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EFFECT OF STEAM TEMPERATURE ON YARN MOISTURE REGULATION IN TEXTILE INDUSTRY

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Abstract: This paper examines steam temperature and its effect on moisture management properties in textile yarns. How steam temperature affects moisture uptake and release processes is examined, and effective management techniques to improve fabric quality are analyzed. Research is important for the introduction of new technologies in textile production.

Keywords: steam temperature, moisture management, textile yarn, moisture release, textile technology.

Introduction and literature review. The effect of steam temperature on moisture management in textile yarns plays an important role in fabric preparation and use. Controlling moisture levels in textile production is necessary to ensure durability, comfort and aesthetic properties of fabrics. Controlling the amount of moisture in the structure of the textile thread with the help of steam allows to optimize the processes of its release or even distribution. This article analyzes the effect of steam temperature on yarn moisture management based on scientific research.

The effects of steam and temperature control fibers on drying speed were studied, and it was concluded that steam temperature allows effective control of moisture in drying fabrics [1]. In a study on the relationship between the structure of textile yarns and steam temperature, it was noted that higher steam temperatures promote faster moisture loss [2]. The effect of steam treatment on the moisture absorption properties of yarn was analyzed. The results showed that steam treatment improves the internal structure of the yarn [3]. The study investigated the effect of steam temperature on the moisture retention and release capacity of textile yarn fibers. An increase in temperature has provided significant changes in humidity management [4]. The research results showed that by changing the steam temperature, it is possible to control the cycle of moisture absorption and release of yarn [5]. Environmental aspects of moisture management in textile fabrics are considered. The effect of steam temperature on the properties of fabrics was analyzed [6]. Steam temperature and its effect on fabric structure are studied. A study found that higher temperatures promote faster vapor absorption [7]. The effect of steam treatment on the physical properties of yarn, including the rate of moisture release, was analyzed [8]. The use of vapor and moisture controlling fibers in textile yarn was studied. The results showed that it is possible to improve the quality of yarns through steam temperature [9]. A study was conducted on the effect of steam temperature on the mechanical and moisture management properties of textile materials [10].

The main part. A SULZER RUTI G 6100 machine was taken as a thread wetting device. The ground and feathered threads are 1.9 meters wide in the working chamber of the machine. And 5,000 to 6,000 threads are woven by machine. The parameters of the machine are listed below:Working width: 190 cm; Number of colors: 4; Number of beams: 1.5; Dobi type: electronic; Jacquard: Staubli JC4 2688 hook; Gantry: available; Speed: 330 revolutions/minute

Before stretching, a horizontal groove passed through the lower part of the threads. This pipe diameter is equal to d. The radii of these holes are x1, x2,....,xn. Cold steam is sent from this pipe, and the steam is required to exit these holes in a uniform flow at a speed of 1.2 m/s each. The problem is that the velocity of the steam exiting the holes is the same regardless of the size of the radii of each hole and the velocity of the steam in the pipe as well as the pressure value. The mathematical model of this situation is as follows.

1. Basic conditions in the pipe

The diameter of the pipe d, its cross-sectional area:

$$A_{truba} = \frac{\pi d^2}{4} \quad (1)$$

The velocity of the steam inside the tube is vtruba and its pressure is Ptruba.

2. Conditions of the steam coming out of the holes

The radii of the holes are x1,x2,…,xn.

Cross-sectional area of each hole:

$$A_i = \pi x_i^2, (\mathrm{i} = 1,2, \ldots, \mathrm{n}) \quad (2)$$

The velocity of steam leaving each hole is:

$$v_i = v_{teshik} = 1{,}2\ m/s \quad (3)$$

3. Law of conservation of mass

The mass of steam entering the pipe and the total mass of steam leaving each hole must be the same:$\dot{m}_{truba}$

$$\dot{m}_{truba} = \rho A_{truba} V_{truba} \quad (4)$$

$$\dot{m}_{teshiklar} = \rho \sum_{i=1}^{n} A_i V_i \quad (5)$$

Here:

r: vapor density.

$\dot{m}_{truba}$= condition is fulfilled.$\dot{m}_{teshiklar}$ =

4. Law of conservation of energy (Bernoulli's equation)

At points near each hole in the pipe, the pressure and velocity relationship is as follows:

$$P_{truba} + \frac{\rho v_{truba}^2}{2} = P_i + \frac{\rho v_i^2}{2} \quad (6)$$

Here:

P_{truba}: initial pressure in the pipe.

P_i: vapor pressure in pores.

Since the steam escapes at the same rate in the holes, all pressures are required to be the same.P_i

5. Completing the model

Combining the above terms and equations:

1. Steam velocity in the pipe:

$$v_{truba} = \frac{\sum_{i=1}^{n} A_i V_i}{A_{truba}} \tag{7}$$

1. The radius of each hole is xi

$$x_i = \sqrt{\frac{A_{truba} V_{truba}}{\pi n v_i}} \tag{8}$$

2. Pressure equation:

$$P_{truba} = P_i + \frac{\rho}{2}(v_i^2 - v_{truba}^2) \tag{9}$$

is equal to:

Using the above models, based on the change in the number of holes in the pipe, if it is known that the diameter of the pipe is 15 mm and it is known that the flow of steam from each hole is 1.2 m/s, the number of holes and their spacing are graphically analyzed can be done Figure 1.

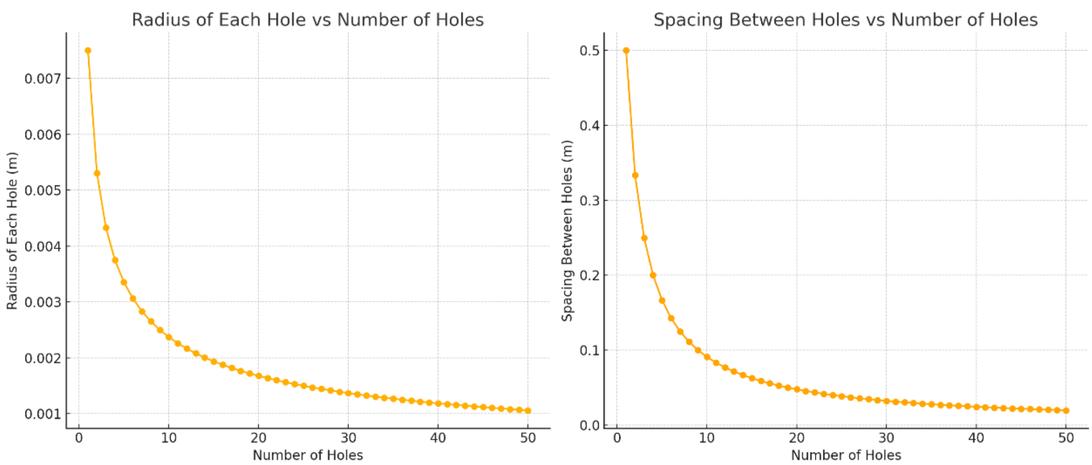

Figure 1.

The graphs show the following information:

1. **Dependence of the Radius on the Number of Holes:**

As the number of holes increases, the radius of each hole decreases. In order to maintain the total cross-sectional area of the pipe, if there are many holes, they should be smaller.

2. **The distance between the holes depends on the number of holes:**

As the number of holes increases, the distance between each hole decreases. This is necessary to ensure that the holes are located at equal distances along the length of the pipe (1 m).

Thus, as the number of holes in the pipe increases, the radius of the holes and the distance between them are significantly reduced.

Changing the pressure in the pipe to keep the pressure in the holes the same is shown in Figure 2.

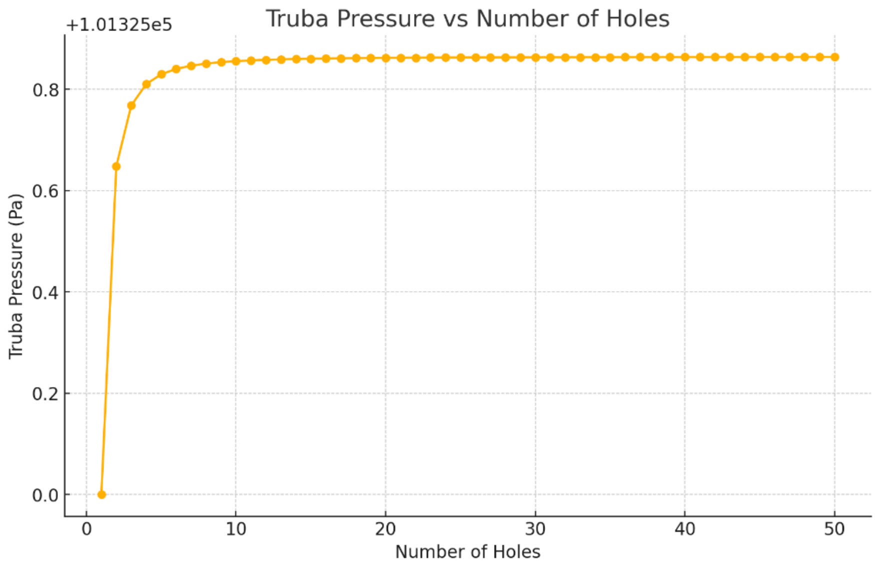

Figure 2.

The graph above shows the pressure values in the pipe depending on the number of holes.

As the graph shows, when the number of holes increases, the inlet pressure in the tube must also increase, because the pressure required to keep the steam leaving the tube at the same rate increases.

When the number of holes in the pipe and their radii are different, it can be seen in Fig. 3 that the velocity at the entrance to the pipe changes in order to leave the steam flow from the holes at the same speed.

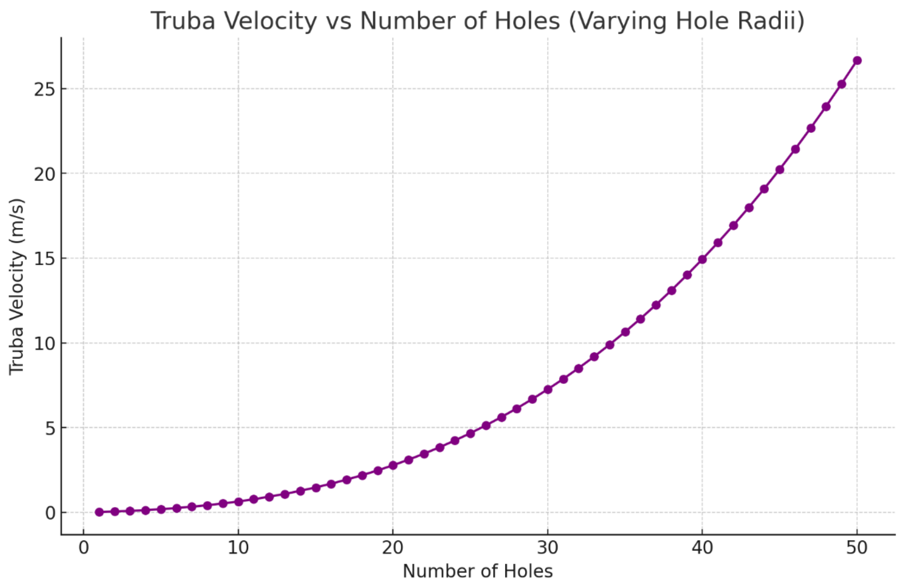

Figure 3.

The graph above shows how the velocity of the steam entering the pipe changes as the number of holes and the radii of the holes change.

As can be seen from the graph:

• **When the number and radii of holes increase**, the total hole area also increases, so an increase in the velocity at the entrance to the pipe is required, so that steam leaves the holes at the same speed.

In this calculation, the radii of the holes were taken at different values and the velocity in the tube was calculated with different radius and number, according to the law of conservation of mass.

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CONTENTS

PRIMARY PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY