ANNOTATION

to the dissertation of Yussupova Laura Khamidovna, submitted for the Doctor of Philosophy (PhD) degree in the educational program 6D072600 - Technology and design of light industry products.

Research topic: Development of a package of materials and anthropometric studies for the manufacture of parts of adolescents footwear using new technologies.

The purpose of the dissertation research: anthropometric study of the size of the adolescents' feet in the Zhambyl region, the study of properties, and the choice of a package of materials for footwear.

To achieve this goal, the following tasks are set:

- anthropometric study of adolescent foot size;
- determination of statistical, correlation and regression indicators of foot dimensions;
- study of footwear material properties and preparation of material package;
- use of single- and multilayer neural networks in the study of the properties of materials for footwear;

Research objectives: conducting an anthropometric study of the size of the adolescents' feet in the Zhambyl region, studying the properties and choosing packages of materials for footwear.

Research methods:

Contact and non-contact methods for measuring the feet of adolescents, statistical programming and mathematical analysis, methods for studying the strength properties of materials using a neural network.

Scientific novelty of dissertation research:

- a full-size range of adolescent footwear has been developed;
- developed a package of materials for adolescent footwear;
- used the methods for the prediction of strength properties of footwear materials by using neural networks.

Main provisions (proven scientific hypotheses and other conclusions that are new knowledge) submitted for protection:

In the dissertation work, the following were proposed and fully proven:

- conducted a review of methods for determining the competitiveness of modern footwear, and the main criteria were identified;
- analysed anthropometric parameters of adolescent's feet in the Zhambyl region;
- developed and constructed a structure for a full range of adolescent footwear, recommendations for adjusting the size-full assortment, contributing to the formation of popular, competitive footwear;
- relevance of the use of neural networks when choosing a package of materials.

The main provisions submitted for protection are not trivial, since the study, along with traditional methods, also used modern neural network methods.

Description of the main results of the study:

The obtained technical and technological solutions are new and justified, which is confirmed by the receipt of a patent for invention No. 3313, from 13.11.2020. Republican State Enterprise ""National Institute of Intellectual Property," Ministry of Justice of the Republic of Kazakhstan.

1. In the literature review, pathological abnormalities were studied and the main causes of foot diseases were identified, in order to develop a dimensional and complete assortment and design of fitting shoes. To form an assortment of fitted shoes and develop an optimal package of materials, work in medical, social, and economic areas has been studied. The methods and means of anthropometric foot size research are investigated, advantages and disadvantages are identified, and a research program is defined.

2. Programs and methods for studying the size of teenagers' feet are defined. Measurements of the feet of teenagers in Zhambyl region were carried out using a standard method and a modern 3D scanning method. Methods of statistical processing of the results of foot measurements have been studied and determined.

3.Anthropometric studies of the size of the feet of adolescents were carried out. As a result of the study, the following anthropometric sizes of young men aged 15 to 21 were determined: foot length (Fl), forefoot width (Fw), forefoot girth (Fg), and heel width (Hw). A variation series of foot sizes was formed and divided into 9 classes. Foot size statistics were processed using PROJECT.The boundaries of the minimum foot length in adolescents are 229.5-236.4 mm, the average length is 233 mm, and the boundaries of the maximum foot length are 289 mm. It is indicated that the boundaries of the overall average foot length are 264.5-271.4 mm, and the average value is 268 mm. Data are calculated as expectation, mode, median, variance and standard deviation. The average foot length (mode) is 268 mm ($n \approx 116$), the mathematical mean is 262.77, the median is 264, and the dispersion is 171.

4. Statistical, correlation and regression indicators of foot size are determined. Correlation curves were plotted to establish a connection between the main dimensional characteristics of the feet of age groups. Correlation coefficients were determined. High correlation coefficients allow you to calculate regression equations, which allows you to set standard sizes for designing the shape of footwear.

5. The properties of shoe materials have been studied and a package of materials has been prepared. Natural chrome-tanned leather with a smooth surface (State standard 3717-84), synthetic, artificial and natural hides of various colors were studied for the upper parts of shoes. Based on the results of the analysis and evaluation of the characteristics of materials for shoe tops, a package of materials for teenage shoes has been compiled. It has been established that the structure of composite leather is close to the properties of natural leather due to the fact that it consists of fibrous fibers. It has been established that the hygienic properties of composite leather differ from the polymer coating of synthetic leather in complex quality indicators: breathability, hygroscopicity, moisture transfer, and others. 5 packages of materials for the tops of teenage shoes were studied, and the material for the outer, inner, and intermediate parts of the shoe was selected.

6. A survey of adolescents was conducted to identify preferences in the types

of footwear. The survey was conducted among young people aged 15-18 years old in training centres in the Taraz city. The experts chose and evaluated the consumer's physical and mechanical, hygienic, anthropometric, and psychophysiological properties of footwear. According to respondents, the most popular type of footwear - sneakers - was rated at 100 points. Ranking, evaluation, and comparison procedures for evaluating the results of the tests conducted by experts, determining their significance, were carried out by the ranking program. Based on the results of the survey, a diagram was built for choosing the type of footwear.

7. According to the results of an expert assessment of teenage shoes, the most significant aesthetic properties were revealed - these are the color, originality and texture of the material. The quantitative values of these criteria were correspondingly: X2 =209, the theoretical value of the Pearson coefficient is less than xt, which showed a positive result.

8. Neural system methods are used in the study of the properties of shoe materials. The strength properties of natural chrome-tanned leather were investigated using artificial neural lines. Calfskin samples were selected, the ultimate strength of the skins was determined by uniaxial tensile tests. The samples were tested for elongation in the longitudinal (along the ridge line), transverse directions and at an angle of 450. The tests were carried out in accordance with GOST on the H25KS Tinius Olsen bursting machine. The conducted studies have shown that in order to increase the accuracy of the forecast, it is necessary to create a separate neural network model for each type of skin. It has been established that the use of an artificial neural network makes it possible to reduce the time spent on testing and the consumption of natural leather in enterprises.

Justification of the novelty and importance of the results obtained:

The topic of the dissertation corresponds to the priority area of science "Other technical sciences," "Engineering of materials".

Compliance with the directions of development of science or state programs:

The topic of the dissertation is characterised by the main directions indicated in the Law of the Republic of Kazakhstan "On Education," in the Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023-2029, as well as in state compulsory standards of higher and postgraduate education.

Description of the doctoral student's contribution to the preparation of each publication:

The results obtained were introduced into the production process at the footwear enterprises of “TarazKozhObuv” LLP, “Tenizbaev” IE and the educational process of the Department of Textile, Materials Science and Standardisation of M.Kh. Dulaty Taraz University. The results of the dissertation research are published in journals included in the Scopus database, 4 articles and in publications included in the list of the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, 6 articles. Publication of study results.

The results and publications of dissertation studies were published in several journals included in the Scopus database. 4 articles were published:

1. Л.Х. Юсупова, С.Е. Мунасипов, А.Р. Соколовский. Определение распределения размерных признаков стоп мужского населения городов Жамбылской области, Almaty. Bulletin of KazNITU, 2020;(4); pp. 105-110 https://official.satbayev.university/ru/research/vestnik-satbayevuniversity/publications

2. Юсупова Л.Х., С.Е. Мунасипов А.Р. Соколовский. Определение связи между размерными признаками стоп мужского населения. Almaty. Bulletin of KazNITU, 2020;(4); pp. 110-117 https://official.satbayev.university/ru/research/vestnik-satbayevuniversity/publications

3. Юсупова Л.Х., Абзалбекулы Б., Байдильдаева А.К., Мунасипов С.Е. Разработка размерного ассортимента обуви для юношей Жамбылской области. Bulletin of the Almaty Technological University. 2023;(4); pp. 18-22. https://doi.org/10.48184/2304-568X-2023-4-18-22

4. Юсупова Л.Х., Абзалбекулы Б., Мунасипов С.Е. Особенности антропометрических показателей стоп подростков Жамбылской области. Bulletin of the Almaty Technological University. 2024; 143(1); pp. 217-223. https://doi.org/10.48184/2304-568X-2024-1-217-223

5. Yussupova L.Kh., Yeldiyar G.K., Baidildayeva A.K., Jumabekova G.B., Abzalbekuly B. Determination of the regularity of the distribution of the adolescents feet size // Mechanics and Technology / Scientific journal. – 2024. – №.3(85). – P.375- 383. https://doi.org/10.55956/VGXP4110 11

6. Юсупова, Г.К. Елдияр, Г.Б. Джумабекова, С. Мунасипов, Б. Абзалбекұлы Жасөспірімдерге арналған аяқ киімнің үстінгі бөлігінің материалдар пакетінің тұтынушылық сипаттамаларын талдау. Mechanics and technology/Scientific Journal. – 2024. – №3(85). – B.423-431. https://doi.org/10.55956/DIPU2854

Four articles were also published at international republican conferences and a patent for an industrial design was obtained.

1.Мунасипов С. Е., Юсупова Л. Х. Результаты антропометрических исследований стоп мужчин Южного Казахстана // Concepts, theory, and methods of fundamental and applied scientific research in the field of inclusive design and technology. – 2020. – vol. 25. – 41p.

2. Юсупова Л.Х., Абзалбекулы Б., Джумабекова Г.Б. Разработка размерного ассортимента для юношей призывного возраста Жамбылской области, Uzbekistan, Tashkent. International scientific conference, October 27-28, 2022.

3. Baidildayeva A.K., Jumabekova G.B., Yussupova L.Kh. Study of the hygienic properties of leather for shoe uppers. Proceedings Book. 7th International Congress on Innovative Aspects for Leather industry. – IAFLI, 2023. – P. 18-22

4. Baidildayeva A.K., Jumabekova G.B., Yussupova L.Kh. Analysis of leatherfootwear industry waste. Proceedings Book. 7th International Congress on Innovative Aspects for Leather industry. – IAFLI, 2023. – P. 22-24

5. B. Abzalbekuly, S. E. Munasipov, Yusupova L. H.,.Dzhumabekova G. B. industrial model Patent No. 5313, orthopedic shoes, 2020