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THE IMPACT OF ELONGATION EQUIPMENT ON THE QUALITY OF RING SPINNING YARN

G. Maxmudova
Assistant, Fergana Polytechnic Institute, Fergana, Uzbekistan

Tursunbayeva Durdona Baxtiyor qizi
Student, Fergana Polytechnic Institute, Fergana, Uzbekistan

Tursunova Farangiz Furqat qizi
Student, Fergana Polytechnic Institute, Fergana, Uzbekistan

Abstract

The purpose of the elongation process is to reduce the linear density of the product by decreasing the number of fibers in its cross-section through pushing the fibers relative to each other. The essence of stretching is to increase the speed of the fibers' movement and allow them to shift relative to each other, redistributing the fibers.

Keywords: Fiber, movement, spinning, elasticity, breakage, quality, density, flexibility, rubber.

Introduction

The Strategy for Further Development of the Republic of Uzbekistan between 2017-2021 set the objectives of "increasing the competitiveness of the national economy, reducing energy and resource consumption in the economy, and widely introducing energy-saving technologies in production" [1]. In achieving these tasks, it is crucial to develop and implement effective spinning technologies and tools that are based on rational control of the working cylinder rotation speed in cotton industry enterprises. One of the key technological processes in spinning enterprises is the elongation equipment, which is responsible for stretching the sliver.

It is known that during yarn spinning, raw materials are progressively thinned out and ultimately form yarn with the required linear density. Technologically, it is not recommended to stretch and thin the product all at once. Therefore, the spinning process is divided into several stages, with one of the most important and complex

being the stretching and thinning of the product. The purpose of the stretching process is to reduce the linear density of the product by decreasing the number of fibers in its cross-section through relative movement between fibers. The essence of stretching is to increase the movement speed of the fibers, ensuring they shift relative to each other and redistribute.

In the strtching equipment, each front pair rotates faster than the subsequent pair. The speed of the front pair is several times greater than the speed of the last pair, and the product elongates accordingly. As the product elongates, the fibers slide over each other, changing their positions, meaning they become rearranged. As the fibers slide, frictional forces are generated: this force straightens the fiber ends and aligns them parallel to each other. The ratio of the speed of the front cylinder pair to the speed of the rear cylinder pair in the stretching equipment is called the stretching ratio, and this ratio serves as the indicator of stretching.

$$E = \frac{\vartheta_2}{\vartheta_1}$$

Here:

ye – stretching ratio;

v_1 – speed of the rear pair in m/min;

v_2 – speed of the front pair in m/min.

In the stretching process, the weight of the product does not change; as its length increases, its linear density decreases by the same proportion. The ratio of the linear density before and after stretching indicates how many times the product has been elongated.

$$E = \frac{T_K}{T_ч} \cdot d,$$

Here:

- The linear density before stretching (at the entry point) of the product;
- The linear density after stretching (at the exit point) of the product;
- The number of added products
- The simplest stretching device consisting of two pairs of cylinders (1 and 2) and rollers placed on them is shown.

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The cylinders are driven by a gear transmission, and the rollers convert the force generated between the cylinders into motion. The front pair of cylinders (2) rotates faster than the rear pair (1), and this causes the product-yarn-to stretch. In order for the stretching pairs to engage well with the fibers and fully transfer their speed to them, the cylinders are made with a threaded (ribbed) surface, while the rollers are pressed against the cylinders by external loads or springs. The surfaces of the rollers are made of elastic polymer and rubber materials.

In the stretching process, if the fibers do not slide relative to each other, this type of stretching is called first-order stretching. If, during the stretching process, the fibers slide relative to each other over their entire length, this is called second-order stretching. Currently, only second-order stretching is used in yarn spinning factories for stretching and thinning the product (yarn, thread). The surface where fibers can slide relative to each other is called the stretching zone. The distance between the start and end of the fiber's movement is referred to as the boundary of the stretching zone.

In the stretching zone, the movement of the fibrous product can be divided into two categories: uncontrolled (free) fibers and controlled fibers.

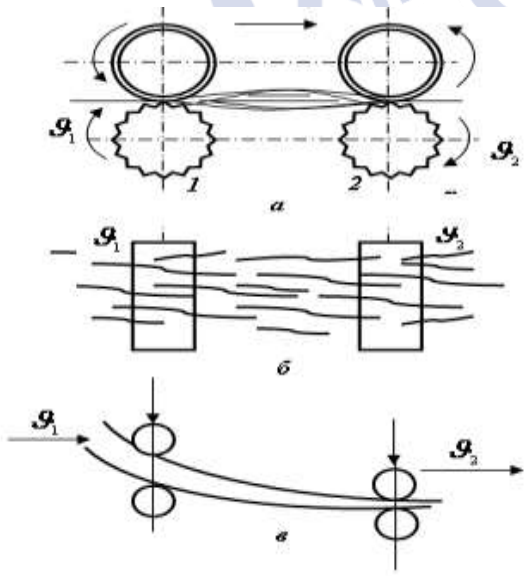

Figure 1. Description of the stretching pairs and the movement of the fibers

The fibrous material (yarn or thread) passing between the stretching pairs in the stretching device is compressed between the cylinder and the roller, creating

frictional forces on their surfaces. The area where frictional forces act between the fibers and between the fibers and the details of the stretching device is called the frictional contact surface.

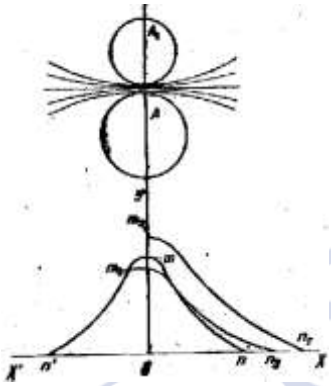

Figure 2. Frictional Force Surface

For the stretching process to proceed normally, the pressure exerted by the outgoing pair should be greater than the pressure exerted by the incoming pair. This ensures that as the front ends of the fibers in the rear pair's nip fall into the nip of the outgoing pair, the fibers begin to move from the speed of the rear pair to the speed of the front pair.

Rollers: In order for the stretching process to proceed normally and for uniform products to be obtained, the rollers placed on the cylinders must be of high quality and should press the fibers onto the cylinder with normal pressure. Rollers are divided into types based on their elasticity, magnetic properties, and the pressure exerted by their own weight.

The main task of the belts is to regulate the moving fibers in the stretching device and to improve the uniformity of the yarn.

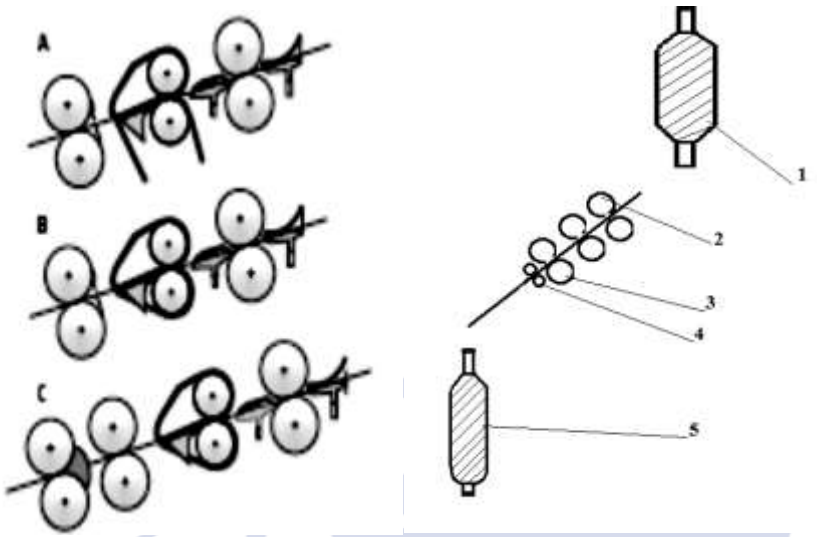

Figure 3. Stretching Equipment for Ring Spinning Machines

1 - Yarn, 2 - Rubber coating, 3 - Guide cylinder, 4 - Additional rubber coating, 5 - Spun yarn

Additional rollers are added to the stretching equipment, and special rubber coatings, such as nephron diamond-shaped mesh, are applied to them. These rollers are installed after the variable and fixed rollers (the diameter of the fixed rollers is 0.25 m, and the diameter of the variable rollers is 0.28 m). The stretching zones consist of two stretching zones. The fibers pass through the rollers and the mesh coating, which ensures proper compression of the mesh. Due to the clarity of the gaps in the mesh, small impurities from the yarn are left in the gaps and absorbed by the air. This process helps to improve the stretching process and increases the parallelism of the fibers. It reduces the amount of waste in the yarn by several times compared to previous technological processes, thereby improving the quality indicators of the product (such as strength, smoothness, evenness, breaking length, and neps count). This leads to an improvement in the fiber's quality indicators as well.

Furthermore, this process helps save a certain amount of raw materials, electrical energy, and labor costs, while also increasing efficiency.

Conclusion

Currently, in ring spinning machines, using the elongation equipment improves yarn quality by reducing the number of neps, increasing smoothness, and reducing breakage during stretching. Therefore, enhancing ring spinning machines and implementing high-quality yarn production processes will allow for broader use

of these machines in various sectors. This equipment is already being utilized in the technological production process of Toshkent Textile Group.

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