

AUTHOR'S REFERENCE

for scientific and scientific - applied contributions on the works

on Ch . As . Dr Blagovesta Nikolaeva Midyurova

*Department of Ecology and Environmental Protection, Faculty of
Natural Sciences ”, University of Prof. Dr. Asen Zlatarov ”, Burgas*

submitted for participation in a competition for the academic position of "Associate Professor" in the field of higher education: 4. Natural Sciences, Mathematics and Informatics, professional field: 4.2. Chemical sciences, scientific specialty: Ecology and environmental protection (Ion exchange and bioelectrochemical methods for water purification), published in the State Gazette, issue 87 / 19.10.2021.

The scientific and scientific-applied contributions of the works of Ch. Assistant Professor Dr. Blagovesta Midyurova are in the field of Ecology and Environmental Protection (Ion exchange and bioelectrochemical methods for water purification), which corresponds to the announced competition for "Associate Professor". One of the trends in modern research is aimed at solving one of the most pressing problems of our time - water pollution and their impact on ecosystems. The scientific publications presented by the candidate are multidisciplinary. They cover three of the priority areas of the "National Strategy for Development of Research", 2030. and "Strategy for the development of research activities of the University" Prof. Dr. Asen Zlatarov ”for the period 2017-2025, namely:

- Environment (water, soil, air) and biodiversity;
- Energy efficiency and alternative energy sources;
- Mathematical modeling and computer simulations.

The application of ion exchange and bioelectrochemical methods for water purification opens a future opportunity to overlap two of the priority areas - Environment (water) and alternative sources of green energy. The scientific research also covers the third priority area - computer simulations, in order to predict the behavior of bioelectrochemical systems (BES). Water pollution assessment was performed by applying neural networks and fuzzy sets, analysis of variance and mathematical modeling of processes.

All the scientific production with which Ch. Assistant Professor Dr. Blagovesta Midyurova participates in the competition is focused on these three priority areas. Evidence of current and promising topics are the quotes in international scientific journals such as: *Journal of Power Sources* with Impact Factor - 9.127, *International Journal of Hydrogen Energy* with Impact Factor - 5.816, *Bioelectrochemistry* with Impact Factor - 5.373, *RSC Advances* with Impact Factor - 3.390 and in others with high index-reference.

For participation in the competition are attached documents proving the teaching, teaching and research activities:

- Teaching experience at the moment - 5 years (assistant and chief assistant);
- Two references for the number of lectures and exercises in the Bachelor's and Master's degrees;
- Developed curricula - 12 pieces : for Bachelor's degree - 6 and Master's degree - 6 - *Annex 2* ;
- List of successfully defended graduates;
- Participation in 8 research projects (national scientific or educational project - 5; international scientific or educational project - 3), which are on the topic of the competition - *Appendix 3* ;

In the course of his research work, Ch. Assistant Professor Dr. Blagovesta Midyurova has participated in several international research teams. Evidence of this is provided by reviews from four international scientific organizations: *American University of Sharjah* , *Tekirdag Hint Kemal University*, *Cyprus Science University* and *University of Kragujevac*. The candidate has participated in the organizing committees of two conferences - the International Scientific Conference " *Environmental Engineering and Environmental Protection* " and the National Conference for Pupils and Students " *Think Ecologically for the Future* ".

The presented scientific papers (*Appendix 1*) include:

- habilitation thesis - scientific monograph: 1 (independent) - *Indicator B* ;
- publications that are referenced and indexed in world-famous databases of scientific information (Scopus and / Web of Science): 17 - 5 independent and 12 co-authored ;
- editions, which are referenced and indexed in world - famous databases of scientific information (*Conference Proceedings*): 2 (independent).

In systematic form, the scientific publications on *indicator D* presented for the competition are as follows:

*SCIENTIFIC PUBLICATIONS IN PUBLICATIONS, REFERENCES AND INDEXED WORLD
FAMOUS DATABASES WITH SCIENTIFIC INFORMATION
Quartiles - Q3*

<i>Scientific journal (no. of publications)</i>	<i>Year</i>	<i>Indexing</i>
Journal of Environmental Protection and Ecology [2.4], [2.5]	2021	ISSN 1311-5065, H-INDEX: 20 SJR = 0.214 Impact Score: 0.57 Impact Factor = 0.577 (2020-2021)
Journal of Chemical Technology and Metallurgy [2.1], [2.2], [2.3], [2.7]	2021	ISSN 1314-7471, H-INDEX: 18 SJR = 0.22 Impact Score: 0.81 Impact Factor = 0.806 (2020-2021)
	2020	ISSN 1314-7471, H-INDEX: 18 SJR = 0.22 Impact Score: 0.81 Impact Factor = 0.806 (2020-2021)
Journal of Materials and Environmental Science [2.13]	2017	ISSN 2028-2508 H-INDEX: 37 SJR = 0.295 Impact Factor = 0.804 (2017)
Oxidation Communications [2.6], [2.8], [2.9], [2.11], [2.12]	2020	ISSN 0209-4541 H-INDEX: 22 SJR = 0.215 Impact Score: 0.54 Impact Factor = 0.541 (2020-2021)
	2019	ISSN 0209-4541 H-INDEX: 22 SJR = 0.224 Impact Score: 0.54 Impact Factor = 0.402 (2019)
	2018	ISSN 0209-4541 H-INDEX: 22 SJR = 0.213 Impact Score: 0.54 Impact Factor = 0.233 (2018)
Journal of the Balkans Tribological Association [2.10]	2018	ISSN 1310-4772 H-INDEX: 16 SJR = 0.289 Impact Score: 1.11 Impact Factor = 0.22 (2018)

*SCIENTIFIC PUBLICATIONS IN PUBLICATIONS, REFERENCES AND INDEXED WORLD
FAMOUS DATABASES WITH SCIENTIFIC INFORMATION
Quartiles - Q4*

<i>Scientific journal (no. of publications)</i>	<i>Year</i>	<i>Indexing</i>
Studies in Computational Intelligence [2.14]	2020	ISSN 1860-949X, 1860-9503 H-INDEX: 68 SJR = 0.185 Impact Score: 0.86 Impact Factor = 0.863 (2020)
Bulgarian Chemical Communication [2.15]	2019	ISSN 0861-9808 H-INDEX: 16 SJR = 0.179 Impact Score: 0.40 Impact Factor = 0.302 (2019-2020)
Oxidation Communications [2.16]	2017	ISSN 0209-4541 H-INDEX: 22 SJR = 0.161 Impact Score: 0.54 Impact Factor = 0.415 (2017)

*SCIENTIFIC PUBLICATIONS IN PUBLICATIONS, REFERENCES AND INDEXED WORLD
FAMOUS DATABASES WITH SCIENTIFIC INFORMATION
SJR*

<i>Scientific journal (no. of publications)</i>	<i>Year</i>	<i>Indexing</i>
IOP Conference Series: Materials Science and Engineering [2.17]	2021	ISSN 1757-8981, 1757-899X H-INDEX: 44 SJR = 0.198 Impact Score: 0.51
16th Conference on Electrical Machines, Drives and Power Systems, ELMA 2019 Proceedings- [2.18]	2019	ISBN: 978-1-7281-1413-2, DOI: 10.1109 / ELMA .2019.8771505 H-INDEX: 4; SJR = 0.12
10th National Conference with International Participation, ELECTRONICA 2019 Proceedings- [2.19]	2019	ISBN 978-172817531-7, DOI 10.1109 / ELECTRONICA 50406.2020.9305161 H-INDEX: 3; SJR = 0.11

The contributions of Ch. Assistant Professor Dr. Blagovesta Midyurova are divided into four main areas:

1. Ion exchange methods in natural water treatment.

In this direction, hydrochemical studies of natural waters have been conducted in order to obtain specific information about their composition and possible sources of pollution. The use of natural waters in everyday life, industry, agriculture, etc., requires them to meet certain standards. In order to meet the requirements of the respective users, their pre-treatment and conditioning is required. The scientific works in this field are: 1 monograph [1.1] and 3 publications published in the international database Scopus [2.3, 2.6, 2.7].

2. Application of bioelectrochemical systems in wastewater treatment.

The scientific works included in this field are focused on studying the behavior of bioelectrochemical systems (BES) in water purification. A large number of microbiological reactors have been studied and the tendency to achieve better efficiency of wastewater treatment and higher generated electromotive voltage has been analyzed. Microbiological fuel cells (MFCs) are bioelectrochemical systems in which the chemical energy of organic matter is converted into electricity due to the specific activity of certain groups of microorganisms. The classical microbiological fuel cell consists of an anode and cathode space, separated by a separator (proton exchange membrane, cation exchange membrane). The membranes serve as a selective barrier, through which protons are transported and direct contact between the anode and cathode electrolytes is avoided. The demand for alternative separators for MFC is determined by the high cost of currently used polymer membranes. They are a major factor influencing the kinetics of processes, operational characteristics and commercialization of MFC. Based on the results of all studies, options for optimizing bioelectrochemical systems are proposed. The scientific works in this direction are: 8 publications in scientific journals, referenced and indexed in Scopus [2.1, 2.2, 2.8, 2.9, 2.10, 2.13, 2.15, 2.16] and 2 publications in proceedings of international scientific conferences, also indexed in Scopus [2.18, 2.19].

3. Methods for assessment of surface water pollution.

The assessment of the state of aquatic ecosystems by physicochemical quality elements was performed on the basis of a classification system based on reference values for indicators: oxygen saturation, dissolved oxygen, biochemical oxygen demand, ammonium nitrogen content, nitrite nitrogen, nitrate nitrogen, nitrate nitrogen and phosphorus. According to the requirements of the Water Framework Directive (WFD), biological, physicochemical and hydromorphological quality elements have different relative roles in determining the ecological status of surface

waters. Various methods for estimating surface water pollution have been proposed. The scientific works in this direction are: 3 articles published in journals in the international database Scopus [2.4, 2.5, 2.17].

4. Application of neural networks and fuzzy sets in bioelectrochemical systems. Mathematical modeling and computer simulations.

The development of mathematical models and the application of neural networks leads to a significant reduction in the time and number of studies, and allows for the optimization of bioelectrochemical systems. For the purposes of modeling, it is necessary to accumulate information about the systems in advance, based on specific observations and research on the state of the individual elements for a certain period of time. The following methods were used: the method of central orthogonal compositional planning, the method of regression analysis and others. For the synthesis of new air cathodes, specific methods have been used to evaluate their parameters and to optimize them. Through the mathematical modeling of the parameters of the cathodes are predicted, summarized, solved problems related to the technology for their synthesis. Using a centrally orthogonally compositional plan minimizes the total number of experimental studies. The scientific works in this direction are: 3 articles published in journals in the international database Scopus [2.11, 2.12, 2.14].

Scientific and scientific - applied contributions in the Thematic direction

1. Ion exchange methods in the purification of natural waters.

- The regularities of the ion exchange processes were established and described. The obtained experimental results under different operating conditions lead to a relatively accurate prediction of the processes in the ion exchange systems. Several methods have been developed for the analysis and conditioning of polluted water fluids [1. 1].
- A thorough analysis was performed and the exchange isotherms were constructed using strongly acidic cations and solutions of different concentrations. The relationship between the contact time of the ion exchanger and the solution was determined, and their influence on the ionic strength, kinetics and dynamics of ion exchange was evaluated [2. 7].
- Attached are technological schemes for ion exchange softening . It is clear that other things being equal, the ions of hardness are affected by the stratification of the ionic layer as well as its regeneration. As a result, it is achieved economical technological process with weaker anthropogenic is n pressure on the Environment [2. 3] .
- Quantitative assessment of the influence of the concentration of electrolytes in aqueous solutions has been made. It was found that it is necessary to calculate the selectivity coefficients in order to operate with the values of thermodynamic equilibrium constants characterizing the processes occurring in water- dispersed systems [2. 6].

Scientific and scientific - applied contributions in the Thematic direction

2. Application of bioelectrochemical systems in wastewater treatment.

- The main characteristics of three types of bioelectrochemical systems have been studied. The multifunctionality of these reactors is demonstrated and the processes taking place in them are presented in detail. The effectiveness of bioelectrochemical methods for the removal of organic matter without reagent increase in pH, reduction of metal ions and desalination of water has been proven [2. 13] .
- The productivity of MFC when working with electrodes of different composition was studied. It has been found that when using a VITO[®] 40:60 air cathode reactor, the removal of organic matter increases up to 80% [2.1].
- It was found that when modifying the cathode with electrically conductive polyaniline (PANI) material, an improvement was observed in the operating parameters of the electrode. It has been experimentally proven that when the cathode is modified, the voltage generated in the MFC increases [2.2]. An empirical relationship has been established between the different types of networks used (pre-treated) and the change in the output power of the cell. Proof of this is the increase in the partial assimilation of organic matter.
- Different combinations of cathodes have been developed containing different amounts of Vulcan[®] and MnO₂ catalyst [2. 8, 2.10]. Satisfactory results have been found at the Vulcan[®] powder cathode and at the cathode with a layer of ceramic powder and MnO₂. The application of these modified air cathodes there is important advantages for the functionality of bioelectrochemical systems. The larger working area range is due to the different material ratio and the improved oxygen transfer acting as an electron acceptor .
- A detailed analysis of the influence of the type of network from which the air cathode is constructed is made. The influence of the electrode geometry on the generated electromotive voltage in the MFC has been experimentally determined [2.9] .
- The possibility of improving the operational stability of the processes in the MFC has been studied. This would be of practical importance for the commercialization of systems for the production of so-called "green" energy. It has been found that the efficiency of bioelectrochemical methods for water purification depends on the optimization of reactor design. Maximum efficiency is achieved only at close values of the internal resistance and the resistance of the externally connected resistor in the circuit [2. 19] .
- Different types of membranes from natural raw materials have been developed. They are applied in BES and a comparative analysis is made by analytical techniques, such as: laser diffraction, spectroscopic methods, etc., in order to select the more efficient membrane based on the obtained characteristics. New electrodes have been developed by assembling

with different coatings - polymeric and inorganic in order to improve the processes of diffusion through the membrane [2. 16 , 2.18].

- The feasibility of treating livestock waste fluids with a high content of organic matter, suspended solids, phosphorus and nitrogen has been assessed, through microbiological fuel cells [2. 15]. It was found that the voltage generated by the system remained relatively constant for nearly 300 hours.

Scientific and scientific - applied contributions in the Thematic direction

3. Methods for assessment of surface water pollution

- The self-purification capacity of river waters on the basis of physicochemical indicators was examined [2.5]. The hydrochemical type of water has been determined - hydrogen carbonate calcium, neutral to slightly alkaline. It was found that the self-purification capacity of river waters on the indicators: mechanical impurities and permanganate oxidizability is relatively low - 30% and 22%, respectively.
- A preliminary study on air pollution has been carried out, which has a negative impact on water quality and damages ecosystems [2. 17]. For the purposes of the study, a database generated by an automatic mobile measuring station located near the Burgas Lake Vaya was used. This study is the initial stage of the survey of the water body and clearly demonstrates that air pollution is an integral and extremely important part of the overall maintenance of aquatic ecosystems.
- The method is applied on Vollenweider for calculation on Trophic index (TRIX) basis on measured physicochemical and biological indicators in surface aquatic ecosystems [2.4]. Four state variables were used: chlorophyll A, dissolved oxygen, dissolved inorganic nitrogen, and total phosphorus. Calculated are two combinations of the TRIX index and coefficient on production efficiency on nutrients in the water object. An easy and fast approach to the assessment of the Burgas Lake monitoring database has been demonstrated. The application of the TRIX index helps undertaking on future actions and measures aimed at prevention and protection on waters from pollution.

Scientific and scientific - applied contributions in Thematic direction

4. Application of neural networks and fuzzy sets in bioelectrochemical systems.

Mathematical modeling and computer simulations.


- The prediction of the behavior of a microbiological fuel cell based on artificial neural networks has been made [2. 14] . This type of modeling makes it possible to identify

complex nonlinear relationships between input and output data. These models are very useful when it is difficult to apply conventional mathematical equations. They can help predict data from biosensors and bioelectrochemical systems by identifying specific contaminants in water.

- Statistical analysis [2. 11] of experimental and predicted data was performed by modeling carbon emissions from the inlet and outlet of the primary precipitator from the Wastewater Treatment Plant - Lukoil, Burgas. The obtained values were compared with similar values obtained using Water 9.3[®] software and the US EPA algorithm AP-42. It was found that the values of hydrocarbons calculated using Water 9.3[®] software are about twice as high, while those calculated using AP-42 are four times lower than experimental. It has also been found that the AP-42 algorithm predicts emission values twice lower than those of Water 9.3[®] software.
- For the purposes of modeling, the method of central orthogonal compositional planning is applied. The role of the reaction parameters for the fabrication of air cathodes, subsequently applied in BES, is defined. As a result of the conducted central orthogonal compositional planning, three significant coefficients b_0 , b_1 and b_2 were obtained and an adequate equation with coded value of the input factors was obtained. $F < F_T$ ($18.64 < 19.33$). The equation adequately describes the process of obtaining air cathodes under the studied conditions. The conducted systematic research shows that there are significant parameters that can be used in process optimization and the model can be applied to another type of polymer and catalyst [2.12].

The author's reference was prepared by Ch. Assistant Professor Dr. Blagovesta Nikolaeva Midyurova .

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Signature: 

/Ch. Assist. Dr. Blagovesta Midyurova /