

REVIEW
of the official reviewer for dissertation work of
Baidildayeva Assel Kuanyshevna on the theme «Research of microencapsulation technology of leather for footwear of people with
pathological deviations of the feet» presented for the degree of Doctor of Philosophy (PhD) in the educational program «8D07211 -
Leather Goods Industry».

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (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: 1) The thesis 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) 2) The thesis was completed within the framework of another state program (indicate the name of the program) 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)	The thesis is consistent with the priority areas for the development of science and technology for 2021–2023, particularly Geology, extraction and processing of mineral and hydrocarbon raw materials, new materials, technologies, safe products and structures.
2.	Importance for science	The work <u>makes</u> /does not make a significant contribution to science, and its importance is <u>well disclosed</u> /not disclosed	The thesis is devoted to the developing a microencapsulation technology for leather footbeds. The study investigates the antibacterial properties of footwear leather treated with microparticles containing Laurel essential oil. The results obtained aim to improve the antibacterial properties of leather footbeds and footwear lining materials, thereby enhancing the hygienic properties of footwear for people with pathological foot

			deviations and general consumers.
3.	The principle of independence	Self-reliance level: 1) <u>High</u> ; 2) Medium; 3) Low; 4) No independence	The author independently defined the thesis's aim and objectives and conducted a systematic review and analysis of the scientific and technical literature. The research planning, development of experimental methods, and physicochemical assessment of the materials were conducted with the direct participation of the author. The obtained results were comprehensively analysed, and the conclusions were formulated. The author played a major role in the preparing of scientific articles and reports, publishing the results, and presenting them at conferences. This is also reflected in being the first co-author on published articles. The main scientific results of the thesis are the outcome of the author's independent scientific research.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) <u>Justified</u> ; 2) Partially justified; 3) Not justified.	The introduction of antibacterial properties into footwear through microencapsulation technology is highly relevant, improving the hygienic characteristics of footwear intended for people with pathological foot deviations, such as persistent hyperkeratosis, onychomycosis, and diabetes.
		4.2 The content of the thesis reflects the topic of the thesis:	The content of the thesis fully

	1) <u>Reflects</u>; 2) Partially reflects; 3) Does not reflect	reflects the topic of «Research of microencapsulation technology of leather for footwear of people with pathological deviations of the feet». The thesis content includes chapters on state of the art, research objective and method, results and discussion.
	4.3. The purpose and objectives correspond to the topic of the thesis: 1) <u>correspond</u>; 2) partially correspond; 3) do not correspond	The purpose of the work is to "use of specific equipment for microencapsulation technology, improving the antibacterial properties of leather footbeds and footwear linings with chitosan and laurel oil, which contain antibacterial components, and increases the hygienic properties of footwear". Experiments and results fully correspond to the objectives and topic of the thesis.
	4.4 All sections and provisions of the thesis are logically interconnected: 1) <u>completely interconnected</u>; 2) the interconnection is partial; 3) there is no interconnection	All sections of the thesis are logically interconnected and consistently address the stated scientific problem. The structure of the research is logically coherent and covers all stages of the study, from the analysis of the scientific literature through the experimental investigations to the processing and analysis of the obtained results.
	4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions: 1) <u>there is a critical analysis</u>;	The thesis provides a critical analysis of existing methods for imparting antibacterial properties to footwear and substantiates the choice of

		2) partial analysis; 3) the analysis does not represent one's own opinions, but quotes from other authors 4) the analysis is absent.	microencapsulation technology using chitosan and Laurel essential oil as an effective solution.
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) <u>completely new</u> ; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	Chitosan and Laurel essential oil are well known in the scientific literature for their antibacterial properties. Here, the research presented in this thesis is novel, as it focuses on the development and production of chitosan- and Laurel essential oil-based microparticles using microencapsulation technology. The combination of these natural components in the form of microencapsulated particles and their application to footwear materials represents a novel scientific and technological approach to imparting antibacterial properties to leather footbeds and footwear linings.
		5.2 Are the dissertation findings new? 1) <u>completely new</u> ; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The thesis findings are novel in terms of the proposed formulation, processing parameters, and application of chitosan-based microparticles containing laurel essential oil to leather footwear components. It investigated the effects of formulation and processing conditions on microparticle properties, evaluated the antimicrobial activity of the treated materials, and assessed the durability

			of the treatment under washing, flexing, and dry and wet rubbing.
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) <u>completely new</u>; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The technological solutions developed to achieve the research's stated aim have not previously been applied in this form. A novel approach to improving the antibacterial properties of footwear footbeds has been developed and implemented. The selected formulation achieved an encapsulation efficiency of approximately 90% and demonstrated antimicrobial activity, supporting the feasibility of the proposed technology.
6.	The validity of the main findings	All main conclusions <u>are/are not</u> based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	Conclusions are scientifically well substantiated and supported by comprehensive experimental evidence. The physicochemical properties of the studied samples were investigated, relevant analyses and evaluations were performed. Microbiological studies confirmed the antimicrobial activity of the treated footwear footbeds and lining materials against the tested microorganisms. The release of laurel essential oil and the durability of the treatment under washing, flexing, and dry and wet rubbing were also evaluated, providing experimental evidence to support the

			main conclusions of the thesis.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: Provision 1: 7.1 Is the provision proven? 1) <u>proven</u>; 2) rather proven; 3) rather not proven; 4) not proven; 5) in its current wording, it is impossible to verify whether the statement has been proven. 7.2 Is it trivial? 1) <u>yes</u>; 2) <u>no</u>; 3) in its current wording, it is impossible to verify whether the statement is trivial. 7.3 Is it new? 1) <u>yes</u>; 2) <u>no</u>; 3) in its current wording, it is impossible to verify the novelty of the statement. 7.4 Application level: 1) narrow; 2) medium; 3) <u>wide</u>; 4) in its current wording, it is impossible to determine the scope of application of the statement. 7.5 Is it proven in the article? 1) <u>yes</u>; 2) <u>no</u>; 3) in its current wording, it is impossible to verify whether the statement has been proven in the article.	Provision 1: 7.1 The provision is supported by the experimental results presented in Section 3.1 of the thesis. 7.2 The provision is not trivial because, although spray-drying microencapsulation of essential oils using chitosan has been reported, this study adapts the technology to laurel essential oil and its application to leather footwear components. 7.3 The novelty lies in developing and experimentally evaluating a spray-drying technology for producing chitosan-based microparticles containing laurel essential oil. 7.4 The developed technology has potential for application in the leather and footwear industries to produce chitosan-based microparticles containing laurel essential oil for treating footwear components. 7.5 The main scientific provisions of the thesis are reflected in the author's published scientific works. Article in Iranian polymer journal. DOI: 10.1007/s13726-024-01417-3 Article in 10th International Conference «Advanced materials and systems» DOI:

	Provision 2: 7.1 Is the provision proven? 1) proven. 7.2 Is it trivial? 2) no. 7.3 Is it new? 1) yes. 7.4 Application level: 3) wide. 7.5 Is it proven in the article? 1) yes. Provision 3: 7.1 Is the provision proven? 1) proven. 7.2 Is it trivial? 2) no. 7.3 Is it new? 1) yes. 7.4 Application level: 3) wide. 7.5 Is it proven in the article? 1) yes. Provision 4: 7.1 Is the provision proven? 1) proven. 7.2 Is it trivial? 2) no. 7.3 Is it new? 1) yes. 7.4 Application level: 3) wide.	10.2478/9788367405805-003 Provision 2: 7.1 The provision is supported by the experimental results presented in Section 3.1 of the thesis. 7.2 The provision is not trivial because it establishes the effects of formulation composition and spray-drying conditions on a specific chitosan-laurel essential oil system. 7.3 The novelty lies in experimentally establishing how formulation composition and spray-drying conditions affect the properties of chitosan-based microparticles. 7.4 The results can be used to select and optimize formulation compositions and spray-drying conditions for producing microparticles with the desired properties for leather treatment. 7.5 The main scientific provisions of the thesis are reflected in the author's published scientific works. Article in Iranian polymer journal. DOI: 10.1007/s13726-024-01417-3 Article in 10th International Conference «Advanced materials and systems» DOI: 10.2478/9788367405805-003
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		7.5 Is it proven in the article? 1) yes.	Provision 3: 7.1 The provision is supported by the experimental results presented in Section 3.5 of the thesis. 7.2 The provision is not trivial because it compares the application of chitosan-based microparticles containing laurel essential oil by spraying and dip-coating, rather than applying chitosan alone. 7.3 The novelty lies in comparing spraying and dip-coating for applying the developed microparticles to leather footwear components. 7.4 The findings can be applied in the development of antibacterial coatings for leather footbeds and lining materials, with spraying offering a promising method for uniform microparticle application. 7.5 The main scientific provisions of the thesis are reflected in the author's published scientific works. Article in Iranian polymer journal. DOI: 10.1007/s13726-024-01417-3 Provision 4: 7.1 The provision is supported by the experimental results presented in Section 3.9 of the thesis. 7.2 The provision is not trivial because it evaluates the persistence
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			of antimicrobial activity in leather treated with chitosan-based microparticles containing laurel essential oil after flex resistance, dry rubbing and wet rubbing tests. 7.3 The novelty lies in evaluating the persistence of antimicrobial activity in leather treated with laurel oil-chitosan microparticles. 7.4 The results can support the development of footwear materials with durable antimicrobial properties, extending the potential application of treated leather beyond conventional footwear materials. 7.5 The main scientific provisions of the thesis are reflected in the author's published scientific works. Article in Iranian polymer journal. DOI: 10.1007/s13726-024-01417-3 Article in 10th International Conference «Advanced materials and systems» DOI: 10.2478/9788367405805-003
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 detail 1) <u>yes</u>; 2) no	The methodology of the thesis is based on widely recognised and well-established scientific approaches. The thesis was conducted by the author using modern technological and analytical methods. The methods selected by the author are sufficiently described and scientifically substantiated,

			including in comparison with established Kazakhstan and international approaches and equivalents.
		8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) <u>yes</u> ; 2) no	The results of the thesis were obtained using modern scientific research methods and computer technologies for data processing and interpretation. In this research, the following equipments was used: Unopex B 15 Mini Spray Dryer, Thermo Scientific Apreo S. SEM, Spectrum 100 FT-IR, Shimadzu Corporation UV-Spectrophotometer, and Konica Minolta spectrophotometer.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) <u>yes</u> ; 2) no	Experimental results confirmed the relationships between formulation, spray-drying conditions, and microparticle properties. FTIR verified the chemical features of L ₃ , while microscopy confirmed its near-spherical morphology and uniform particle size distribution. The results of the thesis were implemented at the enterprises «Tarazski Kozhevennyi Zavod» LLP and «TarazKozhObuv» LLP and were implemented in the educational process. Discipline was «Sanitary and hygienic requirements for leather products», studied in the 5 th semester of the 3 rd year in 2025-2026 academic year.

		8.4 Important statements are <u>confirmed</u> / partially confirmed / not confirmed by references to current and reliable scientific literature	The key conclusions are substantiated by appropriate and reliable references to the relevant scientific literature, as confirmed by the literature review presented in the first section of the thesis.
		8.5 Used literature sources are <u>sufficient</u> /not sufficient for a literature review	In the course of the thesis, the author conducted a comprehensive analysis of scientific publications, including international literature, and an extensive literature review aligned with the thesis's main focus. The scope and depth of the review of previously conducted research are fully consistent with the objectives and volume of the thesis.
9	Practical value principle	9.1 The thesis has theoretical value: 1) <u>yes</u> ; 2) no	The thesis provides theoretical insights into microparticle formation and solvent-dependent release of laurel essential oil. The results of the scientific research have been implemented in production and incorporated into the educational process, as confirmed by the relevant implementation certificates.
		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) <u>yes</u> ; 2) no	The thesis has significant practical relevance, and the research findings have clear potential for practical application. The proposed technological solutions and the obtained results can be applied to the development and production of antibacterial footwear materials.

		9.3 Are the practice suggestions new? 1) <u>completely new</u>; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The proposed practical applications are novel, as the combined use of natural components such as chitosan and Laurel essential oil has not previously been applied in microencapsulation technology for this purpose. This approach provides an innovative technological solution for developing antibacterial footwear materials.
10.	The quality of writing and design	Academic writing quality: 1) <u>high</u>; 2) average; 3) below average; 4) low.	The thesis demonstrates a high standard of academic writing. The text is clear, precise, well-structured, easy to read, and comprehensible.
11.	Notes on a thesis		1. There are numerous types of materials used in footwear manufacturing. Therefore, it would be appropriate to clarify the rationale for selecting only leather and footwear-lining materials as the study's objects. 2. The conclusions of the thesis state that the obtained results can be applied not only to people with pathological foot deviations but also to general consumers. In this regard, what was the rationale for initially focusing the research specifically on footwear intended for people with pathological foot deviations? 3. There are typographical mistakes in the thesis that need to be

			addressed. The identified comments do not affect the thesis's main theoretical and experimental results or diminish its overall scientific value.
12.	Scientific level of the doctoral student's articles on the topic of research (in case of defense of the dissertation in the form of a series of articles, the official reviewers comment on the scientific level of each article of the doctoral student on the topic of research)		The scientific rigor of the author's publications related to the research topic is very high. A total of six scientific articles have been published on the topic of the thesis, reflecting the main results of the research: 1 article in journal included in the Web of Science and Scopus databases, 1 article at an international conference indexed in Scopus, 2 articles in the publication, which was included in the list of the Science and Higher Education Quality Assurance Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and 2 articles at international conferences.
13.	Decision of the official reviewer (pursuant to paragraph 28 of the present Model Regulations)		I recommend Baidildayeva Assel Kuanyshevna be awarded the degree of Doctor of Philosophy (PhD) in the educational program 8D07211 – Leather Goods Industry for thesis entitled "Research of microencapsulation technology of leather for footwear of people with pathological deviations of the feet"

In reviews, official reviewers indicate one of the following solutions:

- 1) to award the degree of Doctor of Philosophy (PhD);
- 2) send the thesis for revision (except for cases of thesis defense in the form of a series of articles);
- 3) refuse to award the degree of Doctor of Philosophy (PhD).

Copies of the reviews of the official reviewers are handed over to the doctoral student no later than 5 (five) working days before the defense of the thesis.

Official Reviewer:

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13-10-2026

(signature)

Prof. Dr. Md. Abul Hashem

(FULL NAME)