 15 of them, and the third author on 4 of them. The candidate wrote the whole monograph that is being presented. I accept that the candidate made an equal contribution to each publication. The submitted materials and my personal observations confirm that the candidate has personal input and unique in the submitted joint publications.

6. Critical notes and recommendations

I have no critical notes. Assoc. Prof. Ph.D Eng Ekaterina Todorova has a diverse, rich in terms of topics and research approaches production, reflected in 1 monograph, 34 articles (presented in the current competition), as well as a significant number of articles previously. The scientific publications presented in the current competition contain contributions from the three categories - scientific, scientific-applied and methodological. All presented materials are well systematized and classified. The contributions are summarized in appropriate thematic areas and fully correspond to the high requirements for occupying the academic position of "professor".

7. Personal impressions

I have known Assoc. Prof. Ph.D Eng Ekaterina Todorova since my first day of work at UF, like a colleague in the EEO department, Deputy. Dean and later Dean of the Faculty of Ecology and Landscape Architecture. Also, from our joint work on research projects. My impressions are that she is a very good professor, an excellent and consistent manager, highly motivated and focused not only on the scientific work, (which undoubtedly has a significant impact in the field of competition), but also in the educational work. Her ability to motivate students is particularly impressive. In our previous relationships, she has proven herself as a reliable colleague and manager, with high professionalism and responsibility towards work.

8. Conclusion

I SUGGEST the candidate ASSOC. PROF. PH.D ENG EKATERINA IVANOVA TODOROVA to occupy the academic position of "professor" in the discipline "technologies for solid waste processing" from professional direction 4.4. Earth sciences.

Reviewer Signature

The review was submitted on: 7/4/2023.