ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 8 , August 2020

Study of the Shape of a Balloon of Natural Silk Thread When Winding From a Fixed Packing

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ABSTRACT: The article investigated the effect of warping speed of natural silk threads on the shape of the balloon. It was found that with an increase in the warping speed, the radius of the balloon increases, with a warping speed of 100 m / min, the radius of the balloon is minimal and the thread slides along the winding.

KEYWORDS*:* warping of threads, balloon of threads, balloon height, speed of warping, radius of the balloon, natural silk, bobbin.

I. INTRODUCTION

In the modern period, the most acute issue is increasing production efficiency, improving and developing resource-saving technologies for processing raw materials and producing products that are competitive in the domestic and foreign markets, meet the requirements of the standard and provide access to the international market.
Without improving technology and developing scientifically grounded methods and ways to improve technological equipment, it is impossible to ensure the rational use of raw materials, the quality of semi-finished products, as well as the quality and competitiveness of products and their entry into the international market.
The use of modern high-performance weaving machines that ensure high quality of the fabrics produced requires a significant improvement in the quality of preparation of warp and weft threads, which significantly affect the quality of the fabrics produced. The quality of the preparation of threads is largely determined by the quality of the packages and the conditions for the implementation of the technological process itself. The choice of these conditions and the optimization of processes affect the performance of equipment, the quality of products and semi-finished products, the yield of waste and the level of consumption of raw materials and materials.

II. RELATED WORKS

The effectiveness of the use of modern textile machines and looms is largely determined by the quality of the preparation of threads for weaving, which depends on the quality of raw materials, packing parameters [1, p. 106-113; 2, p. 212-215; 3, p. 257-261] and optimization of the technological process [4, p. 203-218; 5, p. 185-188], especially when processing natural silk threads [6, p. 101-105 ;, 7, p. 36-40; 8, p. 89-92; 9, p. 53-54].
Warping is one of the most important and crucial processes in the preparation of threads for weaving. The structure of the winding of the input package is one of the essential factors influencing the tension of the threads when winding in the warping process, their breakage and the quality of the warp.
As you know, at a high speed of winding a thread from a stationary package under the action of centrifugal force, it is thrown from the axis of the package and describes in space a surface called a balloon. In this case, the shape of the thread in the balloon is not a flat, but a spatial curve. The shape of the thread in the balloon and the shape of the balloon itself are determined by complex dynamic factors. In the process of unwinding the thread from the package, each element in the balloon performs a complex movement - along the axis of the thread and rotational around the axis of the package [10, p. 13-18; 11, p. 14-15]. The shape and dimensions of the balloon largely depend on the action of the centrifugal force and air resistance forces, and have a great influence on the tension of the wound thread.
In works [12, p. 80-82; 13, p. 44-49], studies of the ballooning of the thread in the warping process were carried out, Mahover VL and Brut-Brulyako AB obtained an exact solution to the approximate mathematical model of the ballooning of the thread, which makes it possible to calculate the shape of the balloon and the tension of the thread in the balloon [14, p. 42-47], Shcherbakov VP and Bolotny AP investigated the process of ballooning the thread on ring spinning machines [15, p. 116-121].

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International Journal of Advanced Research in Science, Engineering and Technology
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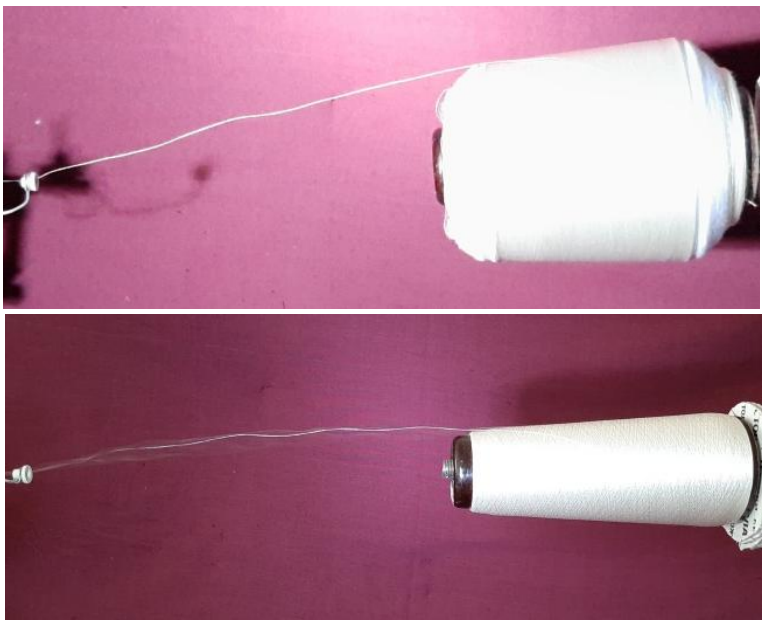
III. METHODOLOGY

In well-known works, studies of the ballooning of cotton thread in the warping process are given, which were carried out at high winding speeds, of the order of 400-800 m / min [12, p. 80-82; 13, p. 44-49]. A different picture of thread ballooning can be observed when warping silk thread, the linear density of which is several times less than cotton yarn and the process is carried out at low speeds.
Investigated the ballooning of a thread of boiled natural silk 3.23 tex x 3 during axial unwinding from a bobbin during warping using a digital camera, the height of the balloon (distance from the eye of the thread guide to the end of the package) is 250 mm. The digital photographs of the balloon were used to determine the angle of separation of the thread turn from the winding surface using an electronic geometric method.

IV. EXPERIMENTAL PART

Analysis of the photographs obtained shows that at a warping speed of 100 m / min, at which the existing process of warping silk threads is carried out, at the beginning of unwinding from a bobbin with a winding diameter of 120 mm, when the winding is fully, a single-wave shallow cone-shaped balloon is observed without separating the thread in the balloon from the surface winding (Fig. 1a). As it unwinds, the shape of the balloon changes, towards the end of the winding, with a winding diameter of 60 mm, a single-wave weakly convex cone-shaped balloon is observed also without detaching the thread in the balloon from the winding surface (Fig. 1b).

a)



b)

Fig. 1. Shapes of balloons of silk thread at winding speed 100 m / min

By studying the dependence of the angle of thread turn detachment from the winding surface at different winding speeds (Fig. 2), it was found that at a warping speed of 100 m / min, only at the end of the thread coming off the bobbin there is a small angle of separation of the thread turn from the winding surface, about 1 degrees, from the beginning of winding the thread from the bobbin with a winding diameter of 120 mm, to the end of winding, with a winding diameter of 60 mm, the process is carried out practically without tearing the thread in the cylinder from the winding surface (Fig. 2).

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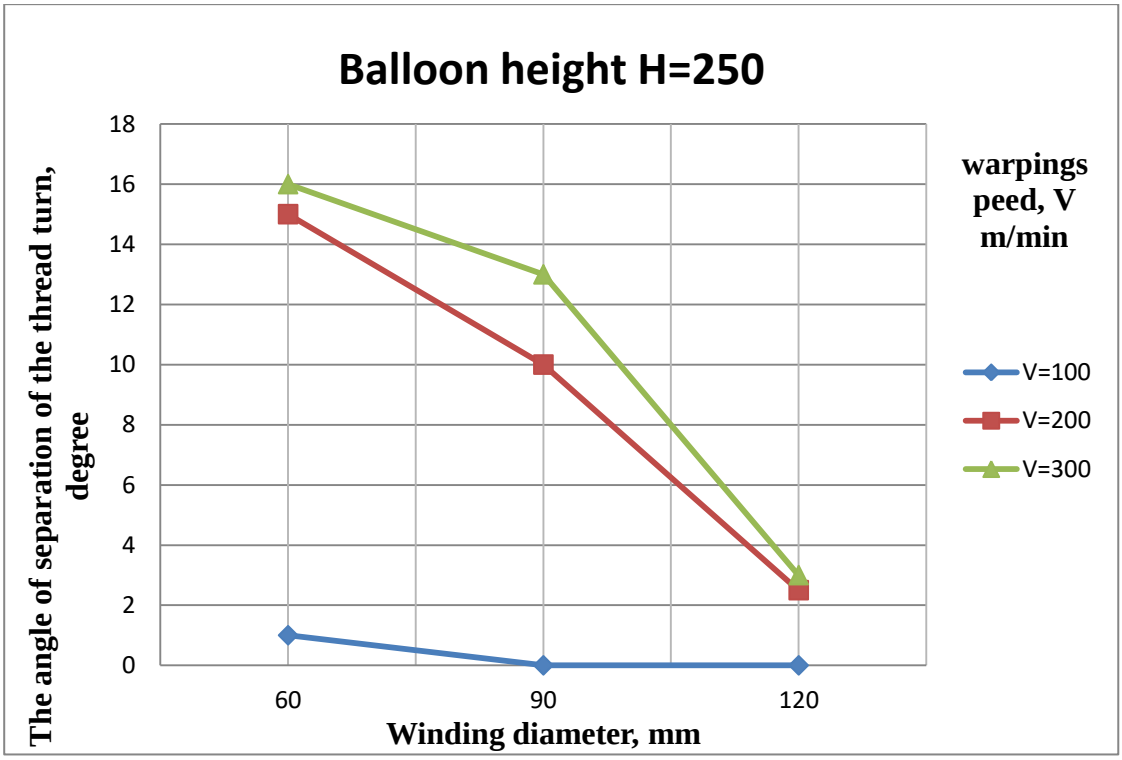

Fig. 2. Dependence of the angle of separation of the thread turn from the winding surface at different winding speeds

It should be noted that in this case, the conditions for winding the thread are unfavorable, from the beginning to the end of the winding, the thread in the balloon slides along the winding surface, the angle of the thread wrap around the winding surface increases. There is a lot of friction of the thread on the winding, while the thread will adhere to the knots, bumps and deposits on the winding surface, which in the dynamic conditions of winding the thread leads to an increase in its breakage.

a **b**

Fig. 3. Shapes of cylinders of silk thread at a winding speed of 200 m / min

At a warping speed of 200 m / min, at the beginning of unwinding from a bobbin with a winding diameter of 120 mm, a single-wave weakly convex cone-shaped balloon is observed with a thread detachment in the balloon from the winding surface (Fig. 3a). As it unwinds, the shape of the balloon also changes, towards the end of the winding, with a winding diameter of 60 mm, a single-wave, slightly convex cone-shaped balloon is observed, also with a separation of the thread in the balloon from the winding surface (Fig. 3b).

It should be noted that in this case, the winding conditions of the thread are improved. From the beginning to the end of the winding, the thread torn off from the winding in the cylinder does not slip on its surface, the angle of the thread wrap around the winding surface decreases, the friction of the thread on the winding decreases, while the thread will not adhere to knots, bumps and deposits on the winding surface, which leads to a decrease its abruptness.

At a warping speed of 300 m / min, at the beginning of unwinding from a bobbin with a winding diameter of 120 mm, a single-wave, slightly convex cone-shaped balloon is observed with a separation of the thread in the balloon from the winding surface (Fig. 4a). As it unwinds, the shape of the balloon also changes, towards the end of the winding, with a

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International Journal of Advanced Research in Science, Engineering and Technology
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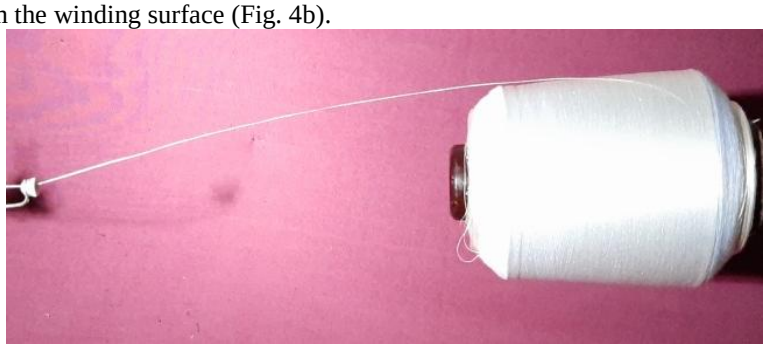
winding diameter of 60 mm, a single-wave convex cone-shaped balloon is observed, also with a separation of the thread in the balloon from the winding surface (Fig. 4b).

a) 

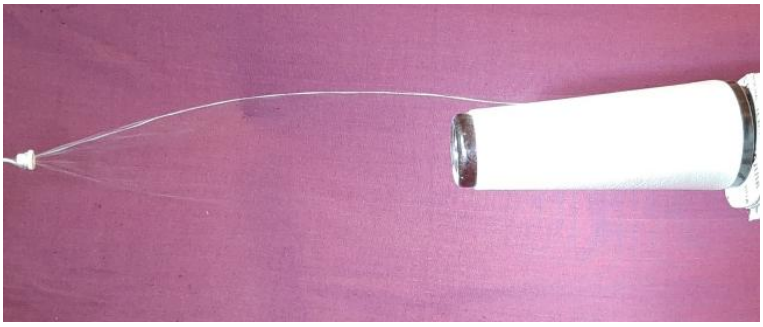
b) 

Fig. 3. Shapes of cylinders of silk thread at a winding speed of 300 m / min

Analysis of the dependence of the angle of thread turn-off on the winding surface at different winding speeds (Fig. 2) shows that at a warping speed of 200 - 300 m / min, from the beginning of winding the thread from the bobbin with a winding diameter of 120 mm, to the end ofwinding, with a windingdiameterThe 60 mmprocessiscarriedoutwiththeseparationofthethreadintheballoonfromthewindingsurface (Fig. 2), andasthethreadleavesthepackageandwithanincreaseinthewindingspeed, theangleofseparation of the thread from the winding surface increases.

In this case, the winding conditions are also improved. From the beginning to the end of the winding, the thread torn off from the winding in the cylinder does not slip on its surface, the angle of the thread wrap around the winding surface decreases, the friction of the thread on the winding decreases, while the thread will not adhere to knots, bumps and deposits on the winding surface, which leads to a decrease its abruptness.

The results obtained can be applied in silk industry enterprises.

V. CONCLUSION

1. Research has been carried out on the influence of the warping speed on the shape of the balloon of a natural silk thread during axial unwinding from the bobbin.
2. It was found that at a warping speed of 100 m / min, at which the existing process of warping silk threads is carried out, only at the end of the thread coming off the bobbin there is a small angle of separation of the thread turn from the winding surface, of the order of 1 degree, while from the beginning to at the end of winding, the process is carried out practically without detaching the thread in the cylinder from the winding surface.
3. It was found that at a warping speed of 100 m / min, the conditions for winding the thread from the bobbin are unfavorable, the thread in the balloon slides over the winding surface, the angle of the thread wrap around the winding surface increases, there is a lot of friction of the thread on the winding, while the thread adheres to knots, bumps and deposits on the winding surface, which in dynamic conditions of winding the thread leads to an increase in its breakage.
4. At a warping speed of 200 - 300 m / min, from the beginning to the end of the unwinding of the thread from the package, the process is carried out with the separation of the thread in the balloon from the winding surface, and as the thread comes off the package and with an increase in the winding speed, the angle of separation of the thread from the winding surface increases.

ISSN: 2350-0328

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5. Starting from a warp speed of 200 m / min and above, the conditions for unwinding the natural silk thread from the bobbin are improved.

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