

**Review
of the scientific advisor
on the thesis of Mrs. Olga Pavlovna Ibragimova
“Development of simple and accurate methods for organic pollutants determination
in the air based on solid-phase microextraction”
presented for the defense of Ph.D. degree on educational program “8D05301 -
Chemistry”**

Monitoring of volatile organic compounds (VOCs) in the air is important for environmental impact assessments. Air pollution is one of the main sources of risk to human health and leads to the destruction of ecosystems, creating huge social and economic damage to society. Quantification of VOCs in ambient air using standard methods requires time- and labor-consuming sample preparation and/or calibrations, toxic solvents for chemical desorption, and expensive additional equipment for thermal desorption. These drawbacks limit the application of standard methods for efficient monitoring of VOCs in developing countries.

Solid-phase microextraction (SPME) is a promising alternative to standard methods for the quantification of VOCs in the air. SPME is a “green”, low-cost, simple, and reliable method, which combines sampling and sample preparation in one step. SPME is widely used for the analysis of organic pollutants in water, solid, and air samples. However, the application of SPME for routine air analysis is still limited by labor-consuming calibration, difficulties related to the preparation of standard gas solutions with known concentrations, and analyte loss during storage and transportation. In addition, there are some knowledge gaps associated with the determination of time-weighted average concentrations of VOCs by SPME.

The Ph.D. thesis of Mrs. Ibragimova is aimed at the development of simple and accurate methods for organic pollutants determination in air based on SPME. The study included the development of methods for the determination of single- and time-weighted average concentrations of volatile and semi-volatile organic compounds in ambient air. Those methods were developed to optimize the extraction and desorption parameters to achieve better accuracy and precision. In addition, under the framework of her study, the sampler with alternative geometry for the determination of the time-weighted average concentration of VOCs in the air was developed.

To achieve proper spike recoveries (90-105%) and reproducibility of quantification of multiple VOCs, 65 μm PDMS/DVB SPME fiber at 10 min extraction and 1 min desorption was used. It has been established that air samples in 20 mL vials can be stored for 8 h without significant loss of analytes. The developed method was successfully applied for VOCs monitoring in the ambient air of Almaty city as well as for investigating the effect of COVID-19 restriction measures on air quality in Almaty.

It has been proven that there are significant seasonal variations for several VOCs and the dependence of the sampling site's location on air pollution levels (lower VOCs concentrations in the south of Almaty city, and higher concentrations – in the north). A study of the effects of COVID-19 restriction measures showed the complex nature of air pollution in Almaty and suggested that traffic-free conditions could not substantially reduce the level of air pollution.

It has been shown that finite element analysis software (COMSOL Multiphysics) can be used for efficient simulation of time-weighted average air sampling by SPME.

Such simulation allows to reduce time and cost for experiments, and avoid uncertainties, as well as to avoid uncertainties that may arise during experiments. The method for determination time-weighted average concentrations of VOCs was developed using an 85 µm Car/PDMS SPME fiber retracted in the proposed sampler with an alternative geometry at a diffusion path length of 67 mm. This method provides a simple and accurate determination of the daily average to create a novel reliable air quality monitoring systems in Kazakhstan and other developing countries, where the application of standard methods is limited. The obtained results represent an input to the theory of the determination of time-weighted concentrations of VOCs by SPME.

During the study, Olga Ibragimova showed herself as qualified, hardworking, and motivated young scientist, able to independently conduct her own research and put forward hypotheses to solve complex tasks. She successfully completed part of the Ph.D. thesis in the laboratories of two departments (chemistry and environmental engineering) of Bolu Abant Izzet Baysal University under the supervision of Professor Duran Karakas, who was highly satisfied with her internship.

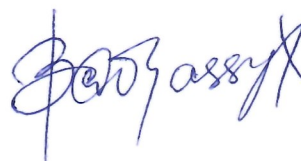
During her study, Mrs. Ibragimova published four articles in peer-reviewed international journals in the fields of analytical chemistry, chromatography, and environmental chemistry: Atmosphere (IF = 3.11), Science of the Total Environment (IF = 10.754), Separations (IF = 3.344) and Molecules (IF = 4.927). Mrs. Ibragimova also published one article in a journal recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, and two patents for invention. All requirements for publications before the defense were satisfied.

The study of Mrs. Ibragimova was carried out under the projects AP05133158 “Development of analytical methods, materials and equipment for cost-efficient “green” environmental monitoring” (2018-2020) and AP09058606 “Development of method for determination of organic pollutants time-weighted average concentrations for monitoring of ambient air of Almaty” (2021-2023) both funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan.


In my opinion, regarding the importance of the topic, scientific novelty, practical value, and volume of the research, the dissertation of Mrs. Ibragimova “Development of simple and accurate methods for organic pollutants determination in the air based on solid-phase microextraction” fulfills all requirements of the Ministry of Science Higher Education of the Republic of Kazakhstan to the Ph.D. thesis, and Mrs. Ibragimova deserves the Ph.D. degree on the educational program “8D05301 - Chemistry”.

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