REVIEW

by Assoc. Prof. PhD eng. Blagovesta Nikolaeva Midyurova

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For the award of the educational and scientific degree **"Doctor"**

Scientific field: **4. Natural Sciences, Mathematics and Informatics**

Professional field: **4.2 Chemical sciences**

Scientific specialty: **Ecology and Environmental Protection**

Author of a dissertation: **Mihai Petrov**, independent preparation doctoral program at the Department of Ecology and Environmental Protection, University "Prof. Dr. Asen Zlatarov" - Burgas

Dissertation topic: **"Thermodynamic study of the temperature dependence on the concentrations of some pollutants of ambient air and the global ecosystem"**

Scientific supervisors: Assoc. prof. PhD Zdravka Nikolaeva and Assoc. prof. PhD Alexander Dimitrov

Reason: member of the scientific jury in the dissertation defense procedure for the award of PhD, according to the Order No. UD-271/23.07.2024 of the Rector of the University "Prof. Dr. Asen Zlatarov" - Burgas

1. Biographical information of the Candidate

Mihai Petrov is a graduate of the State University of Moldova, Faculty of Physics, Chisinau - MSc in Physics. He worked at the Computing Center of the State University of Moldova and as a teacher of mathematics, informatics at the Technical College and State Pedagogical University of Moldova, Department of General Physics.

Mihai Petrov graduated from the State Medical and Pharmaceutical University of Moldova - Master of Pharmacy. Since 2021 he has been an assistant professor at the Department of Mathematics, Informatics and Physics at the Faculty of Physics and at the Department of Physics, Biophysics, Radiology and Radiology at the Faculty of Medicine of the University "Prof. Dr. Asen Zlatarov".

2. Relevance of the problem developed in the dissertation in scientific and applied terms.

In recent decades, there has been an increased interest in the protection of the environment - water, air and soil and the impact of pollutants on biodiversity and ecological balance is

emphasized. This is largely due to the appreciation of the harmful and in many cases fatal effects on living nature caused by anthropogenic activities and the search for modern methods and means to deal with this global problem.

For many years, the possibilities and influence of man on nature have been increasing, without any real consideration of the need to maintain the biological balance in nature. The main cause of the ecological crisis is the global depletion of natural resources combined with environmental pollution. Degradation is reaching threatening proportions. Deforestation is leading to an oxygen deficit as a consequence of reduced photosynthesis and the accumulation of excess carbon dioxide in the atmosphere.

For the first time, this dissertation uses an adiabatic thermodynamic method to investigate the relationship between the concentrations of some pollutants and the variation of atmospheric temperature, and results for the variation of the specific heat capacity of the atmosphere. A functional relationship for the effective temperature and albedo values was also obtained. The origin of natural spontaneous fires has been investigated. The unitary complex system Biosphere - Technosphere - Noosphere is also investigated using the thermodynamic physical quantity entropy, which gives an important result for the calculation of the metabolic energy cost of man.

I believe that the problem developed in the dissertation has its relevance in scientific and applied terms, and the set goals and objectives are fulfilled in the required scope.

3. Review of the cited literature

The dissertation contains a total of 6 chapters developed on 145 pages and includes 97 figures, 28 tables and a total of 333 cited references. The references are directly related to the research topic and show that Mihai Petrov has an excellent knowledge of the nature of the problem, both in theoretical and practical terms. Based on the literature review, the unsolved problems are clearly identified, the research approach is defined and the aim and objectives of the dissertation are clearly formulated.

4. Research Methodology.

In relation to the review and analysis, the aim of this dissertation is formulated: the development of a qualitative and quantitative description of the influence of pollutants on atmospheric temperature with the development of natural cataclysms.

In relation to the objective, the following tasks are formulated:

- Development of an empirical adiabatic model to determine changes in atmospheric temperature as a function of concentrations of some atmospheric pollutants.
- Development of an empirical calorimetric method for the variations of atmospheric temperature with CO2 and O2 concentrations.
- Investigation of the relationship between albedo values, density, specific heat capacity and temperature of biosphere and atmosphere components.

- Development of a model for determining the flash point of forest masses as a function of combustion greenhouse gas concentrations.
- Qualitative study of the interrelationship between atmospheric pollutants and the state of the Biosphere.
- Development of the entropy approach for symbiotic unity of complex Biosphere-Technosphere-Humanity system.

The above is a testament to the author's sound theoretical background and good research skills in the choice of methods and tools for research.

5. A brief analytical description of the nature and an assessment of the reliability of the material on which the contributions of the thesis are built.

This dissertation is devoted to a topical problem related to the thermodynamic study of temperature dependence of concentrations of some air pollutants and the global ecosystem.

The applicability of existing models and the creation of new ones related to functional dependencies between carbon dioxide concentrations and atmospheric temperature increase based on the thermodynamic calorimetric method developed by the PhD student are evaluated. The influence of solar radiation versus Albedo values, which vary with the concentrations of pollutants present in the atmosphere, is investigated.

In the **third chapter** of the dissertation, the possibility of applying empirical methods, i.e. adiabatic and calorimetric, to determine the changes of atmospheric temperature depending on the concentrations of pollutants and of carbon dioxide and oxygen is investigated. The relationship between albedo values, density, specific heat capacity and temperature of biosphere and atmosphere components is determined. The values for densities are inversely proportional to the values of specific heat capacities at different components of the Earth - soils, rocks, lakes, seas, oceans, forests, etc.

A method has been developed for determining the ignition temperatures of fuel material components of forested arrays as a function of fuel greenhouse gas concentrations. The amount of heat absorbed by dry leaves and grasses is calculated and an analytical expression for the ignition time interval is presented.

Numerical results of the application of the different methods and their potential applicability are shown.

In **Chapter four** of the thesis, the method of differencing is used to correlate the change in temperature with the change in greenhouse gas concentrations. Validation of the expression is achieved by determining the adiabatic constant of ambient air. The calculated values for the temperature change with the derived empirical formula can be compared with real values. The identity of the values is verified by the coefficient of determination, which confirms this identity. An empirical expression is derived for the temperature variation as a function of the concentration changes. The validation of the empirical expression is finalized by calculating the excess mass of

carbon dioxide, which is on the order of the real one of 15 billion tonnes/year accumulation in the atmosphere.

The specific heat capacity of the ambient air is found to decrease slowly with increasing pollutant gases. The slow decrease in specific heat capacity can be used as a pretext to explain the recent increase in extreme temperature fluctuations with high frequency, as well as various natural cataclysms with intense hurricanes and strong winds.

In **Chapter 5** of the dissertation, the complex impact on Humanity from pollutants in the atmosphere is investigated and a concept of entropy of the single complex system Biosphere - Technosphere - Noosphere is developed. Changes in the Biosphere lead to corresponding changes in the Noosphere and Technosphere. Using the entropy conceptual approach of this unified system, the energy metabolic costs of humans per day have also been calculated.

6. Scientific and applied contributions of the thesis.

On the basis of the presented dissertation and the publications related to it, I believe that the following more significant scientific and applied contributions can be formulated:

1) The developed adiabatic method, allows to compare the actual measured values in the temperature variation, which are of the same order of magnitude with those calculated by this method.
2) The calorimetric method we developed allows the explanation of natural phenomena, e.g. the intensification of natural cataclysms by abrupt changes in atmospheric temperature, which is a consequence of changes in the specific heat capacities of the atmosphere affected by pollutants.
3) The study of the albedo values of the unified Earth-atmosphere system allows to explain the changes in the physicochemical properties of the components of the biosphere that are important for the formation of the microclimate of the ecosystem concerned. E.g. an increase in the Albedo values of soils leads to their compaction. At the same time, their specific heat capacity decreases.
4) The recent increase in spontaneous wildfires is amplified by the presence of combustible pollutant gases and particles in the atmosphere. The developed empirical expression for the flame temperature, based on the laws of thermodynamics, makes it possible to highlight the following aspect that when no combustible gases are present, the flame temperature reaches the minimum possible values with the possibility of fire containment.

7. Can the dissertation and the contributions be assessed and to what extent do they represent the personal work of the doctoral candidate?

The material submitted to me for review, the information available to me, as well as the publications on the topic of the dissertation lead me to believe that the main results of the dissertation are the personal work of as. Mihai Petrov, of course under the supervision of his supervisors - Assoc. Prof. Dr. Zdravka Nikolaeva and Assoc. Prof. Dr. Alexander Dimitrov.

8. Assessment of the publications on the dissertation.

The main results of the dissertation work are presented in 8 publications, 3 of which - in journals indexed in Web of Science and Scopus databases. Three of the articles are independent, and the rest are co-authored (5 - with his supervisors).

According to the minimum national requirements for PhD in higher education field 4.2 Chemical sciences; the total number of points is 80, of which 50 points from the dissertation for the degree of PhD (indicator group A) and 30 points from scientific publications (indicator group G). Mihai Petrov's points on indicator group G are 36 (as three of the articles are in a Q4 journal), thus, his points exceed the required number of points by 6 (total 86 points).

The presented scientific publications prove that the main results of the dissertation have been well approbated in a number of national and international forums and have become known to the scientific community.

9. Is the abstract made according to the requirements, does it correctly reflect the main provisions and scientific contributions of the dissertation?

The abstract has been prepared as required and correctly presents the main points and scientific contributions of the dissertation.

10. Critical remarks and recommendations:

The critical remarks to the dissertation are related to technical omissions of editorial nature in the layout of the dissertation - spelling errors and inaccuracies in the presentation of figures and tables.

I recommend Mihai Petrov:

1) to publish his future scientific results in international journals with high index-reference.

2) the proposed scientific models to be implemented and used by ecologists, researchers, specialists, etc. in their specific work.

The achieved results can also be used in the educational process of students of the professional field 4.2. Chemical sciences, "Ecology and environmental protection", as well as for developments in master's and doctoral programs.

CONCLUSION

On the basis of the above analyses concerning the results of my presented work, their relevance, originality and significance, I consider that the dissertation work "**Thermodynamic study of the temperature dependence on the concentrations of some pollutants of the ambient air and the global ecosystem**" is a complete scientific research and meets the requirements of the Law on the Research and Development of Environmental Protection and the Regulations for its application for obtaining the educational and scientific degree "Doctor".

This justifies me to give **a positive assessment** of the dissertation and to recommend the members of the esteemed jury to vote for Mihai Petrov to obtain the degree **of Doctor of Education and Science in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.2. Chemical Sciences, doctoral programme "Ecology and Environmental Protection".**

Подпис заличен
Чл.2 от ЗЗЛД

10.09.2024

Reviewer:

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