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## NamMTI ILMIY-TEXNIKA JURNALI TAHRIR HAY'ATI A'ZOLARI

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# DETERMINATION OF FUEL CONSUMPTION FOR DRYING COTTON RAW MATERIALS

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**Abstract:** In cotton gins, drying cotton before cleaning it is of great importance. Since cotton drying is associated with thermal energy, determining the fuel used to dry cotton raw materials is the basis of economic efficiency.

**Keywords:** cotton raw materials, drying, drying of cotton materials, convective method, drying chamber, heat, heat consumption.

**Introduction.** Drying at the very beginning of the continuous process of processing cotton raw materials is aimed at reducing the moisture content of cotton raw materials to the values recommended by the technological regulation, achieving this will ensure reliable and efficient operation of subsequent cleaning equipment. Therefore, drying of cotton raw materials is one of the main and necessary operations of the technological process. There are many known ways to dry cotton material. For the drying of raw cotton, mainly convective method is currently used, wherein the raw cotton is heated by atmospheric air or its mixture with combustion products in a heat generator of natural gas or other fuel. The convective method is used for both local and foreign drying of cotton raw materials[1].

**II. Methodology & empirical analysis. Heat entering the drying chamber is spent on the following:**

- to evaporate moisture in cotton;
- to combine with a drying agent;
- cotton coming out of drums;
- transport of dried cotton;
- Part, to the narrator who surrounds him.

The amount of heat spent on evaporating moisture is determined, *J/ hour*:

$$Q_1 = W_{steam} (i''_n - C_v \cdot T_1) \quad (1)$$

here:

$W_{steam}$  - the amount of evaporated moisture, (kg/hr);

$i''_n - t_2$  And  $\varphi_2$  - of the outgoing steam in the hall

heat saving, which  $i''_n = 2491 \cdot 10^3 + 1968 \cdot t_2$ , is equal to (J/kg);

$C_v$  - is the thermal capacity of water in the material, = 4187 J/kg· grad. is equal to  $C_v$

$T_1$  - Initial material temperature, °C

1 kg The specific heat spent on evaporation of moisture is equal to ,[J/kg]:

$$q_1 = \frac{Q_1}{W_{steam}} = (i''_n - C_v \cdot T_1) \quad (2)$$

The heat spent on joining with the drying agent is determined, [J/kg ];

$$Q_2 = L_{out}(944,83 + 1,97 \cdot d_2) \cdot (t_2 - t_0) \quad (3)$$

here:  $L_{out}$  - outgoing air consumption, kg/h;

$(944,83 + 1,97 \cdot d_2)$  - the quoted heat capacity of the outside air [J/kg · grad].

Specific heat consumption, [j/kg]:

$$q_2 = \frac{Q_2}{W_{steam}} = L_{out}(944,83 + 1,97 \cdot d_2) \cdot (t_2 - t_0) \quad (4)$$

Heat consumption on the cotton entering the drums is determined. [J/kg];

$$Q_3 = G_2 \cdot c_2 \cdot (T_2 - T_1) \quad (5)$$

here:  $c_2$  - heat capacity of outgoing cotton, [J/kg · grad ];

$T_2 - T_1$  - temperature of cotton raw materials entering and leaving the drying drum,

°C

Specific heat consumption, [j/kg]:

$$q_3 = \frac{Q_3}{W_{steam}} = \frac{G_2 \cdot c_2 \cdot (T_2 - T_1)}{W_{steam}} \quad (6)$$

Heat spent on transporting dried cotton [J/hour];

$$Q_4 = G_{tr} \cdot c_{tr} \cdot (t_{tr}'' - t_{tr}') \quad (7)$$

here:  $G_{tr}$  - Transport weight when the dryer runs for 1 hour, [J/kg grad];

$t_{tr}'$  and  $t_{tr}''$  - the temperature before and after drying in transport, °C

Specific heat consumption, [j / kg];

$$q_4 = \frac{Q_4}{W_{steam}} = \frac{G_{tr} \cdot c_{tr} \cdot (t_{tr}'' - t_{tr}')}{W_{steam}} \quad (8)$$

Heat expenditure on drum surround, [J/hr ]

(9)

here:  $F$ - Special surface of the barrier areas of the dryer, m<sup>2</sup>

$t_{out}$ - the air temperature in the dryer, °C

$T_{out}$  - the ambient temperature in the workshop, °C

$K$ - coefficient of heat transfer through separate surfaces (J/m<sup>2</sup> ·soat grad);

Specific heat consumption, [J/kg];

$$q_5 = \frac{Q_5}{W_{steam}} = \frac{\sum [K \cdot F \cdot (t_{inter} - t_{out})]}{W_{steam}} \quad (10)$$

In the process of operation, heat can escape in a variety of ways (air leakage through passages, vents, etc.), which are not taken into account due to the fact that it is very difficult to detect[2].

If such a heat consumption  $Q_6$  If it is taken into account, then the total heat consumption of the dryer will be equal to:

$$\sum Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 + Q_6$$

The specific cost of heat loss is summed up:

$$\sum q = q_1 + q_2 + q_3 + q_4 + q_5 + q_6$$

Only Q1 heat is consumed per drying process. The useful operating coefficient of the drying equipment is the amount of heat spent on evaporation of 1 kg of cotton in the percentage of the total consumed heat consumption, and it is determined as follows:

$$\eta = \frac{q_1}{\sum q} \cdot 100\%$$

The distribution of heat consumption on the drying drum 2SB-10 when the temperature of the hot air transmitted to the drying drum is 300 °C and the temperature of the hot air flowing out of the drum is 100 (Fig. 1).°C

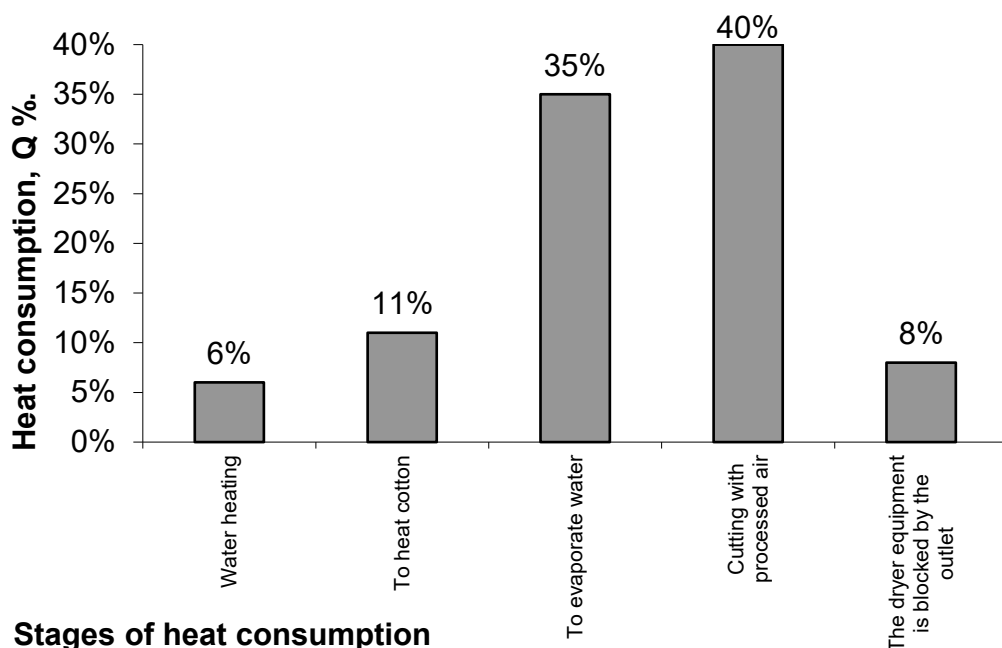


Figure 1. Diagram of the distribution of heat consumption in a drying drum of 2SB-10

As can be seen from this diagram, the expenditure of heat on useful work is 41%, i.e. on heating and evaporation of water (6+35%); most of the remainder is spent on useless work, going out along with the treated air (*M: Analytical account of the drying drum*)

**III. Results.** For the analytical calculation of the drying drum 2SB-10 on the basis of the following conditions, the following initial data should be provided: working yield on wet cotton raw materials 10 t/h; initial moisture of cotton raw materials  $W_1=16\%$ , moisture after drying  $W_2=10\%$ ; outside air indicators: outside air temperature  $t_0=10\text{ °C}$ ; air storage  $d_0=5\text{ g/kg dry air}$ . Air temperature supplied to the drying drum  $t_1=200\text{ °C}$ , air temperature leaving the drying drum  $t_2=100\text{ °C}$ , storage of air going out of the drum  $d_2=27\text{ g/kg dry air}$ : The temperature of cotton raw material entering the drying drum is  $T_1=20\text{ °C}$ , and the temperature of the cotton raw material going out of it is  $T_2=60\text{ °C}$ .

The amount of moisture when steaming in 1 hour from a drying drum:

$$W_{nam} = G_1 \cdot \frac{W_1 - W_2}{100 + W_1} = 10000 \cdot \frac{16 - 10}{100 + 16} = 517,24 \text{ kg/hr}$$

The amount of cotton that dries out of the drying drum:

$$G_2 = G_1 \cdot \frac{100 + W_2}{100 + W_1} = 10000 \cdot \frac{100 + 10}{100 + 16} = 9482,759 \text{ kg/hr}$$

The amount of dry air that is spent on evaporating 1 kg of moisture:

$$l = \frac{1000}{d_2 - d_0} = \frac{1000}{27 - 5} = 45,45 \text{ kg/steam.nam}$$

In this:  $d_0 = d_1 = 5 \text{ g/kg dry air}$ .

Total consumption of dry air:

$$L = l \cdot W_{nam} = 45,45 \cdot 517,24 = 23508,6 \text{ kg/hr}$$

Volume of total humid air:

$$V = L \cdot \rho_{kel} = 23508,6 \cdot 0,854 = 20076,3 \text{ m}^3/\text{hr},$$

here:  $\rho_{kel}$  - Quoted volume, m<sup>3</sup>/kg rate. air.

$$(t_0 = 20^0 C \text{ and } d_0 = 5 \text{ g/kg dry. air. } \rho_{kel} = 0,854 \text{ m}^3/\text{kg of land. air})$$

Selecting a ventilator based on the total volume value of the air found, when choosing it must definitely take into account the resistance of the airway.

I. *Specific heat consumption required to evaporate moisture:*

$$q_1 = (i''_n - C_v \cdot T_1) = 2687800 - 4187 \cdot 20 = 2604060 = 2604,06 \text{ kJ/kg},$$

at this place:  $i''_n = 2491 \cdot 10^3 + 1968 \cdot t_2 = 2491000 + 1968 \cdot 100 = 2687800 \text{ J/kg}$ ,

The total amount of heat spent on evaporating moisture is as follows:

$$Q_1 = q_1 \cdot W_{nam} = 2604,06 \cdot 517,24 = 1346928 \text{ J/hr.}$$

II. *Specific heat consumption of hot air exiting the drying drum:*

$$q_2 = L_{chiq} (994,83 + 1,97 \cdot d_2) \cdot (t_2 - t_0) = 45,45 \cdot (994,83 + 1,97 \cdot 27) \cdot (100 - 20) = 3810982 \text{ J / kg} = 3810,982 \text{ kJ / kg.}$$

Total loss of heat.

$$Q_2 = q_2 \cdot W_{nam} = 3810,982 \cdot 517,24 = 1971198 \text{ J/hr.}$$

III. *The specific heat expended on the cotton-cotton that is drying out of the drying drum (6) is the formula:*

$$q_3 = \frac{G_2 \cdot c_2 \cdot (T_2 - T_1)}{W_{bug}}$$

We determine in advance the amount of heat:

$$C_2 = \frac{100 \cdot C_c + W_2 \cdot C_B}{100 + W_2} = \frac{100 \cdot 1,6 + 104,19}{100 + 10} = 1,835 \text{ kJ/kg. degree}$$

where:  $C_c = 1.6 \text{ kJ/kg. grad}$ . Without it

$$q_3 = \frac{94,82 \cdot 1,835}{517,24} \cdot (60 - 20) = 1345,8 \text{ kJ/kg.}$$

The amount of heat contained in the drying cotton raw material:

$$Q_3 = q_3 \cdot W_{steam} = 1345,8 \cdot 517,24 = 696103,5 \text{ kJ/hr.}$$

We take the drying drum to heat up, that is, equal  $t_0 = 0$ , since the consumption of the amount of heat is small in order to select the desired order. The specific heat lost in the transmission of a 2SB - 10 drying drum through internal barriers is , while the coefficient of heat transfer is  $K=3.36 \text{ kJ}/(\text{m}^2 / \text{h} \cdot \text{grad.})$  is equivalent to

IV. The specific heat consumption is calculated by the following formula:

$$q_5 = \frac{K \cdot F \cdot (t_1' - t_0)}{W_{steam}} = \frac{160,5 \cdot 3,36}{517,24} \cdot (70 - 20) = 52,13 \text{ kJ/kg}$$

here:  $F$ -The drying is the surface of the inner working chamber of drum,

He is  $F=160,5 \text{ m}^2$  equal

$t_1'$  - Average temperature of the drying drum

Total heat consumption

$$Q_5 = q_5 W_{steam} = Q_5 = q_5 \cdot W_{steam} = 52,13 \cdot 517,243 = 26964 \text{ kJ/hr}$$

V. The total consumption of heat is determined as:

$$\sum Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 = 1346928 + 1971198 + 696103,5 + 0 + 26964 = 4041193 \text{ kJ/hr.}$$

VI. The total loss of specific heat spent on 1kg of moisture separation is determined as follows.

$$\sum q = 2604,06 + 3810,98 + 1345,8 + 0 + 52,1 = 7812,9 \text{ kJ/kg.}$$

Then we find the Full Name of the drying equipment as follows:

$$\eta = \frac{q_1}{\sum q} \cdot 100\% = \frac{2604,06}{7812,9} \cdot 100 = 33.3\%$$

or

$$\eta = \frac{Q_1}{\sum Q} \cdot 100\% = \frac{1346928}{4041193} \cdot 100 = 33.3\%$$

Drum dryers of type 2SB-10, which are currently used in cotton mills, have serious drawbacks. For the direct drying of cotton raw materials, the heat consumption of drying kits is only 35-40%, the residual heat mainly consumed to heat the tuner dryer and discharged into the atmosphere with spent drying material, polluting the environment. In this case, due to dirt and dampness, it is almost impossible for the dryer to recycle the feedstock. Based on the results of experiments at cotton ginning enterprise, the full name of the drying equipment is 30-40%. It would be desirable to use the indicator 50% or more in fuel consumption.

**IV. Conclusion.** To increase the cost-effectiveness of drying cotton raw materials in cotton cleaning plants, energy consumption should be used wisely. To do this, it is desirable to first study the heat consumption of the drying device. At the latter stage, a special role is played by the moisture content of the raw material.

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