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Investigation of Unfairness Indicators of Yarn Obtained From Fibers with Different Emulsification Composition and Maturity Degree

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A B S T R A C T

General Background: *Yarn quality is a crucial determinant of the performance and durability of textile products, with uniformity being a key characteristic affecting fabric appearance and mechanical properties. Unevenness in yarn results in defects that impact fabric quality, machine efficiency, and production costs.* ***Specific Background:*** *The emulsification composition and fiber maturity significantly influence the mechanical properties and structural uniformity of yarn. However, the impact of these factors on yarn quality indicators under different conditions remains underexplored.* ***Knowledge Gap:*** *Although previous studies have addressed the effects of fiber processing on yarn quality, limited research has systematically examined the variations in unevenness indicators of yarns produced from fibers with different emulsification compositions and degrees of maturity.* ***Aims:*** *This study investigates the impact of fiber maturity and emulsification on yarn unevenness, analyzing key indicators such as coefficient of variation, hairiness, neps count, breaking strength, and elongation.* ***Results:*** *The findings reveal that fiber maturity and emulsification composition significantly influence yarn uniformity and mechanical properties. The analysis demonstrated that different emulsification options affected the coefficient of variation, neps formation, and relative breaking strength at various fiber maturity stages. The best yarn quality was achieved under specific emulsification conditions, with reduced unevenness and improved tensile properties.* ***Novelty:*** *This research provides a comprehensive assessment of how emulsification and fiber maturity impact yarn quality, offering new insights into optimizing fiber processing for improved textile production.* ***Implications:*** *The results highlight the importance of selecting appropriate emulsification treatments to enhance yarn quality, reduce production defects, and improve fabric performance in the textile industry.*

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1. INTRODUCTION

Testing and controlling the unevenness of products in the spinning industry is of great importance, determining the causes and timing of unevenness. The more yarn breaks during winding and shaping on spinning machines, the higher the unevenness of the yarn. As a result of the increase in yarn breaks, the labor supply of workers increases, and the productivity of the machines decreases[1].

If a product with uneven structure or linear density enters the drawing device of various machines, the area of the tensile force and friction force will change.

If the unevenness of the yarns cooked in linear density is high, defects will appear in the appearance and

structure of the fabric, as a result, the surface of the fabric will become striped, scaly, wrinkled or wrinkled. These defects can also be observed in knitted fabrics.

If the yarns have high unevenness in terms of strength and other properties, then the woven and knitted fabrics will have high unevenness in terms of strength, elongation and elasticity. Unevenly spun yarns in terms of linear density lead to the formation of specific defects in production. Therefore, it is important to study and control the unevenness of spun products under production conditions in accordance with the above factors[2].

The unevenness of the change in product properties along the length is determined based on the following forms: unevenness in linear density, bulk density (density) of the product by the number of fibers in the cross-section of the product at different lengths, unevenness in physico-mechanical properties, etc.

The analysis of the unevenness of spinning products is very complex. There are many types of unevenness for spinning products: those that are formed at the first stage of spinning, and those that change in subsequent stages and the addition of new types of unevenness to them.

Yarn unevenness, combining several components, affects the unevenness of different stages of spinning production. Different types of unevenness are interrelated[3].

2. METHODS

Yarn was produced based on the emulsification of ripened fibers at different times and unevenness indicators were determined. The obtained test results are presented in Tables 1-5.

Table 1. Investigation of unevenness indicators of yarns obtained from fibers with different emulsification composition and maturity level

№	Indicator name	First opened	Emulsion composition options		
			1	2	3
1.	Unevenness of threads U, %	10.68	10,40	10,1	9,0
2.	Coefficient of variation CVm, %	13.57	12,8	13,0	12,4
3.	1 m coefficient of variation CVm, %	4.61	4,30	4,26	4,12
4.	10 m coefficient of variation CVm, %	2.15	1,92	2,10	1,86
5.	Number of neps Neps 50%	111.4	109	111	108
6.	Number of neps Neps+200%	186.5	186	179	175
7.	Number of neps Neps+280%	31	30	29	28
8.	Fatness, H	6.36	5,90	6,10	5,72
9.	omission by coefficient of variation, sh	1.63	1,60	1,62	1,56
10.	breaking load, gf	3.06	3,10	3,0	3,30
11.	breaking elongation,%	4.09	4,20	4,0	5,20
12.	Relative breaking strength, Rkm	15.53	15,70	15,80	16,40

Table 2. Investigation of unevenness indicators of yarns obtained from fibers with different emulsification composition and maturity level

№	Indicator name	Opened for 3 days	Emulsion composition options		
			1	2	3
1.	Unevenness of threads U, %	8.25	8,0	7,80	7,56
2.	Coefficient of variation CVm, %	10.44	10,20	9,60	9,45
3.	1 m coefficient of variation CVm, %	3.19	2,76	2,40	2,10
4.	10 m coefficient of variation CVm, %	1.82	1,80	1,62	1,56
5.	Number of neps Neps 50%	83	81	80	80
6.	Number of neps Neps+200%	14.5	13,6	13,0	11,2
7.	Number of neps Neps+280%	3.0	2,87	2,55	2,00

8.	Fatness, H	5.25	4,92	4,60	4,30
9.	omission by coefficient of variation, sh	1.36	1,29	1,20	1,10
10.	breaking load, gf	3.98	4,0	4,16	4,32
11.	breaking elongation,%	4.78	4,84	4,98	5,20
12.	Relative breaking strength, Rkm	16.19	16,20	16,70	17,0

Table 3. Investigation of unevenness indicators of yarns obtained from fibers with different emulsification composition and maturity level

№	Indicator name	Opened for 6 days	Emulsion composition options		
			1	2	3
1.	Unevenness of threads U, %	7.85	7,46	8,20	8,40
2.	Coefficient of variation CVm, %	9.90	8,72	9,14	10,20
3.	1 m coefficient of variation CVm, %	3.19	2,96	3,40	3,55
4.	10 m coefficient of variation CVm, %	1.72	1,54	1,80	1,88
5.	Number of neps Neps 50%	62.5	60,2	64,0	64,8
6.	Number of neps Neps+200%	12	10	14	18
7.	Number of neps Neps+280%	20	16	24	32
8.	Fatness, H	4.45	3,32	3,60	420
9.	omission by coefficient of variation, sh	1.10	0,90	0,98	1,06
10.	breaking load, gf	4.45	4,52	4,50	4,40
11.	breaking elongation,%	5.31	6,00	5,60	5,40
12.	Relative breaking strength, Rkm	18.08	20,4	18,6	18,8

Table 4. Investigation of unevenness indicators of yarns obtained from fibers with different emulsification composition and maturity level

№	Indicator name	Opened for 9 days	Emulsion composition options		
			1	2	3
1.	Unevenness of threads U, %	9.23	8,80	8,40	8,50
2.	Coefficient of variation CVm, %	11.65	10,80	10,40	10,60
3.	1 m coefficient of variation CVm, %	3.65	2,80	2,40	2,76
4.	10 m coefficient of variation CVm, %	1.86	1,70	1,50	1,68
5.	Number of neps Neps 50%	224	198	186	190
6.	Number of neps Neps+200%	51.5	58,0	50,0	52,0
7.	Number of neps Neps+280%	6.0	5,4	4,0	5,8
8.	Fatness, H	4.20	3,30	3,10	3,40
9.	omission by coefficient of variation, sh	1.02	0,94	0,86	0,96
10.	breaking load, gf	2.35	2,44	2,56	2,40
11.	breaking elongation,%	3.70	4,06	4,10	3,90
12.	Relative breaking strength, Rkm	15.92	15,88	16,20	16,0

Table 5. Investigation of unevenness indicators of yarns obtained from fibers with different emulsification composition and maturity level кўрсаткичларининг тадқиқоти

№	Indicator name	Opened for 12 days	Emulsion composition options		
			1	2	3
1.	Unevenness of threads U, %	9.90	8,80	9,0	8,50
2.	Coefficient of variation CVm, %	12.59	114	11,8	11,20
3.	1 m coefficient of variation CVm, %	4.40	3,90	4,10	3,80
4.	10 m coefficient of variation CVm, %	2.38	2,16	2,24	2,10
5.	Number of neps Neps 50%	415.5	394	406	386
6.	Number of neps Neps+200%	77	67	70	65
7.	Number of neps Neps+280%	16	12	15	10
8.	Fatness, H	6.42	6,0	6,10	5,25
9.	omission by coefficient of variation, sh	1.60	1,40	1,50	1,35
10.	breaking load, gf	3.65	3,40	3,44	3,88
11.	breaking elongation,%	4.34	4,38	4,46	4,56
12.	Relative breaking strength, Rkm	14.81	14,90	15,0	15,20

3. RESULTS

A study was conducted to analyze the flatness indices of yarns obtained from fibers with different emulsion compositions and degrees of ripening. They were compared with the indices of yarns obtained from fibers first opened after deflation. The unevenness of the yarns obtained from the fiber according to the emulsion composition option 1 decreased by 2.3%, the coefficient of variation by 5.7%, the coefficient of variation in 1 m by 6.7%, the coefficient of variation in 10 m by 10.7%, the density by 7.2%, the coefficient of variation in density by 1.9%, the tensile strength by 1.3%, the relative tensile strength by 1.1%. The unevenness of the yarns obtained from the fiber according to the 2nd option decreased by 5.4%, the coefficient of variation by 4.2%, the coefficient of variation in 1 m by 7.6%, the coefficient of variation in 10 m by 2.3%, the density by 4.1%, the coefficient of variation in density by 0.6%, the tensile strength by 2.0%, the relative tensile strength increased by 1.8%, the unevenness of the yarns obtained from the fiber according to option 3 increased by 13.5%, the coefficient of variation by 8.6%, the coefficient of variation at 1 m by 10.6%, the coefficient of variation at 10 m by 13.5%, the fiber content by 10.1%, the coefficient of variation in fiber content decreased by 4.3%, the tensile strength increased by 7.3%, and the relative tensile strength increased by 5.3%[4].

3 days after defoliation were compared to the performance of yarns obtained from exposed fiber. The unevenness of the yarns obtained from the fiber according to the emulsion composition option 1 decreased by 3.1%, the coefficient of variation by 2.3%, the coefficient of variation in 1 m by 13.5%, the coefficient of variation in 10 m by 15.4%, the density by 6.3%, the coefficient of variation in density by 5.1%, the tensile strength by 0.5%, the relative tensile strength by 0.7%[5]. The unevenness of the yarns obtained from the fiber according to the 2nd option decreased by 5.5%, the coefficient of variation in 1 m by 24.8%, the coefficient of variation in 10 m by 11.4%, the density by 12.4%, the coefficient of variation in density by 11.8%, the tensile strength by 4.3%, the relative tensile strength by 0.7%. The breaking strength increased by 3.1%, the unevenness of the yarns obtained from the fiber according to option 3 increased by 8.4%, the coefficient of variation by 9.1%, the coefficient of variation at 1 m by 34.2%, the coefficient of variation at 10 m by 10.8%, the fiber content by 18.1%, the coefficient of variation by fiber content decreased by 19.1%, the breaking strength increased by 7.9%, and the relative breaking strength increased by 4.8%[6].

6 days after defoliation were compared to the performance of yarns obtained from exposed fiber. The unevenness of the yarns obtained from the fiber according to the emulsion composition option 1 decreased by 4.9%, the coefficient of variation by 12.0%, the coefficient of variation by 1 m by 7.2%, the coefficient of variation by 10 m by 10.5%, the density by 25.4%, the coefficient of variation by density by 18.2%, the tensile strength by 1.5%, the relative tensile strength by 11.4%[7]. The unevenness of the

yarns obtained from the fiber according to the 2nd option decreased by 4.3%, the coefficient of variation by 7.7%, the coefficient of variation by 1 m by 6.2%, the coefficient of variation by 10 m by 4.4%, the density by 19.1%, the coefficient of variation by density by 10.9%, the tensile strength by 1.1%, the relative tensile strength by 1.1%, the relative tensile strength by 11.4%. The breaking strength increased by 2.8%, the unevenness of the yarns obtained from the fiber according to option 3 increased by 6.5%, the coefficient of variation by 2.9%, the coefficient of variation at 1 m by 10.1%, the coefficient of variation at 10 m by 8.5%, the density by 5.6%, the coefficient of variation by density decreased by 3.6%, the breaking strength increased by 1.1%, and the relative breaking strength increased by 3.8%[8].

9 days after defoliation were compared to the performance of yarns obtained from exposed fiber. The unevenness of the yarns obtained from the fiber according to the emulsion composition option 1 decreased by 4.7%, the coefficient of variation by 7.3%, the coefficient of variation in 1 m by 11.4%, the coefficient of variation in 10 m by 15.4%, the density by 21.4%, the coefficient of variation in density by 7.8%, the breaking strength by 3.7%, the relative breaking strength by 0.3%. The unevenness of the yarns obtained from the fiber according to the 2nd option decreased by 9.0%, the coefficient of variation in 1 m by 11.3%[9], the coefficient of variation in 10 m by 10.5%, the density by 26.2%, the coefficient of variation in density by 15.7%, the breaking strength by 8.2%, The relative tensile strength increased by 1.8%, the unevenness of the yarns obtained from the fiber according to option 3 increased by 7.9%, the coefficient of variation by 9.1%, the coefficient of variation at 1 m by 14.6%, the coefficient of variation at 10 m by 13.8%, the fiber content by 19.1%, the coefficient of variation by fiber content decreased by 5.9%, the tensile strength increased by 2.5%, and the relative tensile strength increased by 0.5%[10].

12 days after defoliation were compared to the performance of yarns obtained from exposed fiber. The unevenness of the yarns obtained from the fiber according to the emulsion composition option 1 decreased by 11.2%, the coefficient of variation by 9.5%, the coefficient of variation at 1 m by 11.4%, the coefficient of variation at 10 m by 12.6%, the density by 6.5%, the coefficient of variation in density by 12.5%, the tensile strength by 6.8%, the relative tensile strength by 0.7%. The unevenness of the yarns obtained from the fiber according to the 2nd option decreased by 9.1%, the coefficient of variation by 6.3%, the coefficient of variation at 1 m by 6.8%, the coefficient of variation at 10 m by 7.9%, the density by 4.9%[11], the coefficient of variation in density by 6.25%, the tensile strength by 5.8%, the relative tensile strength by 0.7%. strength increased by 1.3%, the unevenness of the yarns obtained from the fiber according to option 3 increased by 14.2%, the coefficient of variation by 11.1%, the coefficient of variation at 1 m by 13.6%, the coefficient of variation at 10 m by 14.2%, the fiber content by 18.2%, the coefficient of variation by fiber content decreased by 15.6%, the tensile strength increased by 5.9%, and the relative tensile strength increased by 2.5%[12].

4. CONCLUSION

The analysis of the research results shows that the indicators of the yarn obtained from the fiber in the first opened boll after defoliation were determined to be of good quality under the influence of emulsion according to option 3, the indicators of the yarn obtained from the fiber in the boll opened for 3 days according to option 3, the indicators of the yarn obtained from the fiber in the boll opened for 6 days according to option 1, the indicators of the yarn obtained from the fiber in the boll opened for 9 days according to option 2, and the indicators of the yarn obtained from the fiber in the boll opened for 12 days according to option 3.

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