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The Property of Twisted Yarn Obtained From Single Yarn of Various Spinning Methods

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ABSTRACT: The article provides a comparative analysis of the influence of a single yarn with a linear density of 29 tex worked out by ring and pneumomechanical methods on the quality of twisted yarn developed on a double torsion machine.

KEY WORDS: single yarn, twisted yarn, breaking load, elasticity, structure, treadmill, tex, double torsion, linear density.

I. INTRODUCTION

Torsion is one of the main technological processes in the production of textile materials. Twisted yarn for domestic use is widespread. The need for it is growing every year. Twisted yarn is a thread consisting of two or more single threads. Twisted yarn has higher qualities than single-strand yarn. The main advantages of twisted yarn are: stable structure, increased breaking load, uniformity of elongation, abrasion resistance, elasticity, uniformity, gloss and smoothness [1]. Expanding the assortment of high-quality fabrics, knitted, curtains and tulle products necessitate a further increase in the production of twisted yarn.

II. EXPERIMENTAL PART

Insufficient attention was paid to technologies for obtaining yarn linear density 50-70 tex from waste, which was primarily due to the limited capabilities of the process equipment installed at spinning mills of the Republic. At present, cotton spinning mills of the Republic are 100% equipped with technological equipment from Rieter, Marzoli, Truetzschler and Zinser.

Experimental studies were carried out in the production conditions of a spinning mill and torsion production.

A single cotton yarn with a linear density of 29 tex was produced both on BD-330 air-spinning machines (Czech Republic, Saurer), and on Zinser 350 ring-spinning machines (Germany) from type 5 I-II cotton fiber.

Twisted yarn in 2 additions of linear density 29 tex x 2 was produced from single yarn of both spinning methods using double torsion machines from Volkmann (Germany) with varying values of the final twist. The characteristics of the studied twist variants are given in table 1.

The aim of the research was to determine the coefficient of hardening of yarn of different spinning methods in torsion, as well as to determine the twist, elongation, and roughness of the properties.

The indices of the basic physical and mechanical properties of twisted yarn with a linear density of 29 tex x 2 obtained from single ring yarn (KP) and pneumomechanical (PHC) spinning methods are shown in Tables 2-10.

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Table 1. Indicators of the basic physical and mechanical properties of twisted yarn

No	The name of indicators	29 tex x 2			50 tex x 2		
1	Twisted yarn, cr/m	420	520	620	330	400	470
2	The ratio of twist when twisting the yarn PHC, α_1/α_0	0,7	0,87	1,04	0,74	0,90	1,05
3	The ratio of twists when torsion yarn KP, α_1/α_0	0,8	0,99	1,18	0,77	0,94	1,1

Table 2. Indicators of the basic physical and mechanical properties of twisted yarn 29 tex x 2 developed from a single yarn of a ring spinning method

No	The name of indicators	29 tex	29 tex x 2		
		742 kr/m	420 kr/m	520 cr/m	620 kr/m
1	Linear density, tex	29,4	29,4 x 2	29,2 x 2	29,4 x 2
2	Metric number	34,0	34/2	34/2	34/2
3	The coefficient of variation in linear density, %	3,2	3,1	2,7	2,6
4	The resulting linear density, tex		58,7	59,5	59,7
5	Wrap,%	-	0,998	1,012	1,0153
6	Breaking load, gs	391	863	886	919
7	Specific breaking load gs/teks	13,3	14,7	14,9	15,6
8	The coefficient of variation in breaking load,%	10,4	9,5	8,9	8,6
9	Coefficient of hardening, Qu.p.	-	1,105	1,12	1,17
10	Level of quality	1,28	1,55	1,67	1,81
11	Elongation,%	6,4	6,8	7,2	7,4
12	Twist, cr/m	40,2	32,2	40,11	47,9
13	Twist Ratio, α_1/α_0	-	0,8	0,998	1,19
14	The coefficient of use of the strength of the fiber in the strength of the yarn	0,53	0,58	0,59	0,61

Table 3. Indicators of the basic physical and mechanical properties of twisted yarn 29 tex x 2, produced from a single yarn of a pneumomechanical spinning method

No	The name of indicators	29 tex	29 tex x 2		
		846 kr/m	420 kr/m	520 kr/m	620 kr/m
1	Linear density, tex	29,2	29,2 x 2	29,2 x 2	29,2 x 2
2	Metric number	34,2			
3	The coefficient of variation in linear density, %	2,6	2,6	2,2	1,8
4	The resulting linear density, tex	-	57,2	57,8	58,4
5	Wrap,%	-	0,98	0,99	1,0

ISSN: 2350-0328
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6	Breaking load, gs	318			
7	Specific breaking load gs / teks	10,9	11,2	11,8	12,1
8	The coefficient of variation in breaking load,%	9,4	8,8	7,7	6,7
9	Coefficient of hardening, Q u.p.	-	1,03	1,08	1,11
10	Level of quality	1,16	1,27	1,51	1,75
11	Elongation,%	5,3			
12	Twist coefficient, $\alpha_т$	45,7	31,76	39,53	47,38
13	Twist ratio α_1/α_0	-	0,76	0,86	1,03
14	The coefficient of use of the strength of the fiber in the strength of the yarn	0,43	0,44	0,46	0,476

For the convenience of comparative analysis, the main quality indicators of twisted yarn of all options from tables 2-3 are summarized in summary table 4.

Table 4. Twisted Yarn Performance

Type of yarn	Twist coefficient		Twistin g $Y_{1\ \%}$	Resulting linear density, tex T_R	Coefficient Hardening K_{up}	The coefficient of utilization of fiber strength in strength K_{up}
	α_0	α_1				
KP						
29 tex x 2	40,2	32,2	0,998	58,7	1,105	0,58
29 tex x 2	40,2	40,1	1,012	59,5	1,12	0,59
29 tex x 2	40,2	47,9	1,015	59,7	1,17	0,61
PHC						
29 tex x 2	45,7	32,2	0,98	57,2	1,03	0,44
29 tex x 2	45,7	40,1	0,99	57,8	1,08	0,46
29 tex x 2	45,7	47,9	1,0	58,4	1,11	0,476

In fig. Figure 1 shows the dependences of the specific breaking load of yarn of different spinning methods and different linear densities on the value of the final twist.

Straight lines in fig. 1 shows the specific breaking load of a single yarn of the corresponding linear density (and spinning methods).

From fig. 1 and table 4 shows the following:

1. In the process of twisting single strands of any spinning method, hardening of twisted yarn occurs.

2. With an increase in the final twist, the hardening coefficient increases, since in the process of torsion, the pressure of the fibers and threads on each other increases.

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3. The hardening in the twisted yarn of the pneumomechanical spinning method is noticeably lower than the hardening of the yarn of the ring spinning method with the same twist and thickness.
This is explained by the presence in the pneumomechanical yarn of a loose outer layer of upholstery fibers, which play a significant role in the process of twisting. Surface fibers subjected to bending due to torsion exhibit less tear resistance than rod, less curved fibers [2].

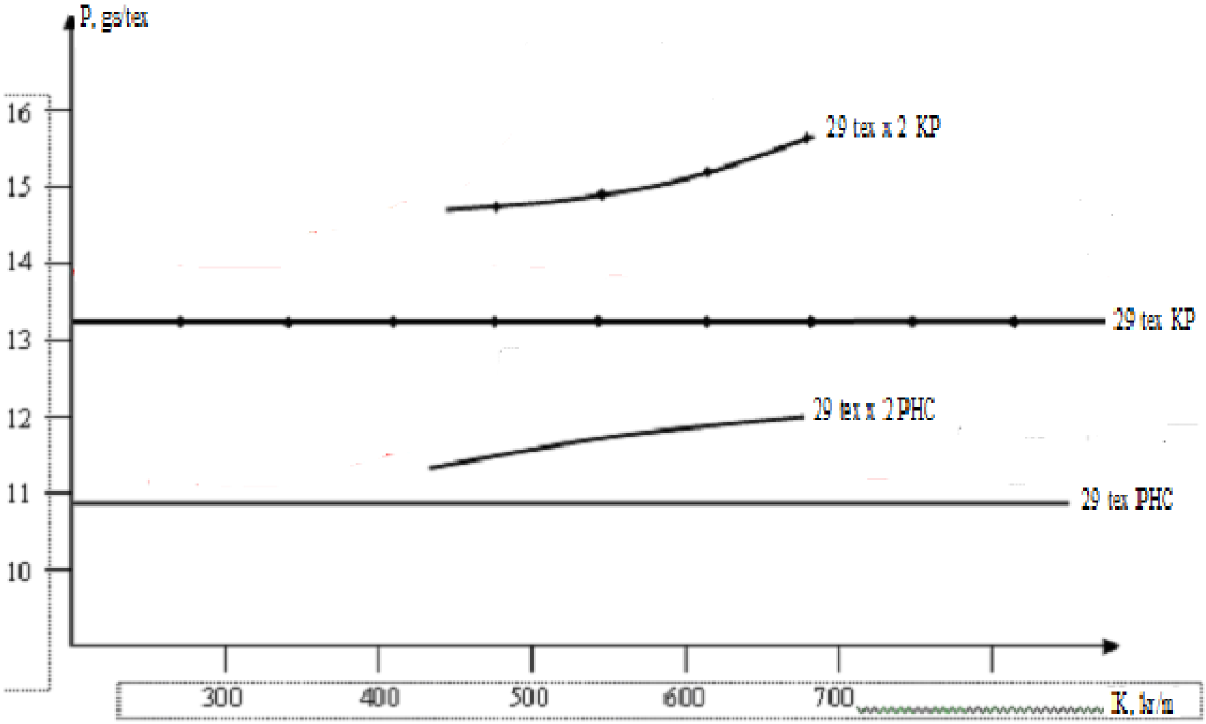

Fig.8. Hardening of yarns of different spinning methods depending on the final twist

III. CONCLUSIONS

It has been established that during the spinning of the pneumomechanical yarn, the strands are slowly unwound at low and medium secondary twists due to the presence of loose outer layers and twisting fibers in the yarn, which, when twisted, create a large contact surface that prevents the unwinding of the component threads. This affects the twist of the yarn, which for PSMP yarn is close to 1 at a ratio of α_1/α_0 = 1.05 and even has a negative twist (i.e., lengthens when twisted) with a small final twist of α_1 (α_0 = 0.73-0.9).

The hardening of the yarn during torsion leads to an increase in the utilization of fiber strength to 0.61 for ring spinning yarn and to 0.476 for PHC yarn.

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