**Development of a Technology for Producing New-Structure Coat-Type Interlock Knitted Fabrics**

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**Abstract.** The range of knitted fabrics are used not only for everyday wear but also for special occasions. Their main advantages include comfort, elasticity, and breathability, which make them stand out among other types of clothing. This article explores the improvement of production technology for knitted coat fabrics. The primary goals of the study are to broaden the range of outerwear, reduce raw material consumption, and—most importantly—enhance key quality indicators of the final product. As part of the research, five innovative variants of knitted fabrics were developed using a CMS 502 Hp Plus Multi Gauge flat knitting machine (gauge class 7 and 12) produced by the German company STOLL. The samples were manufactured using polyacrylonitrile yarn with a linear density of 56 tex × 3 and 56 tex. The coat-knitted fabrics differ from each other in the variation of the knitting structure.

**Keywords:** knitting, product, technology, coat, assortment, textile, fabric, knitting machine, structure

**INTRODUCTION**

At present, comprehensive measures are being implemented across the Republic to organize the production of a wide range of high-quality textile and garment-knitting products, to deepen the localization of their manufacturing, and to increase the export potential of domestic producers.

In order to address the urgent issues and fulfill the objectives mentioned above, a new technology was developed during the course of research for producing coat-type interlock knitted fabrics with a new structure. This aims to expand the assortment of coat-type knitted fabrics, reduce raw material consumption, and improve quality indicators [1].

# **LITERATURE SURVEY**

Based on the technology for producing coat-type knitted fabrics, five sample variants were knitted using STOLL-brand flat double-needle knitting machines of classes 7 and 12. The knitting needles were arranged in a rib configuration.

In producing the samples, linear density of 56 tex × 3 threads was used for the class-7 knitting machine, while polyacrylonitrile yarns with a linear density of 56 tex were used for the class-12 knitting machine [2, 3].

The coat-type knitted fabrics differ from one another by the type of raw material used with various linear densities, the structure of the knit, and variations in pattern repeats (rapport).

The graphical notation (a), structural diagram (b), and photograph (c) of the new-structure coat-type interlock knitted fabrics are shown in Figures 1–5.

The coat-type knitted fabrics were knitted on class-7 and class-12 flat double-needle knitting machines in the following sequence [4]. Since the production technology for the samples is identical, analyzing the technology for the class-7 knitting machine is sufficient.

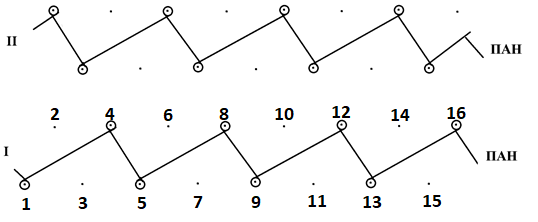
In the knitting machine, the front knitting needles are conventionally designated with odd numbers, while the rear knitting needles are marked with even numbers.

**RESULTS**

The first variant of the coat-type interlock knitted fabric is produced as follows: The full pattern repeat (rapport) of the fabric consists of two courses, with 15 knitting needles engaged across the fabric’s width. To knit the first course of the sample, as the knitting machine carriage moves from left to right, the front needle bed’s knitting needles numbered 1, 5, 9, and 13, and the rear needle bed’s needles numbered 4, 8, 12, and 16, are raised to participate in loop formation. Using the first yarn feeder, a row of double-layered rib loops is created from polyacrylonitrile yarn, forming the first course of the fabric.During the process, the knitting needles numbered 3, 7, 11, 15, 2, 6, 10 and 14 on the front and rear needle beds do not participate in the loop formation. As a result, the first course of the sample is knitted.

In this process, the yarn is fed through every other needle, allowing the knitting machine’s needles to be arranged in a rib configuration. Due to this arrangement, loops formed by the active needles on the front and rear beds, using polyacrylonitrile yarn, result in the first variant of the new-structure coat-type interlock knitted fabric (Figure 1 ,a, Course I).

In order to expand the range of the assortment, variants II, III, IV, and V of the new-structure coat-type interlock knitted fabrics were developed by modifying the production technology of the knitted fabric samples through arranging the knitting needles in a rib configuration.No additional changes were made to the construction of the knitting machine in the process of producing these samples.

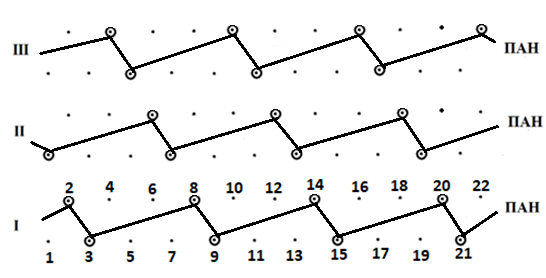


**FIGURE 1**. Graphical notation (a), structural view (b), and photograph (c) of the new-structure coat-type interlock knitted fabric (Variant I)

In the second variant of the coat-type knitted fabric, the loop arrangement within the rapport consists of three courses. In this version, the front needle bed needles are sequentially numbered using Arabic numerals, and the rear needle bed needles are also distinguished using Arabic numerals.

To knit the first course of the sample, the knitting machine carriage moves from left to right, forming loops with the polyacrylonitrile yarn fed through the first yarn feeder, according to the sample rapport, on the selected needles of both the front and rear needle beds. That is, front loops are formed on the front needle bed at needles 3, 9, 15, and 21, while back loops are formed on the rear needle bed at needles 2, 8, 14, and 20. These loops are interconnected with each other through extended sinker loops. During this process, the knitting needles numbered 1, 5, 7, 11, 13, 17, and 19 on the front bed, and 4, 6, 10, 12, 16, and 18 on the rear bed do not participate in the loop formation.

By feeding the yarn through every second needle, the knitting machine needles are arranged in a rib configuration, and as a result, the first course of the next variant of the new-structure coat-type interlock knitted fabric is formed using polyacrylonitrile yarn, with loops formed by the participating needles on the front and rear beds (Figure 2, a, Course I).

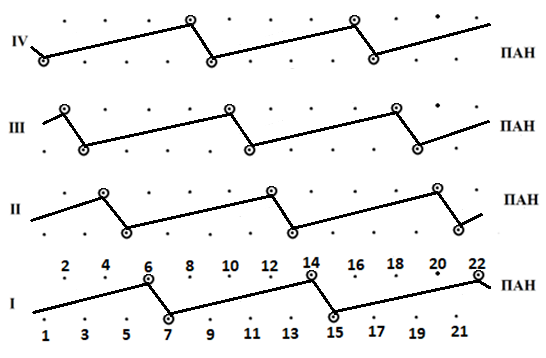


**FIGURE 2**. Graphical notation (a), structural view (b), and photograph (c) of the new-structure coat-type interlock knitted fabric (Variant II)

When knitting the second course of the fabric, the knitting machine carriage moves from right to left. Using the yarn feeder and PAN (polyacrylonitrile) raw material, loops are formed on selected needles of the front and rear needle beds by feeding the yarn over every second needle and shifting it one needle position backward relative to the first course. In this process, front loops are formed on front bed needles 1, 7, 13, and 19, while back loops are formed on rear bed needles 6, 12, and 18. These loops are interconnected through extended sinker loops.Accordingly, front bed needles 3, 5, 9, 11, 15, 17, and 21, and rear bed needles 2, 4, 8, 10, 14, 16, 20, and 22 do not participate in the loop-forming process. As a result, the second course of the sample was knitted on the front and rear needle beds of the knitting machine by feeding the yarn over every second needle, shifting it one needle position backward, and utilizing the knitting needles that did not participate in the knitting process of the first course. (Figure 2 ,a, Course II )

When knitting the third course of the sample, the knitting machine carriage moves from left to right. Unlike the first course, in this case the yarn is fed to the knitting needles by shifting it two needle positions backward, according to the rapport of the third course. In this process, front loops are formed on needles 5, 11, and 17 of the front needle bed, and back loops are formed on needles 4, 10, 16, and 22 of the rear needle bed. These loops are interconnected through extended sinker loops.During the formation of the third course, the following needles do not participate in the loop formation process: 1, 3, 7, 9, 13, 19, and 21 on the front bed, and 2, 6, 8, 12, 14, 18, and 20 on the rear bed. At the end of the process, by feeding the yarn over every second needle and shifting it two needle positions backward on both the front and rear beds, the third course of the sample is knitted using those knitting needles that were not involved in the knitting of the first and second courses (Figure 2a, Course III). As a result, Variant II of the new-structure coat-type interlock knitted fabric, consisting of three courses, was produced.

The rapport of Variant III consists of four courses, and a total of 21 knitting needles are involved across the width of the knitted fabric during its production. When knitting the first course of the sample, the knitting machine carriage moves from left to right, and using the first yarn feeder, loops are formed from polyacrylonitrile yarn on the selected needles of the front and rear beds according to the rapport of the fabric. In this case, front loops are formed on needles 7 and 15 of the front needle bed, and back loops are formed on needles 6, 14, and 22 of the rear needle bed. These loops are interconnected through extended sinker loops.During the process, the knitting needles 1–5, 9–13, and 17–21 on the front bed, and 2, 4, 8–12, and 16–20 on the rear bed, do not rise for stitch formation and do not participate in the loop formation process.

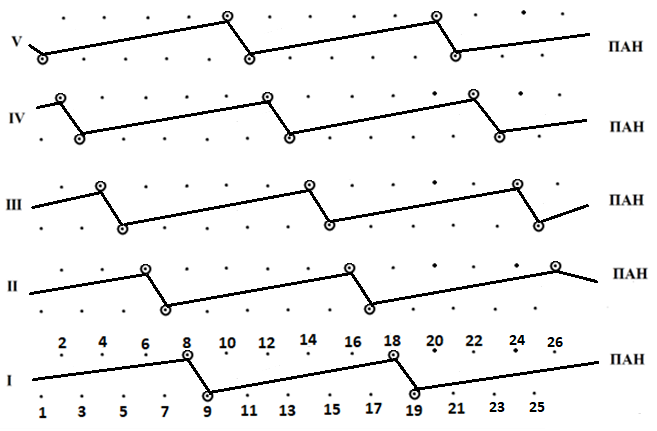


**FIGURE 3.** Graphical notation (a), structural view (b), and photograph (c) of the newly structured coat-type interlock knitted fabric (Variant III)

As a result, by alternating three needles on the front and rear needle beds of the knitting machine, the first course of the sample was formed (Figure 3, a, Course I).

As a result, a new sample of coat-type interlock knitted fabric with a newly developed structure based on new technology and a complete rapport consisting of four courses was produced, with the needles arranged in a rib configuration (elastic pattern).

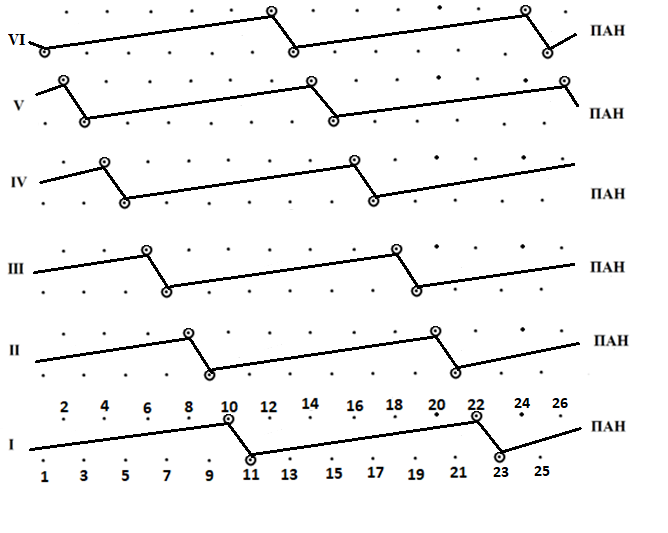
Variant IV of the coat-type knitted fabric, with needles arranged in a rib configuration based on new technology, was developed. The knitting rapport consists of five courses, and the sequence of fabric production was carried out based on the same technology as in previous variants. It differs in that during yarn feeding, the system shifts four knitting needles, and four needles are alternated on both the front and rear needle beds of the knitting machine to form loops. It is advisable to analyze the technological process sequence for those courses that differ from previous variants during the development of this version.



**FIGURE** **4.** Graphical notation (a), structural appearance (b), and photograph (c) of the newly structured coat-type interlock knitted fabric (Version IV)

For this purpose, the knitting technology of the first and fifth courses of the sample was analyzed.While knitting the first course of the sample, the carriage of the knitting machine moves from left to right, and with the help of the yarn feeder, loops are formed from polyacrylonitrile yarn in accordance with the knitting rapport on the selected needles of the front and rear needle beds (Figure 4, a, Course V).

Version V of the coat-type interlock knitted fabric, with the needles arranged in a rib configuration, is also produced based on the same technology as in the previous versions. The fabric rapport consists of six courses and differs in that during yarn feeding, the yarn is shifted across five knitting needles, and loops are formed over every fifth needle on both the front and back needle beds of the knitting machine. The type of raw material and the production technology remain unchanged. As a result, Version V of the newly structured coat-type interlock knitted fabric was developed, in which the needles are arranged in a rib configuration and loops are formed in a complementary manner across the courses (Figure 5).



**FIGURE 5**. Graphical notation (a), structural appearance (b), and photograph (c) of the newly structured coat-type interlock knitted fabric (Version V)

**CONCLUSION**

Based on the technological capabilities of flat double-needle bed knitting machines, a new technology was developed for producing a new assortment of structured coat-type interlock knitted fabrics with different structures and rapports, by arranging the knitting needles of the knitting machine in a rib configuration, using polyacrylonitrile raw material on 7 and 12 gauge knitting machines.

The samples produced using this technology are recommended for the manufacture of outerwear and coat-type knitted products.

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