ANALYSIS OF CONDITIONS AND VARIANTS OF COTTON CONDENSATION

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Abstract: The paper examines vertical and lateral approaches to cotton condensation. The research suggests empirical dependence between bulk weight of raw cotton and condensing loading. Thus, the received theoretical dependence helps to define more effective method of cotton condensation.

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The researches establish empirical dependence between bulk weight of raw cotton and condensing loading. This dependence is considered reasonable for loadings on unit of a surface of raw cotton $P=(1\div30)\cdot10^3 N/m^2$:

$$\gamma = m \cdot P^n , \qquad (1)$$

where, m and n - constant factors describing a grade, sort and humidity of raw cotton.

Besides, there is a generalized formula measuring dependence of bulk weight of raw cotton on loading and its humidity. The formula for cotton harvested by machine appears as

$$\gamma = 75 \cdot P^{0,23} \cdot \omega^{0,21} \cdot k \qquad (2)$$

And for the hand picked cotton

$$\gamma = 123.5 \cdot P^{0,23} \cdot \omega^{0,21} \cdot k \qquad (3)$$

where, k - factor taking into account condensation conditions of raw cotton.

The factor k has the following values at vertical condensation:

- at condensation without possibility of lateral expansion k=1;
- at condensation with possibility of lateral expansion

  for $P = 4.9 - 24.6\ kN/m^2$ $k = 1.03$;

  for $P = 2.94 - 3.94\ kN/m^2$ $k = 1.05$

Under compliance with the deformation (compression) law (formula 1) for raw cotton bulk having height h, the density ratio between upper and lower layers is determined by the formula

$$\frac{\gamma}{\gamma_o} = \left[m \cdot h(1-n) \cdot P_o^{(n-1)}\right]^{\frac{n}{n-1}} = \left[\frac{\gamma_o}{P_o}(1-n) \cdot h\right]^{\frac{n}{n-1}}, \qquad (4)$$

where, P_o, γ_o - pressure and density of raw cotton at a natural bulk condition; γ - density of raw cotton depending on height h.

FIGURE 1. DEPENDENCE OF DENSITY OF WEIGHT OF RAW COTTON FROM PRESSURE

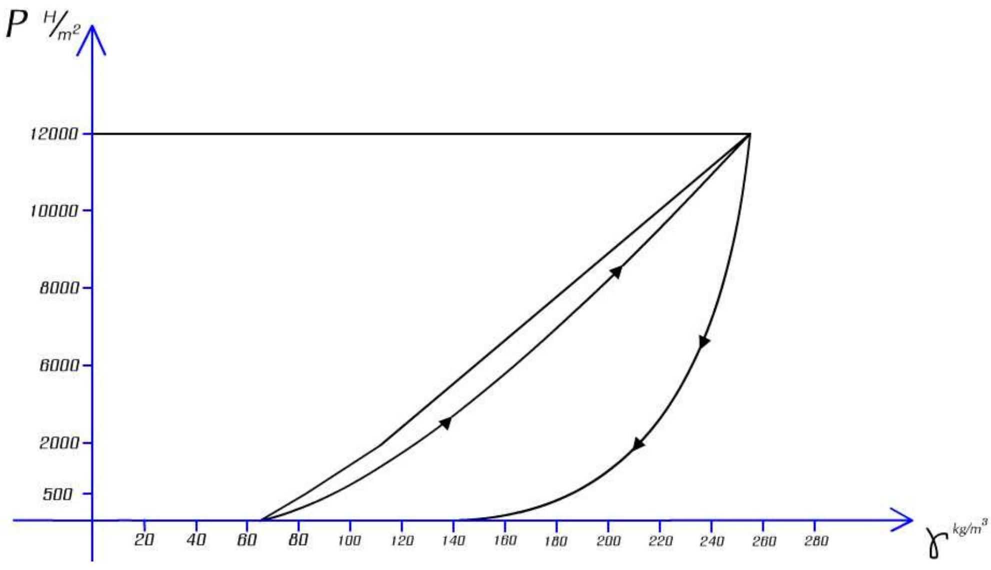
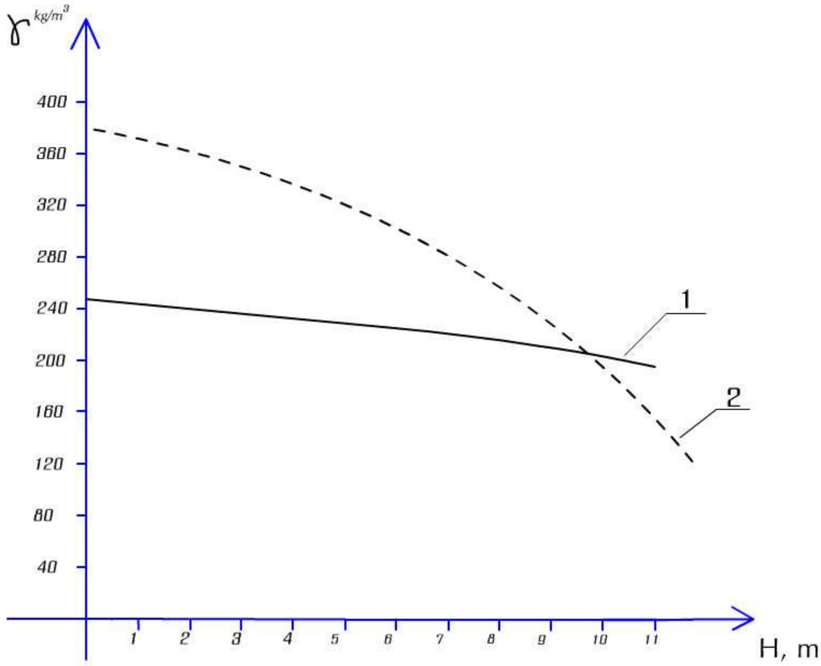


FIGURE 2. DISTRIBUTION OF DENSITY ON LAYERS OF SECTION AT LATERAL CONDENSATION

1- density distribution of cotton in bale prepared by a lateral condensation method

2 - density distribution of cotton in bale prepared by a vertical condensation method



If the diagram of dependence $\gamma = f(P)$ is approximated by several straights (Figure 1), then we have

$$\frac{\gamma}{\gamma_o} = I + \frac{P}{A_1}; \quad 0 \le P \le P_1 \qquad (5)$$

$$\gamma_o < \gamma < \gamma_1; \quad \frac{\gamma_1}{\gamma_o} = I + \frac{P_1}{A_1}; \quad \frac{dP}{dx} = \gamma \qquad (6)$$

Correspondingly, for values $\gamma_o < \gamma < \gamma_1$ we have

$$\frac{\gamma}{\gamma_o} = e^{\frac{\gamma_o \cdot x}{A_1}} \qquad (7)$$

In the bottom layer of raw cotton load ($x=h$) the density ratio is received as

$$\frac{\gamma}{\gamma_o} = e^{\frac{\gamma_o \cdot h}{A_1}} \qquad (8)$$

As it is seen from dependences (2) - (4) and (8), at a free bulk state of raw cotton of a certain bulk the bottom layers are condensed more than top ones.

Using equation (4) there was determined change of raw cotton density at lateral condensation method. In this approach, pressure and the density of raw cotton will be equal to the following values:

$$P_o = 10^4 N/m^2; \quad \gamma_o = 200\ kg/m^3$$

Substituting values of P_o and γ_o into the equation (4) we obtain distribution of density γ of raw cotton depending on height of bale at lateral condensation (curve 1, Figure 2).

Comparing curves 1 and 2 in the Figure 2 allows suggesting that stockpiled mass of raw cotton condensed with a lateral condensation method is less exposed to deformation; this provides uniform-distribution of density over the cross sections of raw cotton bale.

At a long storage of raw cotton bale prepared by a lateral way of condensation, density in the bottom layers reaches 250 kg/m^3 (Figure 2). And at a vertical way of condensation, density in the bottom layers of bale considerably exceeds 250 kg/m^3 and it is the basic reason of deterioration of technological properties of raw cotton.