REVIEW

on a dissertation for the acquisition of the educational and scientific degree "doctor"

Author of the dissertation: Engineer Stella Ivanova Naydenova

Thesis topic: "Study of the content of polycyclic aromatic hydrocarbons in atmospheric aerosol", field of higher education: 4. Natural Sciences, Mathematics and Informatics, professional field: 4.2 Chemical Sciences, specialty: "Ecology and Environmental Protection", scientific supervisors Assoc. Prof. Leniya Gonçalves, PhD and Assoc. Prof. Alexander Dimitrov, PhD.

Reviewer: Assoc. Prof. Vanya Desimirova Gandova, PhD, University of Food Technologies – Plovdiv, order of the Rector of the University „Asen Zlatarov" Burgas, № УД-503/16.12.2024 г.

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

The presented dissertation addresses a problem that is current and significant. Air pollution poses the greatest risk to the environment and human health and is perceived as a major problem after climate change. Its quality is of paramount importance due to the easy and unhindered spread of pollutants.

Poor air quality continues to pose serious problems. Quite often, they are related to the presence of fine particulate matter (PM) in the air and this continues to be a major challenge. The main threat with regard to this pollutant is related not only to the aerodynamic diameter of the particles, but also to their chemical composition.

Of great interest for scientific research is the analysis of different fractions of PM for the content of polycyclic aromatic hydrocarbons, due to their mutagenicity and carcinogenicity. These compounds are released into the environment as a result of incomplete combustion of organic material, accumulate and can have adverse effects on human health.

2. Degree of knowledge of the state of the problem and the literary material

The dissertation has a volume of 156 pages and contains 49 tables and 66 figures.

It is divided into three main sections: literature review, experimental part and results and discussion.

The literature review is presented on 49 pages or covers about one third of the total volume, which makes it sufficient to present the problem under consideration. The dissertation presents 202 literary sources, with over 95% of them being taken from foreign literature. A significant part 149 are after 2010,

and 60 are after 2020. This, in my opinion, is an indicator of a very good knowledge by the PhD student of the research conducted on various air pollutants.

The experimental part first describes the sampling, which was carried out in 7 points in the Burgas region. These are:

- University „Prof. Dr. Asen Zlatarov" - Burgas;
- Trapezitsa roundabout;
- Slaveykov complex;
- Zornitsa complex;
- Dolno Ezerovo district;
- Lazur complex;
- Vazrazhdane complex.

The sampling method is then described. The mass concentration of fine dust particles was determined by gravimetric method. The presence of Polycyclic Aromatic Hydrocarbons in fine dust particles was qualitatively and quantitatively determined. This section concludes with a health risk assessment.

In the section „Results and Discussion" atmospheric levels, with meteorological parameters and other pollutants of PAHs, related to $PM_{2.5}$ in Burgas by year are tracked:

- Fall 2020
- Winter 2021
- Spring 2021
- Summer 2021
- Fall 2021
- Winter 2022
- Fall 2022
- Winter 2023

A large number of experiments have been performed, which have been conducted with average statistical processing in order to obtain reliable research data.

For the analysis of PAHs in fine dust particles at these points, 161 samples were examined. By season, the most filters were analyzed from winter sampling (58 pcs.), due to the more intensive emission release.

Then from autumn sampling (50 pcs.), which are of interest due to the unstable atmosphere and large temperature differences.

During the summer season, 34 samples were analyzed and during the spring season – 18.

Nine conclusions were formulated and for the first time a detailed study of the content of 17 PAHs and associated with $PM_{2.5}$ and PM_{10} on the territory of Burgas

Municipality was carried out. The analysis covers seven points, in different seasons in the period 2020-2023. The application of a complex approach, covering the detailed distribution of 17 PAHs compounds in combination with a correlation analysis with meteorology and other pollutants, indicates the main sources of the studied pollutants in atmospheric aerosols, revealing the complex interaction between the various factors contributing to pollution.

The contributions of the dissertation are divided into scientific and applied science, which I fully accept.

Scientific contributions:

- The first detailed study of the concentrations of PAHs in different fractions of particulate matter for the Municipality of Burgas. The study provides a unique analysis of the concentrations and distribution of 17 PAH compounds in atmospheric aerosols, including both $PM_{2.5}$ and the coarser fractions PM_{10}. This is the first study of its kind to cover different neighborhoods of Burgas and provides important data on the spatial and seasonal distribution of PAHs, which has not been studied before in the region.
- Uncovering the relationship between PAHs, meteorological factors and other atmospheric pollutants. The study investigates and analyzes the correlation between the concentrations of the studied PM-associated PAHs, key meteorological parameters and other atmospheric pollutants and provides new data on the complex interactions in the atmosphere. These results contribute to the understanding of the mechanism of distribution, transformation and retention of PAHs in different meteorological conditions and environments.
- Assessment of health risks associated with exposure to PAHs. The study assesses the impact of PAHs on human health by applying a quantitative health risk assessment. The results show that levels of PAHs, particularly during the winter months, may pose a significant health risk, although the estimated excess cancer risk (ECR) is not considered a high priority.

Scientific and applied contributions:

- Improving air quality management and regulatory policies. The results of the study provide a valuable basis for developing regulatory policies aimed at limiting pollution in urban areas with high concentrations of atmospheric PAHs and improving environmental quality and the related health status of the population.
- The implemented methodology, including modern sampling and analysis techniques, is applicable to other studies and environmental monitoring programs. It can be used to assess air pollution levels in different regions and conditions, identify likely sources of emissions, their impact on air quality according to the specifics of the region, as well as to assess their health impacts.

3. Assessment of dissertation publications and evaluation of the abstract

Four scientific publications are presented, three of which are included in the reference - declaration. In all articles, the PhD student is in first place, which shows that in their design its contribution is significant. The total number of points is 40, which corresponds to the minimum requirements by groups of indicators for acquiring the educational and scientific degree "doctor".

The abstract accurately and fully describes the sampling and methods of work, the experimental data obtained and their discussion, the conclusions and contributions of the dissertation and publications.

4. Opinions, recommendations and notes

The sections in the work are very well structured and allow for a thorough presentation of the results obtained. The results themselves are thoroughly discussed and a comparison is made with the research of other authors.

The conclusions in the dissertation correctly reflect the work done in the individual parts of the section „Results and Discussions".

The dissertation work shows that the PhD student has worked very thoroughly on the research, possesses theoretical and practical knowledge, which she skillfully applies in the scientific work under the PhD program.

I have no particular remarks or recommendations for the PhD student.

5. Conclusion

My dissertation submitted for review represents a completed scientific research work, which is sufficient in volume and quality. The experimental data obtained are formed into scientific and scientific-applied contributions. Based on the analysis made, I give a positive assessment of the developed dissertation work and consider it reasonable to propose Eng. Stella Ivanova Naydenova to acquire the educational and scientific degree "doctor" in the field of higher education: 4. Natural sciences, mathematics and informatics, professional field: 4.2 Chemical sciences, specialty:„Ecology and environmental protection".

Date: 30.01.2025

Reviewer: Подпис заличен чл.2 от ЗЗЛД

/ Assoc. Prof. Vanya Gandova, PhD /