IRSTI 64.41.09

B. Abzalbekuly[1] – *main author*,
A. Baidildayeva[2], Sh. Yerdaulet[3]

[1]PhD, Ass. Professor, [2]Master of technical science, Assistant, [3]Student
[1]https://orcid.org/0000-0002-9552-0388 [2]https://orcid.org/0000-0002-7996-646X
[1,2,3] M.Kh. Dulaty Taraz Regional University,
Taraz, Kazakhstan
[1]bekontiru@mail.ru

https://doi.org/10.55956/MOIS6608

RESEARCH OF THE STRENGTH PROPERTIES OF NONWOVEN MATERIALS OF SHEEP WOOL

Abstract. The work carried out physical and mechanical studies of nonwoven materials using universal tensile testing machine "Tinius Olsen H25S". Nonwoven materials were produced at the enterprise of IE "Miras" (Taraz city). A mechanical needle punching method was used for the production of nonwoven fabric. This method is environmentally friendly, since adhesives or impregnation is not used in production, and the use of high temperatures at which harmful substances are released into the atmosphere is not provided. The following strength indicators of the nonwoven material were determined: the average value of the breaking load, strength and elongation at break along and across the edge of the nonwoven material. The studied nonwoven materials can be used in the footwear industry in the form of insoles, linings and insulating intermediate parts, as building insulation materials, as well as in products for various technical purposes. The production of nonwoven materials is low-cost, which ensures affordable prices for products made from them.

Keywords: nonwoven materials, strength properties, universal tensile testing machine.

Abzalbekuly B., Baidildayeva A., Yerdaulet Sh. Research of the strength properties of nonwoven materials of sheep wool // Mechanics and Technology / Scientific journal. – 2024. – No.1(83). – P.121-126. https://doi.org/10.55956/MOIS6608

Introduction. The Government of Kazakhstan is taking various measures to develop light industry: opening free economic zones, introducing simplified taxation, and issuing preferential loans. The state allocates a large number of grants to train specialists in the field of light industry. Also, public and private investments are attracted to light industry. The opening of wool processing enterprises is of great importance for the economic development of the country and the provision of employment [1].

The government has developed a Business Roadmap-2025 program for the development of light industry. Entrepreneurs have the opportunity to receive preferential loans aimed at the reconstruction of existing and the opening of new workshops for the production of light industry products, including the processing of woolen goods.

In our country, the majority of textile industry enterprises account for the city of Shymkent and the Turkestan region – 36.3 and 22.4%, respectively. Currently,

farmers are engaged in breeding meat-producing sheep, whose wool is coarse with a high content of spinous hair. About 40 thousand tons of sheep wool are produced annually. Almost 70% of it is coarse and semi-coarse wool, which is not in demand on the market [1]. Coarse wool can be used for the production of mainly technical fabrics, such as insulation, nonwoven materials, and etc.

40.4 thousand tons of sheep wool were produced in 2021, of which only 10.7 thousand tons (26.5%) were sent for processing. Of these, 6.8 tons worth $3.027 million were exported. The buyers were China, Russia, Mongolia. That is, only part of the wool is recycled, 73.5% is simply disposed of - burned [1]. There are almost no enterprises left in the republic engaged in deep processing of wool raw materials, so the market is filled with imported goods such as yarn, fabrics, carpets, knitted fabrics and products made from them, knitted finished products. All these prerequisites work for the economic development of countries such as China and Turkey [2].

A perspective direction in connection with the above is the production of various materials with specified properties for wide application [3]. In the production of nonwoven materials for technical purposes, it is possible to use coarse and semi-coarse wool as a raw material, which has a low cost and is produced in sufficient quantities [4]. Nonwoven fabrics can be used in footwear production in the form of insoles and padding. The production of nonwoven materials is low-cost, which ensures affordable prices for products made from them.

Conditions and methods of research. There are three known methods of production of nonwoven fabrics: mechanical, physico-chemical and combined. A mechanical needle punching method was used for the production of nonwoven fabric. This method is environmentally friendly, since adhesives and impregnations are not used in production, and the use of high temperatures at which harmful substances are released into the atmosphere is not provided.

With the mechanical needle-punching method, the bonding of wool fibers occurs due to the friction force and the adhesion of uneven heterogeneous fibers to each other. The needle-punched method of producing nonwoven fabric is ideal for the production of textiles from raw materials of animal origin, that is, wool.

The main indicators of the quality of nonwoven fabrics are breaking load and absolute elongation. The breaking load is the maximum force that is determined when testing an elementary tensile test until the material completely breaks. An increase in the length of the working area is taken as an absolute elongation.

Sampling to determine the physical and mechanical parameters of nonwoven fabric was carried out according to GOST R 50275 and GOST 13587 [5]. To determining the physical and mechanical parameters of needle-punched fabrics was carried out according to GOST R53226-2008 "Nonwoven fabrics. Methods for determining strength" [6].

Elementary samples (test samples) can be different depending on the production method, the scope of application and the composition of the raw materials for the production of nonwoven fabrics. Nonwoven materials for the research of physical and mechanical properties were produced at the enterprise of IE “Miras”, Taraz. When determining the breaking load and elongation of nonwoven fabrics, 20 samples with a size of 50×200 mm are taken (10 along the edge of the fabric, 10 across the edge of the fabric). Samples of nonwoven fabrics are shown in Figure 1.

Figure 1. Samples of nonwoven fabric

The tests were carried out in the laboratory of the Department of Textiles, Materials Science and Standardization on a Tinius Olsen H25S (Figure 2a) bursting universal machine (manufacturing country - England). Tinius Olsen H25S is recommended for determining the physical and mechanical properties of materials such as metals, plastics, rubbers, textiles, wood, film materials, paper and various composite materials for tensile, compression, bending, shear, delamination. The H25S bursting machine fully meets the requirements of GOST 53226-2008 harmonized with international standards: "ISO 9073.3-1989 Textiles. Methods of testing nonwovens. Part 3, Determination of tensile and elongation strength" [6,7].

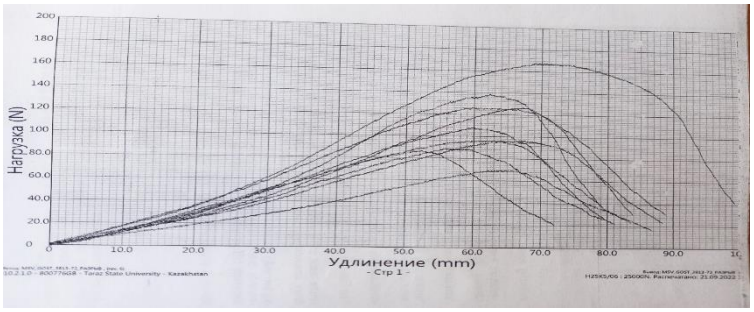
a b

Figure. 2. a) H25S Bursting Machine, b) determination of breaking load and elongation, clamps and test sample

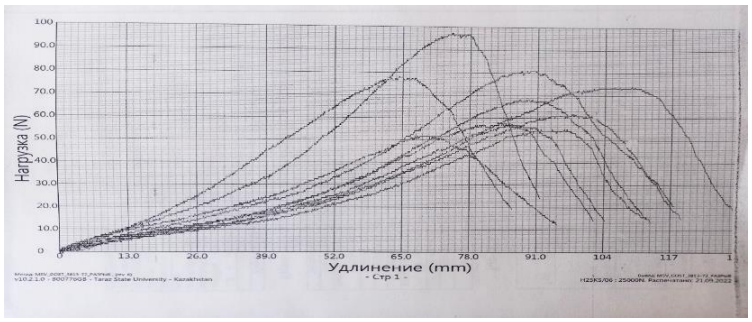
The prepared samples were fixed in the clamps of the testing machine (Figure 2b), so that the longitudinal axes of the clamps and the axis of the sample coincided with each other and the directions of movement of the movable clamp. The clamps are tightened evenly to prevent the sample from falling out during operation and to ensure that the sample does not collapse directly at the clamping site. The tests were carried out at a speed of 100 m/min, with a load of 1 kN. 10 samples cut along the edge of the canvas and 10 across the edge were tested.

Research results and discussion of scientific results. After the tests, the computer calculated all the necessary indicators and built diagrams of the dependence of load and elongation (Figure 3). The tests were carried out under normal laboratory conditions conforming to the international standard ISO 20344.

The value of the breaking load varies in a fairly wide range from 88.3 N to 138 N - along the edge of the fabric and from 51.7 N to 97.3 N across the edge of the fabric. Elongation at break varies in a fairly wide range from 72.1% to 91.6% along the edge of the fabric and from 78.4% to 111% across the edge of the fabric. Moreover, the discrepancy between the elongation of the samples in length and width does not have such a big difference than in breaking load.



a



b

Figure 3. Physical and mechanical strength indicators of nonwoven fabric samples: a – along the edge of the fabric, b – across the edge of the fabric.

The average value of the breaking load along the edge of the fabric is 110 N, strength is 0.318 MPa, elongation at break is 76.5%. The value of the breaking load across the edge of the fabric is 68.2 N, strength is 0.195 MPa, elongation at break is 99.3%.

Comparative analysis showed that the average difference in the breaking load of the samples along the edge of the fabric is 41.8 N higher than the samples across the edge of the fabric. A, the strength indicators are higher by 0.123 MPa. However, the elongation at rupture of samples across the edge of the fabric is 22.8% higher compared to samples along the edge of the fabric.

Conclusion. Research has been conducted to determine the physical and mechanical properties of nonwovens along the edge of the fabric and across the edge of the fabric. The average breaking load along the edge of the fabric is 110 N, and 68.2 N across, strength is 0.195 MPa and 0.318 MPa, elongation at break is 76.5% and 99.3%, respectively.

The studied nonwoven materials made from semi-coarse wool have sufficient strength characteristics for use in the technical industry and footwear production.

References

1. Abishev U.S. Report on the results of marketing research "Production of textiles". Nur-Sultan: National Chamber of Entrepreneurs "Atameken", 2020. – 177 p.
2. Why is the production and processing of sheep wool "limping" in Kazakhstan? Information and analytical portal Elitar. [Electronic resource]. – Access mode: https://elitar.kz/ru/materialy/politika/pochemu-v-kazakhstane-khromayet-proizvodstvo-i-pererabotka-ovechyey-shersti (from October 04, 2022).
3. Abzalbekuly B., Munasipov S.E. Research of structural properties of composite materials for products of light industry // Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti, 2020, Vol. 387, No. 3., P. 66–68.
4. Filippov A.D. Development of the structure and study of the properties of insulating nonwoven materials from regenerated raw materials: Thesis of candidate of technical science. Moscow, 2021, P. 140.
5. GOST R 50275, GOST 13587. Sampling to determine the physical and mechanical properties of nonwoven fabric. Moscow: InterCrim-Press Standards Publishing House, 1977, P. 4.
6. GOST R53226-2008 "Nonwoven fabrics. Methods for determining strength" Moscow: Standartinform, 2009, P. 15.
7. ISO 9073.3-1989 Textiles. Methods of testing nonwovens. Part 3, Determination of tensile and elongation strength.

The work was carried out at the Shoe center within the framework of the Erasmus+ project 618930-EPP-1-2020-1-EL-EPPKA2-CBHE-JP "Reinforcing capacities of HEIs for leather and leather products in Uzbekistan-Kazakhstan" REILEAP at the M.Kh. Dulaty Taraz Regional University.

Material received on 11.03.24.

Б. Абзалбекұлы[1], А. Байдильдаева[1], Ш. Ердаулет[1]

[1]М.Х. Дулати атындағы Тараз өңірлік университеті, Тараз қ., Қазақстан

ҚОЙ ЖҮНІНЕН ЖАСАЛҒАН БЕЙМАТА МАТЕРИАЛДАРДЫҢ БЕРІКТІК ҚАСИЕТТЕРІН ЗЕРТТЕУ

Аңдатпа. Жұмыста Tinius Olsen H25S әмбебап үзу машинасын пайдалана отырып, беймата материалдарға физикалық-механикалық зерттеулер жүргізілді. Беймата материалдар Тараз қаласында орналасқан ЖК «Мирас» кәсіпорнында әзірленді. Беймата материалды жасау үшін механикалық ине тесу әдісі қолданылды. Бұл әдіс экологиялық таза, өйткені өндірісте желім мен сіңдіру қолданылмайды, сонымен қатар атмосфераға зиянды заттар бөлетін жоғары температураны қолдану қарастырылмаған. Беймата материалының келесі беріктік көрсеткіштері анықталды: үзілген жүктеменің орташа мәні, беймата матаның жиегі бойымен және көлденеңмен үзілген кездегі беріктігі мен созылуы. Зерттелген беймата маталарды аяқ киім өнеркәсібінде ұлтарақ, төсеніш және аралық бөлшектер түрінде, құрылыс оқшаулау материалдары ретінде, сондай-ақ әртүрлі техникалық мақсаттағы бұйымдарда қолдануға болады. Беймата материалдарды өндірудің арзан болуы олардан жасалған бұйымдардың қол жетімді құнын қамтамасыз етеді.

Тірек сөздер: беймата материалдар, беріктік қасиеттері, әмбебап созылу сынағы машинасы.

Б. Абзалбекулы[1], А. Байдильдаева[1], Ш. Ердаулет[1]

[1]Таразский региональный университет им. М.Х. Дулати, г. Тараз, Казахстан

ИССЛЕДОВАНИЕ ПРОЧНОСТНЫХ СВОЙСТВ НЕТКАНЫХ МАТЕРИАЛОВ ИЗ ОВЕЧЬЕЙ ШЕРСТИ

Аннотация. В работе проведены физико-механические исследования нетканых материалов с использованием универсальной разрвывной машины Tinius Olsen H25S. Нетканые материалы произведены в предприятии ИП «Мирас», г. Тараз. Для производства нетканого полотна использовался механический иглопробивной метод. Этот метод является экологичным, так как в производстве не применяются клея и пропитки, а также не предусмотрено применение высоких температур, при которых выделяются вредные вещества в атмосферу. Определены следующие прочностные показатели нетканого материала: среднее значение разрывной нагрузки, прочность и удлинение при разрыве вдоль и поперек кромки нетканого материала. Исследованные нетканые материалы могут использоваться в обувной промышленности в виде стелек, простилок и утеблительных промежуточных деталей, в качестве строительных утеплительных материалов, также в изделиях различного технического назначения. Производство нетканных материалов является низкозатратным, что обеспечивает доступную стоимость изделий из них.

Ключевые слова: нетканые материалы, прочностные свойства, универсальная машина для испытания на растяжение.