Review of the local scientific advisor
on the dissertation of Tolkyn Kurmanbayeva
"Development of simple and accurate methods for on-site gas chromatographic determination of volatile organic compounds in environmental objects using solid-phase microextraction" submitted for Ph.D. degree on the educational program "8D05301 – Chemistry"

Quantification of volatile organic compounds (VOCs) includes collecting environmental samples, transporting them to the laboratory and their laboratory analysis. Moving the analysis to the field would avoid transportation, allow decreasing costs, increasing accuracy, faster decision making on the levels of environmental and human health risks, pollution area. Solid-phase microextraction (SPME) is one of the best approaches for on-site analysis because it is very simple, does not require organic solvents, combines sampling and sample preparation into one step. Nevertheless, the number of available SPME-based methods for on-site quantification of VOCs is very low, which is caused by the difficulty in their development. Most available SPME-based methods cannot be directly used for on-site application because they are not optimized for portable instruments and field conditions.

Ph.D. dissertation of Tolkyn Kurmanbayeva is devoted to the development of simple and accurate methods for on-site gas chromatographic determination of volatile organic compounds in soil, water and air using SPME. Three methods for on-site quantification of transformation products (TPs) of rocket fuel unsymmetrical dimethylhydrazine (UDMH) in soil and water, and BTEX (benzene, toluene, ethylbenzene and o-xylene) in air using SPME and portable gas chromatography (GC) were developed and tested in the field.

For more accurate on-site BTEX quantification in air, standard addition calibration was implemented because photoionization detector (PID) response factors can change during the GC transportation to the sampling site. Extraction time of 15 minutes provided sufficient detection limits. For on-site quantification of UDMH TPs in water samples, the method based on Vac-HSSPME previously optimized for more sensitive stationary GC-MS was applied. Limits of detection using portable GC with nitrogen-phosphorus detector (NPD) were 0.2-40 μg/L. For more accurate on-site quantification of UDMH TPs in soil samples, analytes were preliminary extracted with distilled water and subjected to Vac-HSSPME using the parameters optimized for water samples. This allowed to decrease the matrix effect and improve accuracy. Vac-HSSPME was for the first time applied for on-site quantification of VOCs in environmental samples. It required only a minor additional equipment but provided faster extraction and lower detection limits.

As the result of these studies, three articles have been published in reputable journals in analytical chemistry: Advances in Sample Preparation (Q1 WoS), International Journal of Environmental Analytical Chemistry (Q3 WoS) and Microchemical Journal (Q1 WoS). Tolkyn Kurmanbayeva is the first author in all these articles.

The research for the dissertation has been conducted under the project "Development of accurate methods for on-site gas chromatographic determination of volatile organic compounds in environmental objects using solid-phase microextraction" (2022-2024, AP14871374) funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan supervised by me.

Tolkyn Kurmanbayeva is a prospective young researcher in analytical chemistry with a solid background in portable gas chromatography, gas chromatography with mass spectrometric detection, solid-phase microextraction. During her work on the dissertation, she showed the ability to master new analytical instruments. Currently, she participates in the realization of the project AP23484339 "Identification of new potentially hazardous volatile and semi-volatile organic environmental pollutants in Almaty and its suburbs using solid-phase microextraction" (2024-2026) at the Center of Physicochemical Methods of Research and Analysis of Al-Farabi Kazakh National University and works as the leading analyst of the Analytical Center of Scientific and Scientific-Technical Development at the National Academy of Sciences of the Republic of Kazakhstan under the President of the Republic of Kazakhstan.

Based on the published articles, independence, internal unity, scientific novelty, reliability, practical value, and academic honesty, the dissertation meets the requirements of the Rules for Awarding Degrees, and the author, Tolkyn Kurmanbayeva, deserves to be awarded the degree of Doctor of Philosophy (Ph.D.) in the educational program 8D05301 – Chemistry.

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