

The Multi-layer Distributed Pressure Washing Process and Permeability of Viscose Fiber Roll

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Abstract: Viscose fiber is widely used in the production of medium and high-grade fabrics. Pressure washing of fiber roll is an important post-treatment process for viscose filament production, and multi-layer distributed pressure washing is the key equipment for washing fiber roll. In order to reduce the energy consumption of viscose fiber production and preparation, improve the economic benefits of enterprises, and respond to the goal of national green chemical industry, this paper introduces the pressure washing process and the permeability of fiber roll, which provides support for the uniform washing of fiber roll.

Keywords: Viscose fiber, Fiber roll, Multi-layer distribution, Pressure washing process.

1. Introduction

Viscose fiber needs to go through many processes from preparation to molding. In the process after molding, if the pressure washing effect of fiber roll is not ideal, it will bring great economic losses to fiber preparation enterprises[1]. In the pressure washing process, the permeability of different layers of fiber roll is different because of the different gaps of fiber strips. At the same time, with the increase of the number of layers of pressure washing, the pressure of washing liquid in the inner cavity of fiber roll will gradually decrease, which makes the permeability of different layers of fiber roll different. The uniformity of flow distribution and washing completion time in distributed pressure washing process are related to product quality and production efficiency, which has attracted much attention. At present, due to the lack of theoretical support, the determination of fiber roll layout and washing time is mainly based on experience, which restricts the high-quality and intelligent development of pressure washing process and even rayon fiber industry. Therefore, it is very necessary to study the pressure washing process of viscose fiber.

2. Research Status

Because the production and preparation of viscose fiber can not meet the standards of developed countries, and the local workers have high labor costs and lack of advantages in cost, they gradually quit the production field of viscose fiber, and the demand for viscose fiber abroad mainly depends on imports[2-3]. Therefore, foreign scholars have little research on the pressure washing process of fiber roll.

At present, the research on pressure washing of viscose filament roll in China mainly focuses on how to improve the physical properties of viscose filament. Hao Meimei[4] found that the pH value, concentration and temperature of bleaching solution in sodium hypochlorite bleaching process of viscose filament will affect the physical properties and dyeing properties of viscose filament, and put forward that in order to ensure the strength and elongation of viscose filament during pressure washing, sodium hypochlorite bleaching can be reduced or cancelled. Tong Jian[5] and others analyzed the influence of different sulfuric acid concentration and pressure

washing time on product performance, and by adding sulfuric acid washing process, the indexes of finished fiber reached the national standard, and the dyeing uniformity and fiber quality were improved.

3. Pressure Washing Process

The process of pressure washing fiber roll consists of water washing, zinc removal, desulfurization, impurity removal and bleaching[6]. The fiber rolls are stacked on the press car wash tray in turn from bottom to top, and the washing medium is injected into the inner cavity of the fiber roll from the lower end of the press equipment wash through the tray hole at a certain pressure, and the top of the press equipment wash is closed, so that the washing medium seeps out from the inner cavity of the fiber roll to the outside in the form of pressure penetration, and the top pressure is kept constant during the press washing process, thus achieving the purpose of washing the fiber roll.

The fiber roll press washing equipment is mainly composed of press washing car, propeller, track running system, turntable, traverse car and hydraulic station. The technological process is as follows: the fiber roll wrapped with special paper are placed on the fixed positions of the trays of each layer of the press washing machine to form a fiber roll column, the press washing machine loaded with fiber roll is pushed into the preparation station of the press washing line, and then the press washing machine is sent to the first station of the press washing machine by a propeller. At the same time, the station brake positions all the press washing machines of the press washing line, and the liquid inlet port at the bottom of the press washing machine is connected with the treatment liquid pipeline through a quick connector, and the centrifugal pump pumps the treatment liquid to the inner layer of the press washing machine, and the treatment liquid carries out the press washing on the fiber roll with the pressure difference formed between the inner layer and the outer layer of the fiber roll.

4. Permeability of Fiber Roll

In the process of pressure washing, the fiber roll will be subjected to the resistance of the fiber roll, resulting in a head difference, which will produce a driving head to promote the

fluid to flow through the pores of the fiber roll. The penetration of the fluid will produce a drag force on the fiber ribbon and destroy the stability of the fiber ribbon structure in the fiber roll. This force acting on the fiber roll is called penetration force[7]. Permeability is related to the stability of the structure of fiber roll, which is one of the important factors affecting the normal pressure washing of fiber roll.

The ability of fluid to pass through the gap of a fiber roll, that is, the scale to measure the compactness of the fiber roll, is called the permeability of the fiber roll[8]. Permeability is an inherent property of fiber roll, which represents the transmission ability of fluid in porous media roll, that is, the difficulty of fluid passing through porous media when it flows in porous media[9].

The washing medium in the fiber roll flows slowly, and the flow state is approximately laminar, and its flow law can be described by Darcy's law. Under the pressure, the washing medium slowly flows from the inside to the outside of the fiber roll, and there is a certain proportional relationship between the flow rate and the pressure drop per unit length[10], that is,

$$Q = \frac{KA\Delta P}{L}$$

Q—flow rate, m³/s; ΔP—the pressure difference before and after the fluid flows through the fiber roll, Pa; A—cross-sectional area of porous media, m²; K—permeability coefficient; L—the length of seepage path, m.

The permeability coefficient K is an index reflecting the comprehensive permeability of fiber roll, and its size mainly depends on the diameter, cross-sectional shape, winding mode and the density of fiber roll, and it is also related to the physical parameters of washing medium and the injection speed or pressure.

5. Conclusion

Pressure washing fiber roll is an important process in chemical fiber production in chemical fiber factory. The main purpose of pressure washing is to eliminate the residual fatliquoring degree, reduce the sulfur content, remove the content of metal salts and impurities, improve the structure of filaments, improve the appearance, color and feel of filaments,

and improve the physical and chemical properties of filaments, so as to prepare for subsequent weaving. The pressure washing process is not only related to the physical properties and quality of finished fiber, but also related to the economic benefits of enterprises. Therefore, it is necessary to further study the pressure washing process of multi-layer distributed fiber roll.

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