**REVIEW**
**of the official reviewer**
**for the dissertation of Tolkyn S. Kurmanbayeva on the topic "Development of simple and accurate methods for on-site gas chromatographic determination of volatile organic compounds in environmental objects using solid-phase microextraction" in the specialty "8D05301 – Chemistry"**

| № | Criteria | Eligibility (one of the options must be checked) | Justification of the position of the official reviewer |
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| 1. | The topic of the dissertation (as of the date of its approval) corresponds to the directions of development of science and/or state programs | 1.1 Compliance with priority areas of science development or government programs: | Grant No. AP14871374, 2022–2024<br><br>The dissertation research was carried out within the framework of the scientific project funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan: «Development of accurate methods for on-site gas chromatographic determination of volatile organic compounds in environmental objects using solid-phase microextraction» (Grant No. AP14871374, 2022–2024). The topic directly aligns with the national priority direction for science development: «Rational use of water resources, flora and fauna, ecology». |
| | | 1) The dissertation was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program)<br>2) The dissertation was completed within the framework of another state program (indicate the name of the program) | |

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| | | **√ 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)** | |
| 2. | Importance for science | The work **makes** a significant contribution to science, and its importance is **well disclosed** | The work makes a substantial contribution to analytical chemistry and environmental risk assessment. It systematically addresses a major limitation in environmental monitoring: the delay, sample degradation, and analyte loss caused by transporting unstable, toxic, and volatile organic compounds to centralized laboratories. The candidate successfully integrated solid-phase microextraction (SPME) and vacuum-assisted headspace solid-phase microextraction (Vac-HSSPME) with a portable gas chromatograph (SRI 8610C GC equipped with PID and NPD detectors) for accurate in situ quantification. The theoretical and practical importance is thoroughly disclosed through detailed mass-transfer kinetics modeling in COMSOL Multiphysics, comprehensive matrix effect mitigation strategies (standard addition and matrix-matched calibrations), and direct field validation at real contamination sites (atmospheric air in Talgar and rocket stage crash sites in the Ulytau region). |
| 3. | The principle of independence | Independence level:<br>**√ 1) High;**<br>2) Medium;<br>3) Low;<br>4) No independence | The candidate demonstrated a high degree of intellectual and experimental independence. The author independently formulated the research methodology, designed and assembled field-compatible extraction devices (including specialized vacuum-tight sampling caps and modified GC injection ports for narrow-bore SPME liners), executed numerical simulations in COMSOL Multiphysics, conducted demanding multi-day field expeditions in remote regions of Kazakhstan, processed analytical data, and authored the |

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| | | | primary scientific manuscripts published in reputable international journals. |
| 4. | The principle of inner unity | 4.1 Justification of the relevance of the dissertation:<br>**√ 1) Justified;**<br>2) Partially justified;<br>3) Not justified. | The relevance is completely justified by the urgent necessity for operational, field-deployable monitoring tools during chemical emergencies and routine environmental control. The high toxicity and volatility of BTEX and unsymmetrical dimethylhydrazine (UDMH) transformation products demand rapid analytical turnaround times that conventional laboratory workflows cannot achieve. |
| | | 4.2 The content of the dissertation reflects the topic of the dissertation:<br>**√ 1) Reflects;**<br>2) Partially reflects;<br>3) Does not reflect | The content completely reflects the declared title and scope. The dissertation details three coherent analytical workflows: on-site BTEX quantification in air using SPME-GC-PID, and on-site UDMH transformation product determination in water and soil matrices using Vac-HSSPME-GC-NPD |
| | | 4.3. The purpose and objectives correspond to the topic of the dissertation:<br>**√ 1) correspond;**<br>2) partially correspond;<br>3) do not correspond | The overall aim of developing and implementing simple, accurate on-site GC methods using SPME is systematically divided into three realistic, logically structured experimental tasks (air, water, and soil monitoring), all of which were successfully completed. |
| | | 4.4 All sections and provisions of the dissertation are logically interconnected:<br>**√ 1) completely interconnected;**<br>2) the interconnection is partial;<br>3) there is no interconnection | The manuscript demonstrates high internal consistency. The progression from theoretical and numerical modeling (COMSOL Multiphysics) to parameter extraction optimization, matrix-effect evaluation, field hardware adaptation, and real on-site verification exhibits seamless logical continuity. |
| | | 4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions:<br>**√ 1) critical analysis is presented;**<br>2) analysis is partial; | The proposed solutions are critically compared with existing EPA standards (TO-14A, TO-15, TO-17) and previously published GC-MS laboratory protocols. The author candidly evaluates the trade-offs between portable GC detectors (PID/NPD) and high-resolution laboratory GC-MS, demonstrating that while instrumental sensitivity is lower, |

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| | | 3) the analysis does not represent own opinions, but quotes from other authors<br>4) analysis is not available | the total measurement uncertainty is superior due to the elimination of sample storage and transport errors. |
| 5. | Scientific novelty principle | 5.1 Are the scientific results and provisions new?<br>1) completely new;<br>**√ 2) partially new (25-75% are new);**<br>3) not new (less than 25% are new) | For the first time, vacuum-assisted headspace solid-phase microextraction (Vac-HSSPME) has been adapted and deployed for on-site field analysis of soil and water. This is also the first demonstrated quantitative field determination of volatile organic pollutants in environmental samples at sampling sites in Kazakhstan using portable GC-PID and GC-NPD systems. |
| | | 5.2 Are the dissertation findings new?<br>1) completely new;<br>**√ 2) partially new (25-75% are new);**<br>3) not new (less than 25% are new) | The findings establish original thermodynamic and kinetic parameters for on-site SPME of BTEX and Vac-HSSPME of polar UDMH degradation products. The study revealed that preliminary aqueous extraction of soil provides significantly lower matrix variability than alkaline or acidic digestion, establishing an unprecedented benchmark for rapid field analysis. |
| | | 5.3 Technical, technological, economic or management decisions are new and reasonable:<br>1) completely new;<br>**√ 2) partially new (25-75% are new);**<br>3) not new (less than 25% are new) | The engineering adaptations, including the custom-fabricated GC inlet accommodating narrow-bore SPME liners on an SRI 8610C platform, field-deployable vacuum evacuation assemblies, and greenness assessments via AGREE and AGREEprep metrics (scoring 0.59 and 0.56), represent novel, technically rigorous, and economically viable solutions. |
| 6. | The validity of the main findings | All main conclusions **are** based on scientifically significant evidence | The experimental results are fully validated by rigorous analytical methodology: parallel replicate measurements (n>3), spike-recovery evaluations (73.3–123%), calibration linearity (R2>0.97), LOD/LOQ determinations based on signal-to-noise ratios, and cross-comparison with laboratory-based benchtop GC-MS systems (Agilent 6890N/5975C). |
| 7. | The main provisions for the defense | Provision 1:<br>7.1 Is the provision proven? | Provision 1: |

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| | | **√ 1) proven;**<br>2) rather proven;<br>3) rather not proven;<br>4) not proven<br>5) in the current wording, it is impossible to verify the proof of the provision<br>7.2 Is it trivial?<br>1) yes;<br>**√ 2) no**<br>3) in the current wording, it is impossible to verify whether the provision is trivial<br>7.3 Is it new?<br>**√ 1) yes;**<br>2) no<br>3) in the current wording, it is impossible to verify the novelty of the provision<br>7.4 Application level:<br>1) narrow;<br>**√ 2) medium;**<br>3) wide<br>4) in the current wording, it is impossible to verify the application level of the provision<br>7.5 Is it proven in the article?<br>**√ 1) yes;**<br>2) no<br>3) in the current wording, it is impossible to verify the proof of the provision in the article | 7.1: PRovision 1: For determination of BTEX (benzene, toluene, ethylbenzene, m-/p-xylene, and o-xylene) in atmospheric air by 15-min solid-phase microextraction in an aluminium foil-covered 250 mL sealed glass bulb using 85 µm Carboxen/polydimethylsiloxane fiber at 40 °C and an SRI 8610C gas chromatograph with photoionization detection, at least four analyses (three samples – not spiked with analytes and one sample – spiked with analytes) are required.<br>7.2: It is not trivial.<br>7.3: The study is relatively new.<br>7.4: The application level is medium.<br>7.5: Kurmanbayeva et al., Advances in Sample Preparation, 2024, 10, 10011.<br><br>Provision 2:<br>7.1: PRovision 2: Matrix effect during vacuum-assisted headspace solid-phase microextraction of seven transformation products of unsymmetrical dimethylhydrazine (pyrazine, 1-methyl-1H-pyrazole, N-nitrosodimethylamine, 1-methyl-1H-1,2,4-triazole, N-methylformamide, 1H-pyrazole, and 3-methyl-1H-pyrazole) from 5-mL water samples and aqueous soil extracts in 20 mL vials with 1.75 g NaCl using an 85 µm Carboxen/polydimethylsiloxane fiber at 50 °C for 30 min under stirring is not substantial.<br>7.2: It is not trivial.<br>7.3: The study is relatively new.<br>7.4: The application level is medium..<br>7.5: Kurmanbayeva et al., International Journal of Environmental Analytical Chemistry, 2025, 105, 7673–7682. |

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| | | Provision 2:<br>7.1 Is the provision proven?<br>**√ 1) proven;**<br>2) rather proven;<br>3) rather not proven;<br>4) not proven<br>5) in the current wording, it is impossible to verify the proof of the provision<br>7.2 Is it trivial?<br>1) yes;<br>**√ 2) no**<br>3) in the current wording, it is impossible to verify whether the provision is trivial<br>7.3 Is it new?<br>**√ 1) yes;**<br>2) no<br>3) in the current wording, it is impossible to verify the novelty of the provision<br>7.4 Application level:<br>1) narrow;<br>**√ 2) medium;**<br>3) wide<br>4) in the current wording, it is impossible to verify the application level of the provision<br>7.5 Is it proven in the article?<br>**√ 1) yes;**<br>2) no | Provision 3:<br>7.1: Provision 3: Preliminary extraction of the eight transformation products of unsymmetrical dimethylhydrazine (pyrazine, 1-methyl-1H-pyrazole, N-nitrosodimethylamine, N,N-dimethylformamide, 1-methyl-1H-1,2,4-triazole, N-methylformamide, 1H-pyrazole, and 3-methyl-1H-pyrazole) from soil with distilled water prior to vacuum-assisted headspace solid-phase microextraction provides lower matrix effect compared to 1 M NaOH and 1 M HCl.<br>7.2: It is not trivial.<br>7.3: The study is relatively new.<br>7.4: The application level is medium...<br>7.5: Kurmanbayeva et al., International Journal of Environmental Analytical Chemistry, 2025, 105, 7673–7682. |

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| | | 3) in the current wording, it is impossible to verify the proof of the provision in the article<br><br><u>Provision 3:</u><br>7.1 Is the provision proven?<br>**<u>√ 1) proven;</u>**<br>2) rather proven;<br>3) rather not proven;<br>4) not proven<br>5) in the current wording, it is impossible to verify the proof of the provision<br>7.2 Is it trivial?<br>1) yes;<br>**<u>√ 2) no</u>**<br>3) in the current wording, it is impossible to verify whether the provision is trivial<br>7.3 Is it new?<br>**<u>√ 1) yes;</u>**<br>2) no<br>3) in the current wording, it is impossible to verify the novelty of the provision<br>7.4 Application level:<br>1) narrow;<br>**<u>√ 2) medium;</u>**<br>3) wide<br>4) in the current wording, it is impossible to verify the application level of the provision<br>7.5 Is it proven in the article? | |

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| | | **√ 1) yes;**<br>2) no<br>3) in the current wording, it is impossible to verify the proof of the provision in the article<br><br>Provision 4:<br>7.1 Is the provision proven?<br>1) proven;<br>2) rather proven;<br>3) rather not proven;<br>4) not proven<br>5) in the current wording, it is impossible to verify the proof of the provision<br>7.2 Is it trivial?<br>1) yes;<br>2) no<br>3) in the current wording, it is impossible to verify whether the provision is trivial<br>7.3 Is it new?<br>1) yes;<br>2) no<br>3) in the current wording, it is impossible to verify the novelty of the provision<br>7.4 Application level:<br>1) narrow;<br>2) medium;<br>3) wide | |

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| | | 4) in the current wording, it is impossible to verify the application level of the provision<br>7.5 Is it proven in the article?<br>1) yes;<br>2) no<br>3) in the current wording, it is impossible to verify the proof of the provision in the article | |
| 8. | The principle of reliability. Reliability of sources and information provided | 8.1 Choice of methodology - is justified or the methodology is described in sufficient details<br>√ **1) yes;**<br>2) no | The experimental setups, chromatographic conditions, calibration schemes, and sample handling steps are documented in exhaustive, reproducible detail. |
| | | 8.2 The results of the dissertation were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies:<br>√ **1) yes;**<br>2) no | Modern extraction techniques (SPME, Vac-HSSPME), high-efficiency capillary chromatography with selective detectors (PID, NPD), and advanced finite element modeling (COMSOL Multiphysics 5.6) were effectively deployed. |
| | | 8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research:<br>√ **1) yes;**<br>2) no | Theoretical mass transfer and diffusion models were thoroughly validated by empirical extraction profiles and recovery studies in real environmental matrices. |
| | | 8.4 Important statements are **confirmed** by references to current and reliable scientific literature | The dissertation cites 131 relevant scientific citations, referencing authoritative literature in analytical chemistry, green sample preparation, and environmental toxicology. |

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| | | 8.5 Used literature sources are **sufficient** for a literature review | The literature review comprehensively analyzes the evolution of on-site GC systems, micro-GC developments, SPME theory, and the chemistry of UDMH transformation. |
| 9 | Practical value principle | 9.1 The dissertation has theoretical value:<br>**√ 1) yes;**<br>2) no | The theoretical value lies in elucidating the kinetics and thermodynamics of multiphase extraction under reduced headspace pressure for polar, nitrogen-containing environmental toxicants. |
| | | 9.2 The dissertation is of practical importance and there is a high probability of applying the results obtained in practice:<br>**√ 1) yes;**<br>2) no | The developed procedures directly reduce the analytical cycle from several days to 1-4 hours, providing rapid chemical data during emergency rocket spill incidents and routine air quality assessments. |
| | | 9.3 Are the practice suggestions new?<br>**√ 1) completely new;**<br>2) partially new (25-75% are new);<br>3) not new (less than 25% are new) | The practical protocols for rapid on-site screening and matrix-matched quantification using portable GC systems are completely new in field practice in Kazakhstan. |
| 10. | The quality of writing and design | Academic writing quality:<br>**√ 1) high;**<br>2) average;<br>3) below average;<br>4) low. | The dissertation is written in clear, precise, scientific academic language. The illustrations, chromatographic profiles, flowcharts, and tables are structured in accordance with international publication standards. |
| 11. | Comments to the dissertation | While the dissertation is scientifically robust and meets all criteria for the PhD degree, the following constructive observations are noted:<br>1. Methodological and Scientific Inconsistencies<br>A. Discrepancy in Calibration Units and Range in Table 25 (Critical Finding)<br>• Issue (pp. 76-78): In Table 25, the dynamic calibration range for soil analysis is listed under the header "Linear range (mg/kg)" (e.g., 0.21–2.1 mg/kg for pyrazine, corresponding to 210–2100 µg/kg). However, the corresponding limit of detection (LOD = 6 µg/kg), limit of quantitation (LOQ = 20 µg/kg), and quantified soil concentrations are reported in µg/kg (e.g., Pyrazine in Sample 1_7 = 7.5 µg/kg).<br>• Required Revision: If the actual working range is indeed 210–2100 µg/kg, the reported sample concentration of 7.5 µg/kg falls substantially below both the linear dynamic range and the established | |

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| | | LOQ (20 µg/kg). The candidate must clarify whether this discrepancy stems from a unit conversion error involving extract concentration (mg/L or µg/L) and soil dry weight (V/m = 10 mL / 1.0 g = 10 L/Kg) and revise the column header and numerical data accordingly.<br><br>B. Quantitative Reporting Below the Limit of Quantitation (LOQ)<br>• Issue (pp. 76, 78): According to established analytical chemistry conventions, analyte signals observed below the LOQ cannot be reliably quantified and should be reported as "< LOQ" or "trace". In Table 25:<br>o For pyrazine (LOQ = 20 µg/kg), discrete numerical values of 7.5 µg/kg (sample 1_7) and 9.2 µg/kg (sample 1_11) are reported.<br>o For 1-MPA (LOQ = 11 µg/kg), concentrations of 7.6 µg/kg and 6.9 µg/kg are reported.<br><br>• Required Revision: The candidate must explicitly address this issue in the text, either by designating values below the LOQ as semi-quantitative estimates via clear table footnotes or by replacing them with "< LOQ".<br><br>C. Matrix Interference and Analyte Co-Elution Assessment (This is not mandatory but useful for suggestion)<br>• Peak overlap for polar analytes in complex matrices: During water and soil analyses by GC-NPD, elevated spike recoveries for DMF (and occasionally MFA) were observed in specific samples due to co-eluting matrix peaks. While the author correctly identified these interferences and applied Grubbs' test to treat them as outliers, future analytical protocols would benefit from using columns with alternative stationary phase polarities or dual-detector configurations to enhance confirmatory selectivity.<br>• Issue (pp. 55, 79): During the analysis of water and soil samples, remarkably elevated spike recoveries were obtained for DMF (221%–338%) and MFA across certain samples, which were subsequently excluded from aggregate means as statistical outliers via Grubbs' test.<br>• Required Revision: In single-column GC-NPD configurations, co-elution from endogenous matrix components is well documented. Given that NPD provides selective elemental detection without mass spectral fragmentation confirmation, the discussion must explicitly acknowledge the vulnerability to false-positive determinations and recommend dual-column confirmation or complementary mass spectrometry for unambiguous peak identification of polar nitrogenous species. |

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| | | D. Influence of Ambient Field Temperature Variations on SPME Partitioning<br>• Influence of ambient temperature on field extractions: In Chapter 2, bulb extractions were conducted at 40 °C using an air thermostat. While effective, the impact of extreme ambient field temperatures (such as -20 °C in February versus +13 °C in March) on bulb cooling during manual fiber insertion could be modeled or evaluated in greater detail to assess minor thermal fluctuations on the partition coefficient Kf a.<br>• Issue (pp. 29, 30): Sample bulbs for BTEX determination were conditioned in an air thermostat at 40 □C. However, ambient field temperatures ranged drastically from -20 □C in February to +13 □C in March. The manuscript notes that opening the thermostat cover for manual fiber introduction caused brief temperature drops inside the bulbs to 30-35 °C.<br>• Required Revision: The potential thermodynamic impact of extreme ambient temperature fluctuations on fiber–gas distribution coefficients (Kf a) and overall extraction repeatability must be discussed as a method limitation, emphasizing the necessity of enhanced thermal insulation in portable field configurations.<br><br>E. Discrepancy Between On-Site Portable GC-NPD and Benchtop GC-MS Results<br>• Issue (p. 77): While 8 target analytes were identified in soil samples using on-site portable GC-NPD, confirmatory laboratory analysis via benchtop GC-MS (Agilent) detected only 2 analytes (MTA and trace levels of pyrazine). The text attributes this discrepancy primarily to differences in detector sensitivity and selectivity.<br><br>• Required Revision: The candidate must provide a more critical and thorough discussion examining whether this disparity arose from sample losses (volatilization, degradation, or adsorption during the 1,500 km transport to the laboratory) or, conversely, from baseline artifacts and matrix-induced noise mimicking analyte peaks on the portable GC-NPD.<br><br>F. Feasibility Assessment of Field Automation Protocols (Chapter 5)<br>• Issue (pp. 83–86): The conversion of the SRI 8610C system to a vertical oven architecture (8610V) integrated with an HTA autosampler is proposed for automated field operations.<br>• Required Revision: While technically sound, this recommendation should include a brief engineering and operational feasibility evaluation addressing vehicle-induced mechanical vibrations, supplementary power requirements, and mechanical stability under rugged mobile field conditions. |

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| | | 2. Linguistic, Typographical, and Formatting Errors<br>A. Title Page, Introduction, and Front Matter<br>1. Title Page (p. 1):<br>o The primary supervisor's academic title is listed as "C.Chem.Sci., Proffessor"; it should be corrected to "Professor" (single "f").<br>o The co-supervisor's institutional affiliation contains a misspelling: "Nothern (Arctic) Federal University"; it should be corrected to "Northern".<br>2. List of Original Publications (p. 6, Items 2 & 3) and Chapter Preambles (pp. 13, 14, 45):<br>o The erroneous term "chromatogramphic" appears multiple times across article titles and text bodies; it must be corrected to "chromatographic". Alternatively, check the term, and if it is correct usage, kindly prove it.<br>3. Introduction (p. 9):<br>o In the sentence "This research aimes to develop...", the verb is misspelled; correct to "aims".<br>o In "...suporting sustainable societal development", correct the spelling to "supporting".<br>4. Key Provisions for Defense (p. 11, Item 1):<br>o British English ("aluminium foil-covered") is used here, whereas American English ("aluminum") is adopted elsewhere. Spelling conventions must be standardized consistently throughout the manuscript. Kindly check it for consistency.<br>B. Chapter 1: Literature Review<br>1. Page 19 (Bullet points):<br>o "...portable GC incorporate minituarized injectors..." contains a spelling error; correct to "miniaturized".<br>2. Page 20:<br>o In "In conventional and most portable GC, injectors are heated chambers...", plural agreement requires "portable GCs".<br>3. Page 22:<br>o The phrase "...simplicity, needlessness of organic solvent use..." lacks academic precision; rephrase to "elimination of organic solvents" or "absence of organic solvent requirements".<br>C. Chapter 2: Development of the Analytical Method for BTEX Quantitation<br>1. Page 32:<br>o "...were installed into a trank of a crossover car" contains a typo; correct to "trunk" (or "boot").<br>2. Page 34 (COMSOL Modeling):<br>o "...is complex and resourse-demanding" should be corrected to "resource-demanding". |

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| | | o In "...system pressure (particulary for vacuum-assisted HSSPME)...", correct to "particularly".<br>3. Page 35 (Equations & Descriptions):<br>o "...and has a dimention m2/s" should be corrected to "dimension".<br>o "Fuller, Schettler and Giddings equiation..." should read "equation".<br>4. Page 36 (Beneath Equation 12):<br>o "The difusion volume of a molecule..." should be corrected to "diffusion".<br>5. Table 9 Caption (p. 43):<br>o The table sub-caption reads "Air sampes from Almaty"; correct to "Air samples from Almaty".<br>D. Chapters 3, 4, and 5<br>1. Detector Nomenclature (pp. 48, 50, 62, 64, 88):<br>o The detector is frequently cited as "nitrogen-phosphorous detector". In chemical nomenclature and standard analytical practice, the noun form must be used: "nitrogen-phosphorus detector" (NPD).<br>2. Section Heading (p. 81):<br>o The conclusion heading is formatted as "4 Chapter conclusion"; format systematically as "4.4 Chapter conclusion".<br>3. Page 83 (Chapter 5 Title Consistency):<br>o In the Table of Contents, the title appears as "5 AUTOMATION POSSIBILITIES AND PROPOSAL OF METHODOLOGICAL RECOMMENDATIONS...", whereas in certain sections of the body text the phrasing is distorted ("...PROPOSAL FOR OF THE RECOMMENDATIONS METHODOLOGICAL DEVELOPMENT..."). Align the body heading verbatim with the Table of Contents.<br>4. Page 86:<br>o "...a briefing is conducted with field personnel" must be corrected to "personnel" (double "n").<br>5. References (p. 99, Ref. 103):<br>o In the reference title, "1,1-Dimrthylhydrazine" should be corrected to "1,1-Dimethylhydrazine". Check the literature, kindly.<br>These comments do not diminish the high scientific value, validity, and practical relevance of the results obtained.<br>The dissertation work by Kurmanbayeva Tolkyn Serikbaykyzy is an accomplished, high-caliber scientific study that fully meets all requirements of the Rules for Awarding Degrees approved by the Ministry of Science and Higher Education of the Republic of Kazakhstan. The candidate thoroughly deserves the award of the degree of Doctor of Philosophy (PhD) in the specialty «8D05301 – Chemistry», subject to minor revisions. |

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| 12 | The scholarly quality of the doctoral candidate's articles on the research topic (in the case of a dissertation defended in the form of a series of articles, the official reviewers provide comments on the scholarly quality of each of the candidate's articles on the research topic) | The scientific level of the candidate's publications is outstanding. The dissertation is based on 3 peer-reviewed articles published in reputable international journals indexed in Web of Science and Scopus:<br>1. Advances in Sample Preparation (2024, Q1, IF = 6.5) devoted to on-site BTEX air analysis.<br>2. International Journal of Environmental Analytical Chemistry (2025, Q3, IF = 2.5) devoted to on-site water analysis of UDMH TPs.<br>3. Microchemical Journal (2025, Q1, IF = 5.1) devoted to on-site soil analysis of UDMH TPs.<br>In all three articles, Ms. Kurmanbayeva is the first author who made substantial contributions to conceptualization, experimental investigation, methodology, formal analysis, and drafting the manuscript. In addition, the findings were presented at three leading international conferences:<br>1. ExTech 2023 in Spain,<br>2. EuSPGSAC 2024 in Greece, and<br>3. Pacifichem 2025 in Hawaii |
| 13 | Decision of the official reviewer | 1) to award the degree of Doctor of Philosophy (PhD);<br>2) √ **to return the dissertation for revision if the dissertation does not comply with paragraphs 4 and/or 6 of the Rules and/or only partially complies with the principles (except for the principle of academic integrity) specified in paragraph 5 of the Rules, and/or if it contains deficiencies requiring correction. In the case of a dissertation submitted in the form of a series of articles, the dissertation shall not be returned for revision;**<br>3) to refuse to award the degree of Doctor of Philosophy (PhD) or Doctor by Profile in the event of a violation of the principle of academic integrity or non-compliance with the principles of scientific novelty, internal consistency, and reliability. |

**Official Reviewer:**
Muğla Sıtkı Koçman University, Department of Chemistry, Muğla, Türkiye

Professor of Analytical Chemistry, PhD

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(place of work, academic title)

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(signature) November 3, 2026

MEHMET ÖZTÜRK
(FULL NAME)