

УДК
677.025:620.17

Oksana DMYTRYK, Svitlana BOBROVA,
Liudmyla HALAVSKA
Kyiv National University of Technologies and Design, Ukraine

THE INFLUENCE OF KNITTING PARAMETERS ON THE STRUCTURE PARAMETERS AND LOOP SHAPE OF KNITTED MATERIAL FROM HIGH- STRENGTH YARN

***Purpose.** Determination of the influence of the high-strength type yarn on the parameters of the structure and shaping of weft knitwear loops by implementing a one-factor experiment.*

***Keywords:** yarn of increased strength, para-aramid yarn, high-molecular polyethylene yarn, high-strength knitwear, protective textile material.*

Introduction. High-strength yarn have several unique physical and mechanical characteristics, so the demand for their use in various areas of human life is increasing. This is especially true for producing protective textile materials and composites for a wide range of industrial applications in the fields of engineering, aerospace, clothing industries, including the needs of the military-industrial complex and the civilian population.

Under the conditions of a full-scale war, establishing domestic production of functional textile materials with specified physical and mechanical characteristics at the industrial capacities of Ukrainian enterprises is of great importance. This will reduce the import of materials for the needs of the formation of clothing and tactical equipment for the military personnel. It should be noted that the production capacities of our enterprises allow us to realize the production of such materials in the development of their manufacturing technology.

In the course of previous studies, we have found that the shape of the axial line of the yarn in the loop is affected not only by the type of heavy-duty yarn but also by the type of the knitting equipment [1].

The research work [2] proposed a method for predicting the parameters of knitted fabrics based upon the use of 3D geometric models. However, it is not indicated according to which parameters the samples of knitwear were produced.

The authors of another work [3] established the influence of the parameters of the knitwear structure made from high-strength polyethylene and para-aramid yarns on its resistance to cutting and puncturing.

The authors proposed to apply a protective coating to increase the resistance of the textile material to cuts. However, the work does not indicate precisely how a change in raw material type affects the loops' formation.

The work [4] is devoted to studying the resistance to puncture and cutting of knitted fabrics of different weave structures (three types) produced from five kinds of high-strength yarns on an E10 Stoll flat knitting machine. The authors established the influence of the weave structure upon the resistance to cutting and piercing. However, there is no information about knitting parameters or the nature of the impact of the type of raw material on the structure parameters and shaping of loops.

The authors of the research [5] studied the cut resistance of woven and knitted materials made of high-strength yarns: kevlar, polyethylene, and their 50/50 combination. However, the authors do not specify the knitting parameters, which does not allow us to evaluate their effect on cut resistance.

The analysis of scientific publications in the field of research made it possible to emphasize the relevance of studying the influence of the type of high-strength yarn and knitting density on the parameters of the knitting structure and loop shaping.

Methodology. Method of regression analysis of an active experiment and constructing a linear one-factor regression model was applied.

Research results. To study the influence of knitting parameters, a one-factor experiment was implemented. Prototypes of knitwear were made by stockinette weaving from two types of high-strength yarns (polythene and para-aramid) with a linear density of 44texX3 on flat knitting equipment of the E8 PVRK type at five levels of knockover depth of the fabric within $h = 2,5 \div 3,5$ mm with a step of 0,25 mm, under the condition of constant yarn tension, regulated by a plate-shaped yarn tensioner, and the operation of the tension compensator during the reciprocating movement of the carriage; the established level of the pulling force of the web, which ensures the normal course of the knitting process, in the amount of H per one wale.

In the course of the research, the nature of the influence of a change in knockover depth on the structure parameters (the length of the yarn in the loop, the surface density, the knitwear thickness, the number of loops in the wale and course direction in 100 mm knitwear) and the parameters characterizing the shape of the loop (the loop area, angle of inclination, angle tilt of the left and right legs of the loop).

Conclusion. In the course of the research, it was found that a change in knockover depth in the range of 2,5÷3,5 mm had led to an increase in the loop length of samples from polyethylene yarn (PE) by 7%, of samples from the para-aramid yarn (PA) – by 7.8%. At the same time, the fabric thickness decreased by 2,3% and 6,2%, respectively. The influence of the physical and mechanical characteristics of PA and PE yarns on the formation of loops has been established. In particular, it has been found that the change in knitting density does not significantly affect the angle of inclination of the tangent at the weaving point of knit made of PE yarns within 5%. . Significantly a greater bending stiffness of the PA yarn leads to a zigzag structure of loops in adjacent loops in the wale direction and a change in the angle of inclination of the tangent at the weaving point with a change in knitting density of up to 10%.

Acknowledgements. The research was carried out within the framework of the state budget program "Development of multifunctional knitted fabrics and products for the formation of property and tactical equipment of servicemen" DB 16.04.73, state registration number:0121U109756 (2021-2022) supported by the Ministry of Education and Science of Ukraine.

References

1. Dmytryk O.M., Bezsmertna V.I., Halavska L.Ye. Influence of type of flat knitting equipment on the loop structure of knitwear from high strength raw materials and in combination with metal monofilament. Herald of Khmelnytskyi national university. Technical sciences. 2020. № 1 (281). C. 80–86 <https://er.knutd.edu.ua/handle/123456789/15147>.
2. S. Bobrova, T. Ielina, N. Beskin, V. Bezsmertna, L. Halavska. The use of 3D geometric models in special purpose knitwear design and predicting of its properties. Vlákna a textil (Fibres and Textiles). 2018. №2, Vol.25, June. P. 19–26.
3. Alireza Mollaei & Mohammad Saleh Ahmadi (2019): Effect of structural parameters on the cut resistance of para-aramid and ultra-high molecular weight polyethylene weft knitted fabrics, The Journal of The Textile Institute, DOI: 10.1080/00405000.2019.1656700.
4. Fangueiro R, Carvalho R, Silveira D, Ferreira N, Ferreira C, et al. Development of High-performance Single Layer Weft Knitted Structures for Cut and Puncture Protection. Journal of Textile Science & Engineering January 2015 DOI: 10.4172/2165-8064.1000225.
5. Memon, A.A., Peerzada, M.H., Sahito, I.A. et al. Facile fabrication and comparative exploration of high cut resistant woven and knitted composite fabrics using Kevlar and polyethylene. Fash Text 5,5 (2018). <https://doi.org/10.1186/s40691-017-0122-0>.