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COMBINED SEWING THREAD OF NEW STRUCTURE

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An abbreviated manufacturing process was developed for production of combined sewing thread. Use of updated ring spinning and spinning-twisting machines allows obtaining sewing thread similar in structure to traditional reinforced thread but with lower process costs. It was found that polyester microfibres should be used to ensure good physicomechanical, process, and performance properties of the combined sewing thread during production. Introduction of the abbreviated production technology for combined sewing thread instead of the traditional multipass technology increases labor productivity and reduces production areas and power consumption.

Sewing companies in Belarus currently almost do not use domestic reinforced sewing thread, since it does not guarantee quality sewing of clothing on high-speed sewing equipment: longitudinal shifts of the fibre braid along the surface of the chemical fibre and consequently increased thread breaks during sewing are observed. One case of this drawback is weak securing of the fibre coating on the complex thread due to the small number of polyester fibres in the section of the reinforced thread. This drawback can be eliminated by using fibres of low linear density. Decreasing the linear density of the fibres increases the breaking load of the yarn by increasing the number of fibres in its cross section and decreasing the irregularity of the yarn in short segments, which is important for sewing thread. Using microfibres in the braid of combined sewing thread guarantees better cohesiveness and wear resistance of the fibres.

Production of reinforced thread with the traditional technology provides for spinning of the reinforced thread on modernized ring spinning machines with existing technology* by feeding complex polyester thread under the front pair of the draw box and winding it with the fibre bundle thinned in the draw box. They are then rewound on winding machines, wound on doubler winders, and twisted in several threads on ring twisting frames. The drawback of this technology is the comparatively large number of process changeovers and use of equipment with low output, which requires important labor, power, and material resources.

A manufacturing process for combined sewing thread using updated ring spinning and spinning-twisting machines was developed in the Department of Natural and Chemical Fibre Spinning at Vitebsk Technological University. The process changeovers for production of combined polyester sewing thread are shown in the diagram in Fig. 1. The new manufacturing process provides for preparation of polyester fibres and spinning of roving and reinforced thread with the existing spinning system. In the twisting plant, instead of three process changeovers, there is only one using the updated spinning-twisting machines instead of ring twisting frames. This not only allows eliminating the operation of rewinding single threads and combining the slubbing and twisting operations in the twisting plant, but also reducing expenses in the spinning plant by halving the number of spinning spindles.

According to the new technology, cops with the reinforced thread, one of the strands to be twisted, are placed on hollow spindles on the updated spinning-twisting machines. The second strand, which has the structure of the reinforced thread, is spun directly on the updated spinning-twisting machine by braiding the complex chemical fibre introduced under the upper

*A. G. Kogan, *Production of Combined Yarn and Thread* [in Russian], Leg. Pishch. Prom-st', Moscow (1981).

Vitebsk State Technological University, Belarus'. Translated from *Khimicheskie Volokna,* No. 3, pp. 52-54, May—June, 2007.

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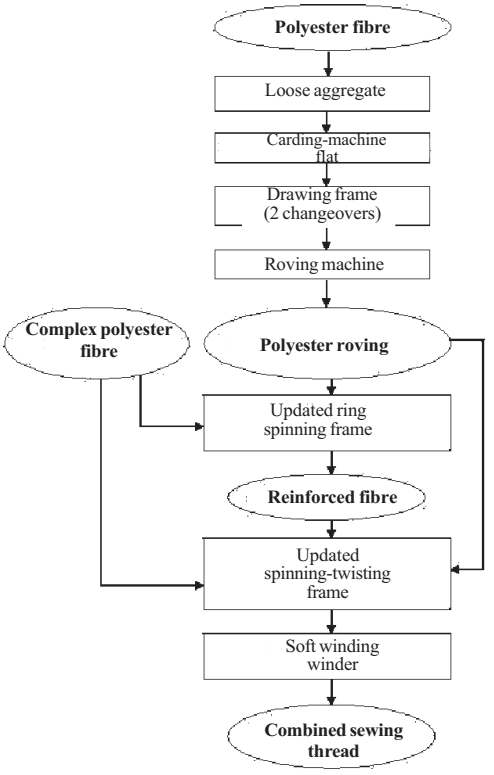

Fig. 1. Diagram of process changeovers for production of combined sewing thread.

TABLE 1. Physicomechanical Properties of Reinforced Fibres

Indexes	Values of index						
	real					nominal	
Linear density of thread, tex	16.6	16.4	21.0	20.5	50.5	16.7	21.0
Linear density of fibre, tex	0.08	0.17	0.08	0.17	0.17	–	–
Composition, %							
polyester fibre	32.3	32.3	34.3	34.3	44.0	32.3*	34.3*
complex polyester thread	67.7	67.7	65.7	65.7	56.0		
Coefficient of variation in linear density, %	3.8	3.9	2.1	3.1	2.3	–	–
Relative tenacity, cN/tex	51.5	51.6	45.8	48.1	40.7	47.5*	45.6*
Coefficient of variation in tenacity, %	4.3	4.1	3.2	5.4	3.3	5.0**	6.5**
Relative elongation at break, %	15.6	15.7	14.4	14.5	11.1	19.0**	19.0**
Twist factor	31.2	30.7	34.4	34.5	50.8	34.0**	36.0**

*Minimum. **Maximum.

draw box pair with the fibre bundle. At the top of the hollow spindle, both strands are taken up and twisted inside the channel, forming a twisted combined thread.

This technology ensures stability of spinning and twisting since it reduces end breaks as a result of incorporating the complex chemical fibres under the front pair of the draw boxes on the spinning and spinning-twisting frames. To implement this process, it is necessary to modernize the PK-100M3 spinning-twisting frame, which consists of installing a feed frame and tensioner for complex chemical fibres and a twist stabilizer in the lower part of the hollow spindle.

TABLE 2. Physicomechanical Properties of Combined Thread

Indexes	Values of index						
	real					nominal	
Commercial number	35LL		45LL		100LL	35LL	45LL
Structure	16.7 tex × 2		21 tex × 2		50 tex × 2	16.7 tex × 2	21 tex × 2
Linear density of combined thread, tex	34.0	34.0	43.0	41.4	94.2	34.5	43.5
Linear density of fibre, tex	0.08	0.17	0.08	0.17	0.17	–	–
Composition, %							
polyester fibre	32.3	32.3	34.3	34.3	44.0	–	–
complex polyester thrread	67.7	67.7	65.7	65.7	56.0	–	–
Breaking load, cN	1603	1560	1901	1885	3950	1522*	1811*
Coefficient of variation in breaking load, %	3.3	3.5	4.9	6.6	6.4	7.5**	7.5**
Relative elongation at break, %	15.9	12.1	15.0	13.8	17.9	22.0**	22.0**
Twist factor	34.1	35.0	39.1	40.1	49.6	–	–

*Minimum. **Maximum.

TABLE 3. Process Properties of Sewing Thread

Thread type	Commecial number*	End breaks in stitching**	Breaking load, cN		Loss of strength in stitching, %	Wear resistance, cycles	Nonequilirium, tw./m
			before stitching	after stitching			
Reinforced	45LL	62	1758	1609	8.5	416	2.9
Combined	45LL	65	1789	1648	7.9	438	2.7
Same	45LLm	94	1869	1789	4.3	532	2.5

*LL — braid from polyester fibres with a linear density of 0.17 tex, LLm — braid made from 0.08 tex polyester fibres.
**Length of stitch with no breaks, m.

The optimum twist stabilizer design which eliminated thread breaks at the outlet of the hollow spindle was established as a result of the theoretical studies of the tension of the combined thread and the strand constituting them.

The range of the linear density of the combined sewing thread manufactured with this technology is relatively wide — from 25 to 100 tex, and its structure can be varied. Complex high-strength, low-shrinkage polyester filaments with a linear density of 7.6 to 28 tex can be used as the core filament. The shell can be composed of 0.167 and 0.08 tex polyester fibres.

The manufacturing process for combined polyester sewing thread with a commercial number of 35 LL, 45LL, and 100LL was developed and investigated. The optimum combination of twist values in spinning and twisting which would allow forming thread of the new structure that satisfies the requirements in the standard was established.

The properties of the combined sewing thread were investigated using polyester fibres with a linear density of 0.17 and 0.08 tex as the fibre constituent. The physicomechanical properties of reinforced fibres of different structure are reported in Table 1 in comparison to the requirements of TU RB 00311987.037—97 "Reinforced Yarn with Polyester and Cotton Braid." The physicomechanical properties of coarse combined sewing thread of different structure are compared with the requirements of TO RB 500046539.053—2002 "Double-twist Coarse Yarn" in Table 2.

Based on the results obtained, we note that reinforced fibres and combined thread with a polyester microfibre braid have high breaking characteristics and the least irregularity.

The process properties of the sewing thread determined in stitching suiting are reported in Table 3. The combined polyester sewing thread using polyester fibres with a linear density of 0.17 tex has process properties similar to traditional reinforced thread. The combined polyester sewing thread, whose braid consists of 0.08 tex polyester fibres, has much better process properties than thread made with 0.17 tex polyester fibres: lower breakage and loss of strength during sewing, better wear resistance.

The abbreviated technology for manufacturing the combined sewing thread has been recommended for introduction at Groniteks Co. in Grodno.