

ABSTRACT

to the dissertation of **Nurizina Makpal Manarbekovna**
for the degree of Doctor of Philosophy (PhD)
in the educational program 8D01502 – Physics

The research topic is the preparation of a future physics teacher in the field of tribology in the professional cycle of disciplines.

The purpose of the study Theoretical and practical substantiation of the methodology of training a future physics teacher in the field of tribology in the professional cycle of disciplines and the development of a model of a methodological system.

Research objectives:

- to analyze the current state of the problem of the application of selected topics (content) in the field of tribology in the educational programs of physics teacher training in higher educational institutions;
- to take part in the development of the technology of the gas-thermal method of spraying wear-resistant coatings based on UHMWPE with the analysis of scientific achievements in the field of polymer tribology;
- to develop a model of a methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines;
- to determine ways to include the topics of the physical foundations of tribology in the physics course of the university (to select and structure the material for various forms of training sessions with students, choose teaching methods, etc.);
- to develop a special course on the physical foundations of tribology, which will accompany the teaching of physics to university students;
- conduct a pedagogical experiment to test the research hypothesis based on the developed model.

Research methods:

- анализ отечественной и зарубежной научно-теоретической, учебно-методической, философской, социальной, психолого-педагогической и методологической литературы, обобщение, сравнение, уточнение и патентный поиск материалов по теме исследования;
- observation of students and teachers, exchange of opinions; conducting questionnaires; analysis of normative and educational documents, testing, experimental work and statistical processing of results.

The main provisions of the dissertation submitted for defense:

- 1) the results of the analysis of the current state of the problem of reflection of tribology issues in the educational programs of physics teacher training in a number of universities, indicating the importance of studying tribology and the need to develop appropriate educational and methodological support;
- 2) a model of the methodological system of training in the professional cycle of invariant and variable disciplines of the curriculum, including goals, content, methods, forms and means of training, including design and research laboratory work on the innovative technology of the gas-thermal method of applying wear-resistant coatings based on ultra-high molecular weight polyethylene;
- 3) the results of a pedagogical experiment confirming the effectiveness of the

developed model of the methodological system of teaching a future physics teacher in the field of tribology.

The main results of the study:

1) theoretical foundations of effective integration of education, science and production in the field of tribology;

2) theoretical justification and methodology of training a future physics teacher in the field of tribology in the professional cycle of disciplines;

3) experimental foundations of the methodology of training a future physics teacher in the field of tribology in the professional cycle of disciplines.

Analyzing the novelty and significance of the obtained results:

The first result is new, since for the first time the expediency of studying tribological issues in the professional cycle of disciplines by university students in order to improve their professional and pedagogical training is justified. If you purposefully train a future physics teacher in the field of tribology, you can give students a qualitative idea of the process of obtaining fundamental physical knowledge and subsequently apply this knowledge in school practice.

The second result is new, since for the first time a model of a methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines has been created, including goals, content, forms, methods and means of teaching. The content of the model contains invariant, variable and design-research blocks.

The third result is new, since for the first time a methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines has been developed, including educational and methodological support for the process of training a future physics teacher in the field of tribology in the professional cycle of disciplines, determining the methods and procedure for conducting presentations of tribological topics of the working curriculum, taking into account the specifics of the future teacher's professional activity and the principle of unity of fundamental and professional orientation of training, namely:

- the criteria for selecting material from the field of tribology for study within the invariant part of the university physics course are revealed (the importance of the concept or regularity as the key elements of knowledge in tribology necessary for the study of other concepts and patterns; connection with the concepts and patterns studied in the course of physics; the possibility of applying the knowledge gained in educational and research work);

- selection and structuring of tribological material for inclusion in the sections «Molecular physics», «Mechanics», «Thermodynamics and statistical physics» and «Electricity and Magnetism» of the university physics course were carried out;

- methods (gnostic, self-control), forms (lectures and laboratory classes) and teaching tools (a system of tasks) have been identified that allow for the training of physics students - future teachers in the field of tribology, including providing an understanding of the ways of forming knowledge and skills in this field;

- a special course «Physical fundamentals of tribology» has been developed, accompanying the teaching of physics to students of higher educational institution: its content includes a number of sections of tribophysics, contains lecture material and

methodological guidelines for laboratory work for design and research work on the innovative technology of the gas-thermal method of applying wear-resistant coatings based on UHMWPE with the analysis of scientific achievements in the field of tribology polymers;

- an Internet portal has been created, where up-to-date information on tribology, literature, material for control and verification activities, etc. are posted;

- multi-level options for conducting educational, research and project activities of students in the field of tribology are proposed.

Compliance with the directions of science development or state programs:

The main idea of the study is related to the development of the Kazakh education system, improving the quality of training of competitive specialists in accordance with the Law of the Republic of Kazakhstan «On Education», the strategic development plan of the Republic of Kazakhstan until 2025, the State Program for the Development of Education and Science for 2023-2029, the national project «Quality Education «Educated Nation», Meets the requirements approved by the Minister education and science of the Republic of Kazakhstan, aimed at solving priorities and tasks, specified in the state mandatory standard of education of all levels of education and other state regulatory documents.

The contribution of the doctoral student to the preparation of each publication (the contribution of the author of the dissertation is indicated, measured as a percentage of the total volume of the publication):

The main results of the dissertation were reported and discussed at twelve international conferences:

1. Development and Studying of the Technology for Thermal Spraying of Coatings Made from Ultra-High-Molecular-Weight Polyethylene // Coatings — 2023. — Vol. 13, — P. 698. — 2022. — Vol. 8, No. 408. — P. 1–20. (Co-authors: Skakov M.K., Ocheredko I., Tuyakbaev B.T., Bayandinova M.B.) Share of doctoral student – 70%) <https://doi.org/10.3390/coatings13040698>. In the article, the doctoral student developed and studied the technology of thermal spraying of coatings made of ultrahigh molecular weight polyethylene.

2. Пәндердің кәсіби циклінде трибология саласындағы болашақ физика мұғалімін дайындаудың қажеттілігі // Ясауи университетінің хабаршысы. — 2021. — №1 (119). —Б. 114-123. (Co-authors: Скаков М.К.) Share of doctoral student – 90%. <https://doi.org/10.47526/habarshy.vi1.482>. In the article, the doctoral student considers the need to train future physics teachers in the field of tribology in the professional cycle of disciplines. It is also proposed to develop a special course on the physical foundations of tribology and introduce it into the educational process when studying the relevant sections of the physics course.

3. Evaluation of advanced technology for the formation of research competence of physics students in the field of tribology // Доклады Национальной академии наук Республики Казахстан — 2022. — № 4. – С. 136-152. (Co-authors: Ramankulov Sh. Zh., Skakov M. K.) Share of doctoral student – 90%. <https://doi.org/10.32014/2022.2518-1483.177>. In the article, the doctoral student investigated the issues of determining the capabilities of the tribology laboratory workshop for the formation of research competencies, identifying the content, methods

and means of the tribology laboratory workshop that contribute to the formation of research competencies and systematization of diagnostics of the formation of research competencies of physics students.

4. Influence of silicon oxide and diabase powders on the degree of crystallization and chemical structure of a polymer (uhmwpe) coating produced by the method of gas thermal spraying // Доклады Национальной академии наук Республики Казахстан. — 2022. — № 4. — С. 153-163. (Co-authors: Skakov M. K., Kantay N., Tuyakbayev B., Bayandinova M.) Share of doctoral student – 70%. <https://doi.org/10.32014/2022.2518-1483.178>. In the article, the doctoral student investigated the problems of studying the formation of ideas about the physical foundations of tribology in future specialists.

5. The study of the formation of ideas of future specialists about tribology // Вестник Национальной академии наук Республики Казахстан — 2023. — №1(401). — С. 212-223. (Co-authors: Skakov M. K., Ramankulov Sh. Zh. Share of doctoral student – 90%. <https://doi.org/10.32014/2023.2518-1467.433>. In this study, the doctoral student investigated the effect of silicon oxide and diabase powder on the degree of crystallization and the chemical structure of the polymer coating (UHMWPE) obtained by gas thermal spraying

6. Principles and content of teaching physics in english for future physics teachers // Вестник Национальной академии наук Республики Казахстан. — 2023. — С. 2. (Co-authors: Ramankulov SH., Dosymov Y., Akhanova A.) Share of doctoral student – 90%. <https://doi.org/10.32014/2023.2518-1467.501> In the article, the doctoral student reviewed the methods of CLIL (subject-language integrated learning) and provides the possibilities and content of implementing this technique in the preparation of textbooks and digital resources for teaching physics.

7. STEM жобалық оқытудың болашақ физика мамандарын даярлаудағы ерекшеліктері // ҚР ҰҒА Хабарлары. Физика-математика сериясы. — 2023. — Б. 2. (Co-authors: Келесбаев К., Раманкулов Ш., Паттаев А., Мұсахан Н.) Share of doctoral student – 70%. <https://doi.org/10.32014/2023.2518-1726.193> In his work, the doctoral student identified the features of project-based STEM learning in the effective implementation of education.

8. Research and development of a teaching model for the physical foundations of tribology. // Cypriot Journal of Educational Sciences. — 2022. — Vol. 17(11), — P. 4163-4181. (Co-authors: Skakov M.K., Ramankulov Sh. Zh., Coruh A.) Share of doctoral student – 90%. <https://doi.org/10.18844/cjes.v17i11.7659>. In the article, the doctoral student investigated the experimental foundations of the model of teaching tribology in the process of training future physics teachers.

9. Physical aspects of tribology // 23rd International Conference on Wear of Materials», Канада, 26-28 апреля 2021 г. — P. 55. (Co-authors: Skakov M.K., Ramankulov Sh. Zh., Ahmet Zeki Saka.) Share of doctoral student – 90%.

10. The methodology of studying the gas-thermal method of coating from UHMWPE in the course of physics specialties of the University // «2nd Online International Conference on Functional Materials and Chemical Engineering», China, April 04-05, 2022. — P.45-46. (Co-author: Skakov M.K.) Share of doctoral student – 90%.

11. A teaching model for the physical foundations of tribology // International Conference on Education in Mathematics, Science and Technology (ICEMST) and International Conference on Research in Education and Science (ICRES) Nevsehir, TURKEY, May 18-21, 2023. – P.43. (Co-author: Skakov M.K.) Share of doctoral student – 90%.

12. Physical foundations of tribology // Международной конференции «Передовые технологии производства и исследования материалов: новые материалы и методы (АММ&R 2021)», ВКУ Д. Серикбаева, 19 февраля 2021г. – P.26. (Co-authors: Скаков М.К, Раманкулов Ш.Ж.) Share of doctoral student – 90%.

13. Трибологияның физикалық негіздері «Физика» білім беру бағдарламасының элективті курсы ретінде // «Уәлиев оқулары – 2020» Халықаралық ғылыми-тәжірибелік онлайн-конференциясы 26 қараша 2020. – Б.207-211. (Co-author: Skakov M.K.) Share of doctoral student – 90%.

14. Болашақ физика мұғалімдерінің трибология саласындағы жобалық және зерттеу қызметі // Абай атындағы Қазақ ұлттық педагогикалық университеті ұлт ұстазы А.Байтұрсынұлының туғанына 150 жыл толуына орай «Ахмет Байтұрсынұлының педагогикалық мұрасы, заманауи білім мәселелері: бүгін мен болашағы» атты халықаралық ғылыми-практикалық конференция материалдары 25 қараша 2022 жыл – Б. 400-405. Share of doctoral student – 100%.

15. ЖОО мамандықтарының физика курсына аса жоғарымолекулалық полиэтиленнен жабындарды жағудың газотермиялық тәсілін оқу әдістемесі // С. Аманжолов атындағы ШҚУ 70 жылдығына арналған «Қазіргі сын-қатерлер жағдайындағы ғылым мен білімнің өзекті мәселелері» «Уәлиев оқулары-2022» Халықаралық ғылыми-тәжірибелік конференциясы. –2022. – Б. 428-435 (Co-authors: Раманкулов Ш.Ж., Скаков М.К., Али Чорух.) Share of doctoral student – 90 %.

16. Пәндердің кәсіби циклінде трибология саласында болашақ физика мұғалімін даярлаудың теориялық негіздемесі мен әдістемесі // Әл-Фараби атындағы Қазақ ұлттық университетінде 2023 жылы 17 ақпанда педагогика ғылымдарының докторы, профессор Ш.Т. Таубаеваның 75 жылдығына арналған «Үздіксіз білім беру жүйесіндегі педагогтердің зерттеу мәдениетін дамыту: тәжірибе және инновациялар» атты халықаралық ғылыми-практикалық конференция. Share of doctoral student –100%.

17. Трибология саласындағы студенттердің жобалау және зерттеу қызметі // Халықаралық ғылыми-практикалық конференция «Сұлтанғазин оқулары – 2023» «Қазіргі білім беруді дамытудыңөзекті мәселелері». – 2023 жылдың 15 наурызы – Б. 81-86. Share of doctoral student –100%.

18. Technologies of thermal spraying of coatings made of ultrahigh molecular weight polyethylene // Казахский национальный педагогический университет имени Абая Международная научная конференция “Обратные и некорректные задачи в естествознании” Алматы, 11-12 апреля 2023 г. (Co-author: Skakov M.K.) Share of doctoral student – 95 %.

19. Formation of design and research competence of future teachers in the field of tribology // «Әуезов оқулары-21: жаңа қазақстан-еліміздің болашағы» М. Әуезов атындағы оңтүстік қазақстан университетінің 80 жылдығына арналған

халықаралық ғылыми-тәжірибелік конференция (Co-author: Ali Coruh) Share of doctoral student – 90 %.

20. Development of students' research skills through project-based physics training // Республиканской научно-практической конференция на тему «Научное наследие заки ахметова и национальные ценности», В честь 95-летнего юбилея Заки Ахметова, академика Национальной академии наук РК, доктора филологических наук, профессора, лауреата Государственной премии и премии имени Ш.Уалиханова Национальной академии наук РК, заслуженного деятеля науки РК «Современная национальная система образования: традиций, ценности и инновации», (Co-author: Али Чорух) Share of doctoral student – 90%.

21. Трибологияның физикалық негіздері // Оқу құралы. Өскемен: С. Аманжолов атындағы ШҚУ «Берел» баспасы. – 2021. – Б. 210., (Co-author: Скаков М.К.) Share of doctoral student – 80 %.

22. Трибологияның физикалық негіздерінен зертханалық жұмыстарды орындауға арналған әдістемелік нұсқаулық // Оқу - әдістемелік нұсқаулық. Өскемен: – 2021. – Б. 76., (Co-author: Раманкулов Ш.Ж.) Share of doctoral student – 80 %.

23. Трибологияның физикалық негіздері пәні бойынша практикалық сабақтарға әдістемелік нұсқаулар // Оқу - әдістемелік нұсқаулық. Өскемен: – 2021. – Б. 44., (Co-authors: Скаков М.К., Раманкулов Ш.Ж.) Share of doctoral student – 80 %.

24. «Трибологияның физикалық негіздері» электронное учебное пособие // Свидетельство о внесении в государственный реестр прав на объекты, охраняемые авторским правом № 35482, от 5 мая 2023года (Co-author: Скаков М.К.) Share of doctoral student – 90%.

25. Трибологияның физикалық негіздерінен зертханалық жұмыстарды орындауға арналған электронды әдістемелік нұсқаулық Свидетельство о внесении в государственный реестр прав на объекты, охраняемые авторским правом № 35320, от 2 мая 2023года (Co-author: Раманкулов Ш.Ж.) Share of doctoral student – 80%.

26. «Ғылыми-зерттеу негіздері» электронное учебное пособие // Свидетельство о внесении в государственный реестр прав на объекты, охраняемые авторским правом № 35845, 17 мая 2023 года (Co-author: Нуризинов М.К.) Share of doctoral student –80%.

27. «Трибологияның физикалық негіздері пәні бойынша практикалық сабақтарға электронды әдістемелік нұсқаулар» электронное учебное пособие // Свидетельство о внесении в государственный реестр прав на объекты, охраняемые авторским правом № 38308, 8 августа 2023 года (Co-authors: Скаков М.К., Раманкулов Ш. Ж.) Share of doctoral student – 80%.