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STRUCTURAL PARAMETERS OF ELASTIC FABRICS FOR COMPRESSION PRODUCTS

Purpose. *This work aims to determine the effects of both the repeat of the bend-weft thread and the technological parameters of knitting on the structural parameters of an elastic weft-knitted fabric.*

Keywords: *bend-weft interlooping, elastomeric thread, structural parameters, yarn tension, elastic knitted fabric.*

Task Assignment. Today, compression therapy is effectively used for the prevention and treatment of lower limb diseases, edema reduction, and rehabilitation [1]. To ensure effective therapy, the pressure created by compression clothes or devices on the body should be uniform and controlled. Circular products, primarily knitted structures with incorporated elastomeric treads, are used in the manufacturing of compression garments [2]. The properties of the products depend on interlooping, the method of introducing the elastomeric thread, and the knitting parameters [3]. Even small changes in knitting parameters affect the structure, physical, and mechanical properties of fabric, as well as the linear dimensions of the compression product [4]. The correspondence of the shape and size of the product to the corresponding part of the human body is an important factor for exerting pressure level [5]. Therefore, determining the factors that affect the knitted structure's characteristics, particularly changes in width and height, is an urgent task for designing advanced compression products.

Methods. Standard test methods were used in an experimental study of elastic knitted fabrics: EN 14971:2006 for the number of stitches per unit length; ISO 5084:1996 for thickness; and EN 12127:1997 for mass per unit area. Mathematical statistics methods were used to analyze the experimental data.

Results. The elastic fabrics in the form of a tube were knitted on a 13 gauge MD-C300C single-cylinder automatic hosiery machine by the Mingde Company. The machine, with a 3.75-inch cylinder and 168 needles, is equipped with a device for forced feeding an elastomeric thread. Two sets of elastic knitted fabrics based on a plated plain interlooping, in which the bend-weft thread is laid in the form of tuck stitches through one needle.

Two options for the bend-weft yarn repeat were selected for the study: tuck stitches are formed at every second needle on the same needles in every course (option A), or with an offset of one needle at every other course (option B). Two plies of core-spun elastomer yarn were used as the ground for the plain structure. The yarn consists of a 2.2 tex elastomer core wrapped by two 4.4 tex polyamide threads. A 20.2 tex polyamide thread was used for the plating ground yarn. To ensure the required pressure level of future products, a core-spun elastomer yarn was used as a bend-weft. This yarn is thicker than ground and consists of a 7 tex elastomer core wrapped by two 8 tex polyester threads. To investigate the effect of technological conditions on the fabric's structural parameters, the density of the ground plain stitches and the elastomer bend-weft yarn feeding were varied. Three levels (7, 9, and 11) and four levels (50, 70, 90, and 110) were fixed for ground density and elastomer feeding, respectively. The values given are dimensionless indicators entered into the knitting program on the equipment. For each set, 12 fabric variants were produced. After knitting, all fabrics were the subject of washing and drying on a flat surface according to ISO 6330:2021, and then conditioned under standard atmospheric conditions in accordance with ISO 139:2005

A graphical representation of the obtained results is presented in Fig.1. The number of courses and wales per 100 mm of the fabric characterizes the density of the knitted fabric and determines the dimensions of the future product. The number of wales per 100 mm indicates (Fig. 1 a, b) that the feeding speed of the bend-weft thread is a determining parameter. Changing the parameter from 50 to 110 results in a 24% decrease in the number of wales, thereby increasing the width of the future product. This trend is featured at all levels of ground density for both fabric sets. Changing the ground density parameter from 7 to 11 leads to a 5-10 % decrease in the number of wales per 100 mm and a respective increase in product width for both fabric sets. The repeat of the bend-weft thread does not significantly affect the parameter. The number of courses per 100 mm indicates (Fig. 1 c, d) that the ground density is a determining parameter. Changing the parameter from 7 to 11 results in a 20-28% increase in the number of wales, thereby decreasing the length of the future product. This trend is featured at all levels of bend-weft feeding for both fabric sets. At the same time, the feeding speed and the repeat of the bend-weft thread do not significantly affect the parameter. The differences in both cases do not exceed 5%. Both the ground density and the feeding speed of the bend-weft thread affect the fabric thickness. Changing the parameters from 7 to 11 for ground density and from 50 to 110 for feeding speed results in thickness decreases of 17-26% and 5-12%, respectively. Both the ground density and the feeding

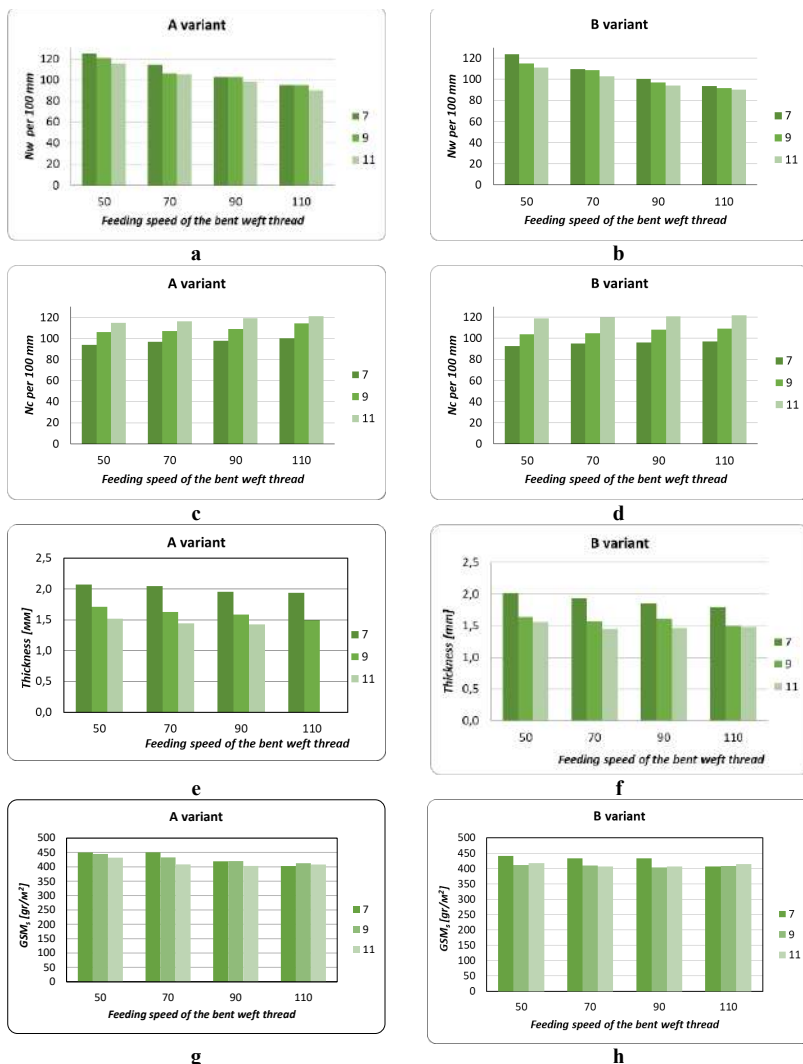


Fig. 1. Dependences of structural characteristics on knitting parameters:
a, b – number of wales per 100 mm; c, d – number of courses per 100 mm; e, f –
thickness; g, h – area density

speed of the bend-weft thread affect the fabric area density as well. Changing the parameters within the experiment range results in a 10% decrease in area density.

Conclusion. Within the scope of the work, elastic weft knitted fabrics of plated plain interlooping with bend weft core spun elastomer yarn were manufactured and investigated. Two repeats for the tuck stitches were used for the bend-weft yarn. The obtained results allow predicting the parameters of knitted fabrics, including the dimensional characteristics of the future product, based on the technological conditions, thereby ensuring the manufacture of products of a given shape.

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