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Fiber steam humidification at different temperatures before pressing

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ABSTRACT: The article suggests moistening cotton fiber by steam below 26.5 degrees Celsius in accordance with test results, conducted on moistening cotton fiber under various temperatures before pressing on the new laboratory test set, created on the basis schemes of the new device for heating and moistening.

KEYWORDS: fiber, moisture absorption, temperature, steam, humidity, regulated technology, condenser, tray, roller conveyor, press.

I.INTRODUCTION

At processing of raw cotton on cotton factories on the regulated technology (PDI 70-2017) according to point 2.1.14. in cases of economic feasibility and if the quality indicators of hygroscopicity at the level of requirements, it is allowed to humidify cotton of I,II grades up to 8-9%, and III, IV, V grades up to 9-10%. Thus humidity of a fibre after jining should make about 6 % [1]. When pressing fiber into bales is optimal is the humidity in the range of 7-8,5% [2], at which the process of pressing is stable, the spacing force of the fiber does not exceed the established norms, provided the requirements of energy saving and consumption of strapping materials.

Due to the low efficiency of fiber humidifiers currently used in cotton mills in the technological flow per tray between the fiber condenser and the press, fiber steam moistening does not exceed 0.6% [2].

In order to increase the efficiency of fiber hydrating up to 1.5-2.0 % in the flow of cotton plant together with the employees of the design and industrial design department of JSC "Pakhtasanoat research center " the working drawings of the fiber humidifier were developed, the laboratory sample of which was made in the "RIM Ustaxonasi" and in the laboratory conditions of JSC "Pakhtasanoat research center " the researches on the ability to study the moisture absorption by fiber at different temperatures were conducted (Fig.1).).

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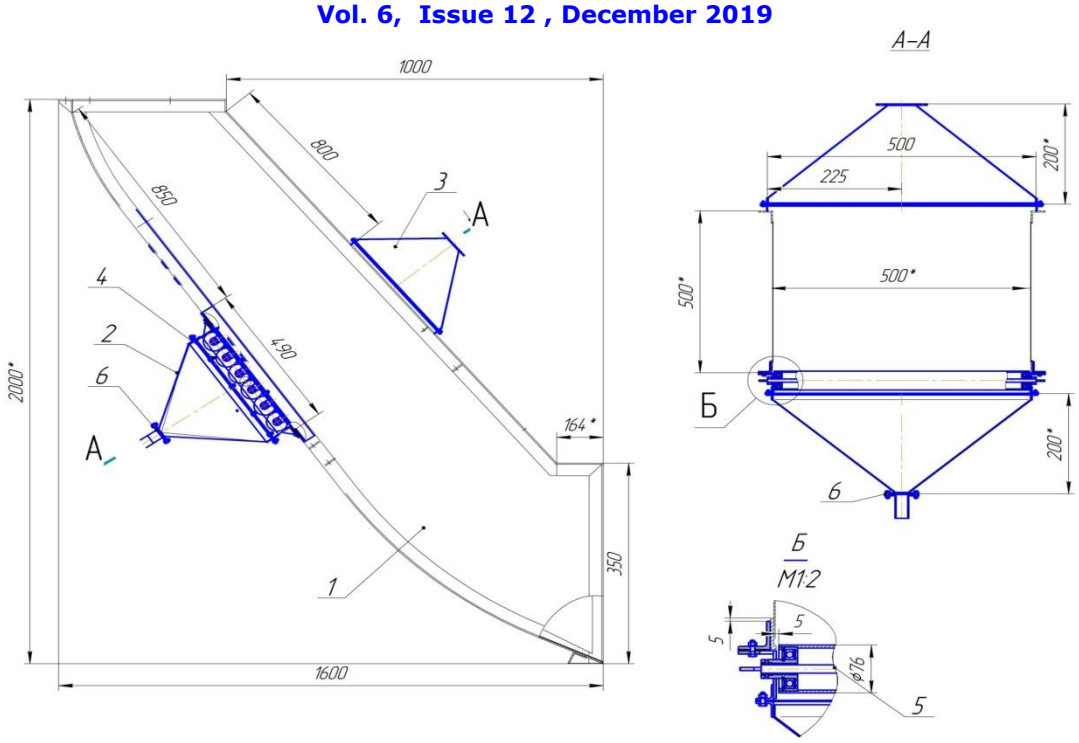

Fig. 1 The working drawing of the device of heating and humidifying of a fibre.
1-press tray; 2 - branch pipe; 3- top part of the branch pipe; 4-rollers; 5 - electric heater; 6 - steam line.

Tests of the laboratory sample (Fig.2) have shown that the steam is distributed unevenly between the rollers and due to the prevailing upward movement of pairs leaves mainly around the upper roller.

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Fig. 2 Photos of the fiber heating and humidifying device made according to the working drawings.

To eliminate this shortcoming, a new device (Fig. 3) was made.

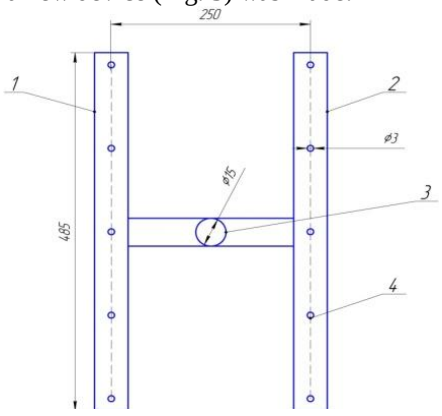

Fig. 3 working drawing of a new steam outlet device.

First row of pipes; second row of pipes; third row of pipes; third row of pipes connecting the first and the second row of pipes; four holes for steam outlet.

Two rows of 15 mm diameter pipes are installed on this device for even steam supply between the rollers and 5 3 mm holes are arranged on each row so that the outlet steam is directed between the two rollers. The fixture is built into the fiber heater and humidifier so that its position can be changed as shown in Figure 4.

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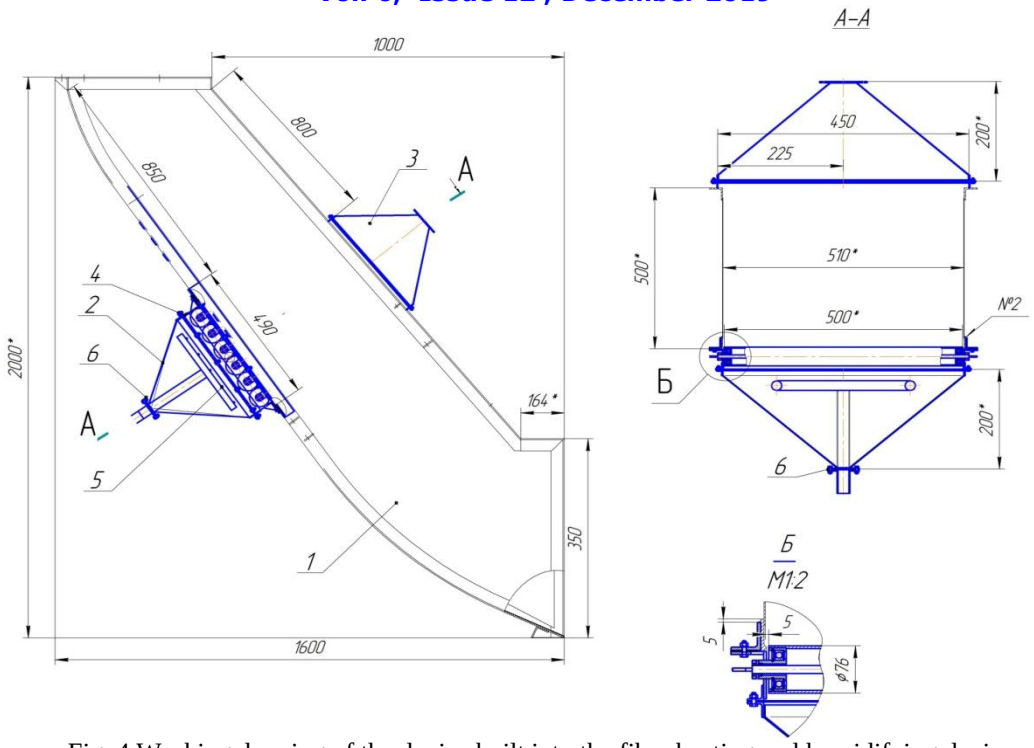

Fig. 4 Working drawing of the device built into the fiber heating and humidifying device.
1-chamber tray; 2-pipe; 3-pipe upper part of the pipe; 4-rollers; 5-piece for even steam supply; 6-pipe for steam supply.

The tests were carried out on the selection fiber of Sultan I grade "Oliy", produced at the experimental cotton plant of JSC "Pakhtasanoat research center". Initial moisture content of the fiber after the processes of jeaning and fiber cleaning, taken from the condenser tray was 5.6%, then the fiber was humidified by steam at different ambient temperatures [3].

The results of the experiment are given in Table 1.

Table 1

Fibertemperature, ^{0}C	Fiberhumidityaftersteaming, %				
	Repetition				Average significance
	I	II	III	IV	
18	7,18	7,24	7,24	7,30	7,24
23	7,15	7,20	7,23	7,18	7,19
28	7,02	7,03	7,03	7,03	7,03
30	6,70	6,80	6,75	6,71	6,74
31,5	6,49	6,49	6,44	6,46	6,46

By results of experiment dependence of humidity of a cotton fibre on its temperature which is presented on figure 5 is constructed.

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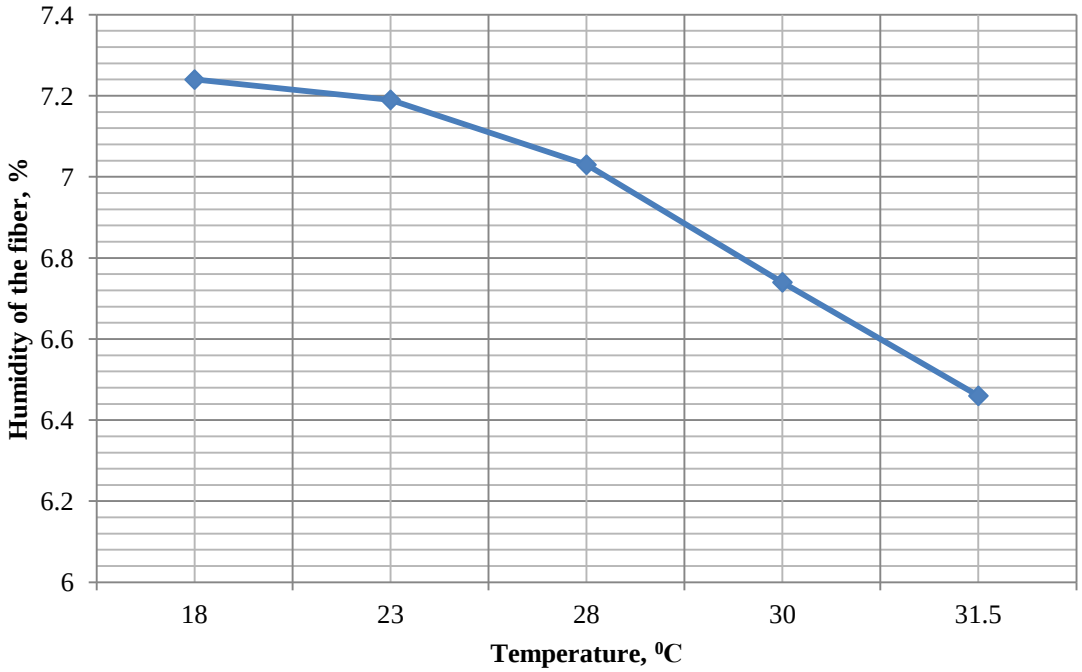

Fig. 5 Influence of fiber temperature on its humidity

As a result of processing of results of experiment by a method of the regression analysis the mathematical model of dependence of humidity of a cotton fibre from its temperature which is described by the following equation is received:

$$y = -0{,}000506x^3 + 0{,}031x^2 - 0{,}631x + 11{,}46 \qquad (1)$$

where: y - fiber humidity, %

x - Fiber temperature, °C.

The analysis of the given dependence shows that at its initial humidity of 5,6 % as a result of its humidifying by steam, with reduction of temperature from 31,5 ^{o}C to 18 ^{o}C its humidity increases from 6,46 % to 7,24 %. This process also remains active when the fiber temperature drops from 31.5 ^{0}C to 25 ^{0}C, raising its humidity from 6.46% to 7.16%, and when the fiber temperature drops to 18 ^{0}C, the increase in fiber humidity relative to its temperature state at 25 ^{0}C is only 0.06%.

As a result of the experiment and the analysis of the obtained mathematical model, the temperature range from 18 ^{o}C to 26.5 ^{o}C, at which the fiber actively absorbs and retains moisture, is optimal to achieve fiber moisture content of 1.5 percent and more.

CONCLUSION

To achieve fiber hydration of 1.5 percent or more, it is recommended to steam the fibers at fiber body temperature below 26.5 ^{o}C.

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