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# Analysis of Heat Heat Transmission of Cotton-Raw Components

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**ABSTRACT**: The rate of heating of raw cotton components significantly affects the uniformity of fiber and seed drying. The article theoretically and experimentally determined the patterns of heat propagation in a lump of raw cotton and its components, depending on the initial moisture content of the raw material, the temperature of the drying agent and the duration of the drying process using the Bubnov-Galerkin projection method. This method makes it possible to analyze the rate of fiber heating and seeds, also use it when choosing the optimal regime for drying raw cotton with maximum preservation of quality while ensuring the uniformity of heating of their components.

**KEY WORDS**: Drying, Drying time, Temperature, Heating, Raw cotton, Fiber, Seeds, Heat exchange.

## I.INTRODUCTION

For uniform drying of raw cotton and its components, it is necessary to ensure their uniform heating, the study of which is topical when arranging the drying process. It is known [1-3] that the lower the value of the heating temperature, the less likely the deterioration of their natural properties.

The impact of social spam is already significant. A social spam message is potentially seen by all the followers and recipients' friends. Even worse, it might cause misdirection and misunderstand-ing in public and trending topic discussions. For example, trending topics are always abused by spammers to publish comments with URLs, misdirecting all kinds of users to completely unrelated web-sites.

## II. LITERATURE SURVEY

In work [4] the analysis of studies on the influence of drying agent temperature on the qualitative parameters of raw cotton components and on the uniformity of drying under different process conditions and the conditions of the dried material was carried out.

In production conditions, raw cotton is drying in a convective way in the form of lumps. An important factor for the preservation of fiber and seed quality during drying is the rate of heat spreading in the lump of raw cotton and its components. In this connection, we have considered the problem of heat propagation in a lump of raw cotton.

## III. METHODOLOGY

The task of heat and mass exchange in a lump of raw cotton can be expressed as follows: It is given an inhomogeneous two-component spherical body of radius R, having the property of isotropy, with a known initial temperature distribution: $u_1(0,r)=g_1(r)$, $u_2(0,r)=g_2(r)$, - initial seed and fiber temperature at a distance $r$ from the center of the lump; inside the body there is a convective heat exchange between the components (between the seed and the fiber). On the contact surface with the medium, convective heat transfer takes place according to Newton's law, while the heating of the body occurs uniformly throughout the surface of the body. It is required to find the radial distribution of the temperature of the components of the body at any time [5].

Then, relying on the laws of thermodynamics (the laws of thermal conductivity of Fourier, Newton, conservation of energy, etc.), this problem can be formulated in the form of a system of differential equations of parabolic:

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type: $$\begin{cases} \dfrac{\partial u_1}{\partial \tau} = a_1\left(\dfrac{\partial^2 u_1}{\partial r^2} + \dfrac{2}{r}\cdot\dfrac{\partial u_1}{\partial r}\right) + \dfrac{\alpha}{c_1\rho_1}[u_2 - u_1] + \dfrac{1}{c_1\rho_1} f_1(\tau) \\ \dfrac{\partial u_2}{\partial \tau} = a_2\left(\dfrac{\partial^2 u_2}{\partial r^2} + \dfrac{2}{r}\cdot\dfrac{\partial u_2}{\partial r}\right) + \dfrac{\alpha}{c_2\rho_2}[u_1 - u_2] + \dfrac{1}{c_2\rho_2} f_2(\tau) \end{cases} \quad (1)$$

with initial
$u_1(r, 0)=g_1(r)$, $u_2(r,0)=g_2(r)$, (2)

and boundary conditions: when $r=R$

$$\begin{aligned} -\frac{\partial u_1}{\partial r} + \alpha_1[u_B - u_1] = 0 \\ -\frac{\partial u_2}{\partial r} + \alpha_2[u_B - u_2] = 0 \end{aligned} \quad (3)$$

where $\alpha_1$- coefficient of heat exchange between the seed and the heat-transfer; $\alpha_2$- coefficient of heat exchange between the fiber and the heat-transfer; $\alpha$- coefficient of heat exchange between the seed and the fiber; $f_1(\tau)$, $f_2(\tau)$- given continuous functions describing the process of evaporation of moisture from the seed and from the fiber, correspondingly, $u_B$- air temperature, $\tau$- drying time; $u_1(r, \tau)$, $u_2(r,\tau)$- the required functions representing the temperature of the seed and fibers at the point $r$ at a given time $\tau$.

### A. ALGORITHM OF SOLVING THE PROBLEM OF DETERMINING THE TEMPERATURE FIELD OF COTTON-RAW COMPONENTS

Making the change of variables
$$\theta_i(r, \tau) = r\cdot u_i(r, \tau), \qquad i = 1,2$$

we obtain a system of equations in the form:

$$\begin{cases} \dfrac{\partial \theta_1}{\partial \tau} = a_1 \dfrac{\partial \theta_1^2}{\partial r^2} + \tilde{\alpha}(\theta_2 - \theta_1) + \dfrac{1}{c_1\rho_1} r f_1(\tau) \\ \dfrac{\partial \theta_2}{\partial \tau} = a_2 \dfrac{\partial \theta_2}{\partial r^2} + \hat{\alpha}(\theta_1 - \theta_2) + \dfrac{1}{c_2\rho_2} r f_2(\tau) \end{cases} \quad (4)$$

with initial conditions
$$\theta_1(r,0) = r\cdot g_1(r), \qquad \theta_2(r,0) = r\cdot g_2(r) \quad (5)$$

and the boundary conditions when $r=R$

$$\begin{aligned} -\frac{\partial \theta_1(R,\tau)}{\partial r} + \frac{1}{R}\cdot\theta_1(R,\tau) + \alpha_1(u_B - \theta_2(R,\tau)) = 0 \\ -\frac{\partial \theta_2(R,\tau)}{\partial r} + \frac{1}{R}\cdot\theta_2(R,\tau) + \alpha_2(u_B - \theta_2(R,\tau)) = 0 \end{aligned} \quad (6)$$

Where $\tau \in [0; T]$, $r \in [0; R]$. $\tilde{\alpha} = \dfrac{\alpha}{c_1\rho_1}$, $\hat{\alpha} = \dfrac{\alpha}{c_2\rho_2}$

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To solve this problem, we use the projection method of Bubnov-Galerkin, i.e., we introduce a basic function $\varphi_i(x)$ comply with the conjugacy condition $\varphi_i(0)=0$, $\varphi_i(r)\in W_2^1(0,R)$. Then the solution of system (4) - (6) we will seek in the form

$$\theta_{iN}(r,\tau)=\sum_{K=1}^{N}a_{iK}(\tau)\cdot\varphi_K(r) \qquad (i=1,2) \qquad (7)$$

where the coefficients $a_i(\tau)(i=1,2)$ are determined from

$$\begin{cases}\left(\dfrac{\partial\theta_{1N}}{\partial\tau}-a_1\dfrac{\partial^2\theta_{1N}}{\partial r^2}-\dfrac{\alpha}{c_1\rho_1}(\theta_{2N}-\theta_{1N})-\dfrac{1}{c_1\rho_1}r\cdot f_1(\tau),\varphi(r)\right)_2=0\\ \left(\dfrac{\partial\theta_{2N}}{\partial\tau}-a_2\dfrac{\partial^2\theta_{2N}}{\partial r^2}-\dfrac{\alpha}{c_2\rho_2}(\theta_{1N}-\theta_{2N})-\dfrac{1}{c_2\rho_2}r\cdot f_2(\tau),\varphi(r)\right)_2=0\end{cases} \qquad (8)$$

Identifying by

$$\alpha_{ik}=(\varphi_i(r),\ \varphi_j(r))_2;$$

$$\beta_{ik}=a_1(\varphi_i'(r),\ \varphi_k'(r))_2+a_1\left(\frac{I}{R}-H_1\right)\varphi_i(R)\cdot\varphi_k(R)+H_3\cdot\alpha_{ik};$$

$$\overline{\beta}_{ik}=a_2(\varphi_i'(r),\ \varphi_k'(r))_2+a_2\left(\frac{I}{R}-H_2\right)\varphi_i(R)\cdot\varphi_k(R)+H_4\cdot\alpha_{ik};$$

$$\gamma_{ik}=H_3\cdot d_{ik}; \qquad \overline{\gamma}_{ik}=H_4\cdot d_{ik}$$

$$f_{1i}=(f_1(\tau)\cdot r,\ \varphi_i(r))_2+a_1H_1R\ u_B\cdot\varphi_i(R)$$

$$f_{2i}=(f_2(\tau)\cdot r,\ \varphi_i(r))_2+a_2H_2R\ u_B\cdot\varphi_i(R)$$

we obtain the following system of differential equations:

$$\begin{cases}Q_n\cdot\dfrac{dA_n(\tau)}{d\tau}+P_nA_{1n}(\tau)+G_nA_{2n}(\tau)=F_{1n}(\tau,r)\\ Q_n\cdot\dfrac{dB_n(\tau)}{d\tau}+\tilde{P}_nA_{2n}(\tau)+\tilde{G}_nA_{1n}(\tau)=F_{2n}(\tau,r)\\ Q_nA_n(0)=F_{10}(r)\\ Q_nB_n(0)=F_{20}(r)\end{cases} \qquad (9)$$

where $Q_n=(\alpha_{ik})$, $P_n=(\beta_{ik})$, $G_n=(\gamma_{ik})$, $\tilde{P}_n=(\tilde{\beta}_{ik})$ и $\tilde{G}_n=(\tilde{\gamma}_{ik})$ square matrix size $(NxN)$;$A_{1n}(\tau)=(a_{11}(\tau), a_{12}(\tau), \dots, a_{1n}(\tau))^T$, $A_{2n}(\tau)=(a_{21}(\tau),a_{22}(\tau), \dots, a_{2n}(\tau))^T$ – the unknown vectors; $F_{1n}(\tau,r)=(f_{11}(\tau,r), f_{12}(\tau,r), \dots, f_{1n}(\tau,r))^T$, $F_{2n}(\tau,r)=(f_{21}(\tau,r), f_{22}(\tau,r), \dots, f_{2n}(\tau,r))^T$ - known vectors, the elements that are defined by the above formulas; elements of vectors $F_{10}(r)=(f_{01}(r), f_{02}(r), \dots, f_{0n}(r))^T$ и $F_{20}(r)=(\tilde{f}_{01}(r),\ \tilde{f}_{02}(r),\ \dots,\ \tilde{f}_{0n}(r))^T$ are determined from the relation $f_{0i}=(rg_1(r),\varphi_i(r))$, $\tilde{f}_{0i}=(rg_2(r),\varphi_i(r))$.

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**B. ON THE STABILITY OF THE GALERKIN METHOD FOR ONE SUM (PROBLEM) OF HEAT TRANSMISSION IN A COTTON-RAW.**

We research the question of the stability problem (9). Assume that the coordinate system $\{\varphi_i(x)\}$ is strongly minimal in space $L_2(\Omega)$ i.e. there exists a constant independent of $n$, which $0 < q < q_i^n$, where $q_i^n$ - eigenvalues of matrix $Q_n = \left\{(\varphi_k, \varphi_j)_{L_2}\right\}_{k,\ j=1}^{n}$

Suppose that instead of the Galerkin system (6) we solve the "perturbed" system

$$\begin{cases} (Q_n + \Gamma_n)\tilde{C}_n'(\tau) + (P_n + \Gamma'_n)\tilde{C}_n = F_n(\tau) + \varepsilon_n \\ (Q_n + \Gamma_n^0)\tilde{C}_n(0) = F_0 + \varepsilon_0 \end{cases} \qquad (10)$$

where $\tilde{C}_n(\tau) = \left(\tilde{A}_{1n}(\tau); \tilde{A}_{2n}(\tau)\right)$ - solution of the perturbed problem.

Let the admitted errors $\Gamma_n, \Gamma'_n$ are as follows

$$\|\Gamma_n\| \le e_1 q, \quad \|\Gamma'_n\| \le e_2 q; \quad 0 \le e_i \le 1, \quad q > 0.$$

We denote by $Z_n(\tau) = \tilde{G}_n(\tau) - G_n(\tau)$. From the system of equations (10) we subtract the systems of equations (9). The resulting equation is multiplied scalar by $Z_n(\tau)$, i.e.

$$\frac{1}{2}\frac{d}{d\tau}((Q_n + \Gamma_n)Z_n, Z_n) + ((P_n + \Gamma'_n)Z_n, Z_n) = (\varepsilon_n, Z_n) + (\Phi_n, Z_n)$$

where $\quad \Phi_n(\tau) = -\Gamma_n \cdot \dot{G}(\tau) - \Gamma'_n\ G_n(\tau)$.

Since the matrix $P_n$ is positive-definite and estimating the terms of the right-hand side of the equality, we obtain

$$\frac{1}{2}\frac{d}{d\tau}((Q_n + \Gamma_n)Z_n, Z_n) \le \varepsilon_1\|Z_n\|^2 + c_1\left(\|\varepsilon_n\|^2 + \|\Phi_n(\tau)\|^2\right)$$

We integrate the last inequalities in τ. Taking into account inequality

$$\|Z_n\|_{E_n}^2 \le \frac{1}{2}\|\tilde{U} - U\|_{L_2}^2$$

We obtain

$$((Q_n + \Gamma_n)Z_n, Z_n)_{E_n} \le 2\varepsilon_1\int_0^\tau \|\tilde{U} - U\|_{L_2}^2\, d\tau + c_1\int_0^\tau \left(\|\varepsilon_n\|^2 + \|\Phi_n(\tau)\|_{L_2}^2\right) d\tau + ((Q_n + \Gamma_n)Z_n(0), Z_n(0))_{E_n}$$

On the other hand,

$$((Q_n + \Gamma_n)Z_n, Z_n)_{E_n} \ge (Q_n Z_n, Z_n) - e_1 q\|Z_n\|_{E_n}^2 \ge (1 - e_1)\|\tilde{U}_n - U_n\|_{L_2}^2,$$

$$((Q_n + \Gamma_n)Z_n(0), Z_n(0))_{E_n} \le (Q_n Z_n(0), Z_n(0))_{E_n} + e_1 q\|Z_n\|_{E_n}^2 \le c_2(1 + e_1)\|\tilde{U}(r,0) - U(r,0)\|_{L_2(\Omega)}^2$$

$$\int_0^\tau \|\Phi_n(\tau)\|_{E_n}^2\, d\tau' \le 2M\int \|\Gamma_n\|^2 d\tau' + 2K\int_0^\tau \|\Gamma'_n\|^2 d\tau' \le 2MT\|\Gamma_n\|^2 + 2KT\|\Gamma'_n\|_{E_n}^2$$

We denote

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$$\int_0^{\tau} \left\| \tilde{U}_n(r,\tau) - \dot{U}_n(r,\tau) \right\|_{L_2}^2 d\tau = y(\tau)$$

$$F_n(\tau) = c_2(1+e_1) \left\| \tilde{U}_n(r,0) - U_n(r,0) \right\|_2^2 + c_1 \left\| \varepsilon_n \right\|_{E_n}^2 + 2MT \left\| \Gamma_n \right\|_{E_n}^2 + 2KT \left\| \Gamma'_n \right\|_{E_n}^2$$

Hence, by virtue of the theorem on differential inequalities, the inequality follows:

$$\left\| \tilde{U}_n(r,\tau) - U_n(x,\tau) \right\|_2^2 \le p_0 \left\| \varepsilon_0 \right\|^2 + p_1 \left\| \varepsilon_n \right\|^2 + p_2 \left\| \Gamma_n^0 \right\|^2 + p_3 \left\| \Gamma'_n \right\|^2 + p_4 \left\| \Gamma'_n \right\|^2 \qquad (11)$$

where the constants $p_i\left(i = \overline{0,4}\right)$ do not depend on $N$. Therefore,

$$\left\| \tilde{G}_n(\tau) - G_n(\tau) \right\|_{E_n}^2 \le \frac{1}{q} \left\| \tilde{U}_n(r,\tau) - U_n(r,\tau) \right\|_2^2 \le \frac{1}{q} \omega^2$$

Where $\omega^2$- is the right-hand side of inequality (11). The last correlation imply the stability of the algorithm for structure an approximate solution and the numerical stability of an approximate solution in the space $L_2(\Omega)$.

**C. NUMERICAL SOLUTIONS OF THE PROBLEM OF HEAT TRANSMISSION IN A COTTON-RAW LUMP.**

We consider an approximate method for calculating the model (9) constructed for the heat transmission problem in a lump of raw cotton.

To obtain numerical results, we choose the basic functions. As basic functions, we take piecewise-continuous functions defining in the space $L_2(\Omega)$,i.e.

$$\begin{cases} \varphi_0(r) = 0 \\ \varphi_i(r) = \dfrac{1}{\sqrt{h}} \begin{cases} \dfrac{r - r_{i-1}}{h}, \ если\ r \in (r_{i-1}; r_i) \\ \dfrac{r_{i+1} - r}{h}, если\ r \in (r_i; r_{i+1}) \end{cases} \\ \varphi_N(r) = \dfrac{1}{\sqrt{h}} \begin{cases} \dfrac{r - r_{N-1}}{h}, если\ r \in (r_{N-1}; r_N) \\ 0 \qquad , если\ r \notin (r_{N-1}; r_N) \end{cases} \end{cases}$$

constructed on the grid $0<r_0<r_1<r_2<\ldots<r_N=R$, $h=r_i-r_{i-1}$, $i=1,2,3,4,\ldots N-1$.

Obviously, this system is linearly independent and each of them is non-zero only in an interval of length $2h$. If we denote the linear hull by $H_N$, then the functions in $H_N$ are continuous piecewise linear functions that are summable with any finite (ultimate) derivative, i.e. $H_N \in L_2[0;R]$, $H_N \in W_2^1[0;R]$. It can also be noted that these functions are almost orthogonal, i.e. only for the neighboring functions is the scalar product in $L_2[0;R]$ different from zero. It follows that the system of equations (9) has a sparse matrix. Selecting the basic functions in this way and constructing implicit difference schemes on the interval $[0;T]$ we obtain a system of algebraic equations.

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$$\begin{cases} (Q_n + \Delta\tau P_n)\cdot A_n^{l+1}(\tau) + G_n B_n^{l+1}(\tau) = F_{1n}^l(\tau) - Q_n A_n^l(\tau) \\ \tilde{G}_n A_n^{l+1}(\tau) + (Q_n + \Delta\tau\tilde{P}_n)\cdot B_n^{l+1}(\tau) = F_{2n}^l(\tau) - Q_n B_n^l(\tau) \\ Q_n A_n^0(\tau) = F_{10} \\ Q_n B_n^0(\tau) = F_{20} \qquad\qquad l = 0,1,2,3,..M \end{cases} \quad (12)$$

The system of algebraic equations (12) is solving by the Gauss method. The found value of $A_n^l(\tau),B_n^l(\tau)$ putting to (10) and find the temperatures of fiber and seeds, i.e.

$$u_i(r,\tau) = \frac{1}{r}\cdot\theta_i(r,\tau),\ \ i=1,2.$$

## IV. EXPERIMENTAL RESULTS

The subject of research was cotton-raw, varieties of C-6524, II of industrial grade. Below in Table 1 the calculation results obtained for the following values of the parameters of the model (1) [6].

- For the seed:$u_{10}=10^0C$; $\lambda_1=0{,}26\ W/m\cdot K$; $c_1=1800\ J/kg\cdot K$; $\rho_1=50\ kg/m^3$; $R_1=0{,}006m$; $k_1=0{,}005\ W/m^2\cdot K$; $W_{H1}=19\%$; $\alpha=2{,}30\ J/m^2$; $\varepsilon_1=0{,}8$; $r_{21}=2082000\ J/kg$; $W_{P1}=8\%$; $\alpha_1=2{,}01\ J/m^2\cdot h$;
- for fiber: $u_{20}=15^0C$; $\lambda_2=0{,}07\ W/m\cdot K$; $c_2=1600\ J/kg\cdot K$; $\rho_2=12\ kg/m^3$; $R_2=0{,}025\ m$; $k_2=0{,}0003\ W/m^2\cdot K$; $W_{H2}=9\%$; $\varepsilon_2=0{,}8$; $W_{P2}=0\%$; $\alpha_2=2{,}5\ J/m^2\cdot h$; $R=0{,}1\ m$.

**Table 1. Temperature changes with respect to the radius of the lump raw cotton and drying time**

| R, м / τ, sec | | 0,1 | 0,2 | 0,3 | 0,4 | 0,5 | 0,6 | 0,7 |
|---|---|---|---|---|---|---|---|---|
| | | **The temperature field of raw cotton components ($^0$C)** | | | | | | |
| 60 | $U_1$ | 28,410 | 27,979 | 22,585 | 19,264 | 17,257 | 16,032 | 15,262 |
| | $U_2$ | 48,185 | 46,651 | 37,922 | 31,277 | 26,143 | 22,218 | 19,261 |
| 120 | $U_1$ | 34,147 | 33,403 | 27,304 | 22,999 | 19,997 | 17,939 | 16,532 |
| | $U_2$ | 56,898 | 54,259 | 45,507 | 38,577 | 32,876 | 28,144 | 24,228 |
| 180 | $U_1$ | 38,360 | 37,250 | 30,884 | 26,086 | 22,521 | 19,893 | 17,98 |
| | $U_2$ | 61,947 | 58,486 | 49,815 | 42,891 | 37,082 | 32,127 | 27,883 |
| 240 | $U_1$ | 41,784 | 40,312 | 33,733 | 28,720 | 24,811 | 21,789 | 19,484 |
| | $U_2$ | 65,324 | 61,215 | 52,612 | 45,738 | 39,920 | 34,897 | 30,524 |
| 300 | $U_1$ | 44,703 | 42,88 | 36,192 | 31,02 | 26,089 | 23,086 | 20,981 |
| | $U_2$ | 67,744 | 63,109 | 54,551 | 47,728 | 41,929 | 36,887 | 32,46 |
| 360 | $U_1$ | 47,262 | 45,099 | 38,336 | 33,060 | 28,773 | 25,272 | 22,436 |
| | $U_2$ | 69,549 | 64,478 | 55,947 | 49,165 | 43,389 | 38,348 | 33,897 |

**Table 2.Temperature changes with respect to the drying time**

| τ, sec | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 |
|---|---|---|---|---|---|---|---|---|---|
| $u_1(\tau,r)$ | 12,733 | 15,369 | 17,724 | 19,858 | 21,814 | 23,625 | 25,313 | 26,896 | 28,389 |
| $u_2(\tau,r)$ | 27,759 | 36,037 | 42,095 | 46,864 | 50,777 | 54,074 | 56,905 | 59,371 | 61,543 |
| τ, sec | 150 | 165 | 180 | 195 | 210 | 225 | 240 | 255 | 270 |
| $u_1(\tau,r)$ | 29,804 | 31,148 | 32,430 | 33,656 | 34,831 | 35,960 | 37,046 | 38,093 | 39,104 |
| $u_2(\tau,r)$ | 63,473 | 65,200 | 66,756 | 68,163 | 69,444 | 70,612 | 71,682 | 72,665 | 73,570 |
| τ, sec | 285 | 300 | 315 | 330 | 345 | 360 | | | |
| $u_1(\tau,r)$ | 40,081 | 41,027 | 41,943 | 42,831 | 43,695 | 44,533 | | | |
| $u_2(\tau,r)$ | 74,406 | 75,179 | 75,896 | 76,560 | 77,179 | 77,547 | | | |

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Table 3 shows the results of calculations with respect to the radius of a lump of raw cotton at an air temperature is $100^0$C, an initial temperature is $15^0$C and a humidity of seeds and fiber are $W_{H1}$= 19%, $W_{H2}$=9% , respectively. The drying time is 360 seconds.

**Table 3. Temperature changes with respect to the radius of the lump**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *R, м* | 0,1 | 0,2 | 0,3 | 0,4 | 0,5 | 0,6 | 0,7 |
| $u_1(\tau,r)$ | 47,262 | 45,099 | 38,336 | 33,060 | 28,773 | 25,272 | 22,436 |
| $u_2(\tau,r)$ | 69,549 | 64,478 | 55,947 | 49,165 | 43,389 | 38,348 | 33,897 |

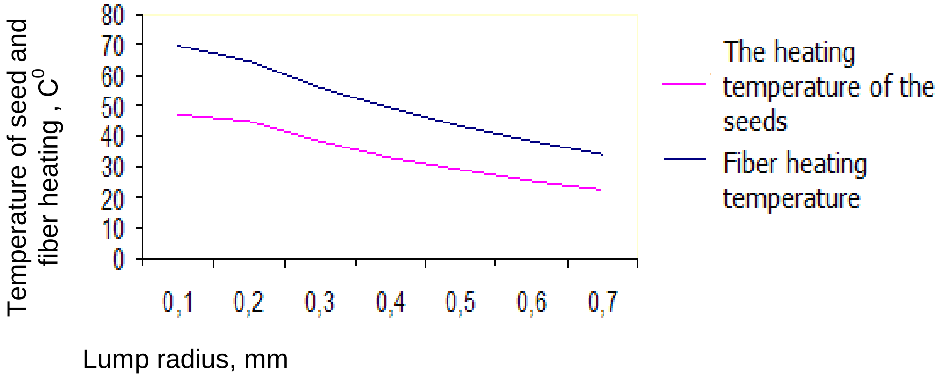


Fig.1. Dependence of the heating temperature of fiber and seeds on the radius clap of raw cotton.

## V.CONCLUSION AND FUTURE WORK

Analysis of the results of Table 3 (Fig.1) shows that the lump diameter significantly affects the intensity of the drying process, i.e. with an increase in the diameter of the lump, the rate of heating of seeds and fiber sharply decreases. The temperature difference inside the seeds along the radius of the lump and the temperature difference between the fibers and seeds that are at equal distances from the lump surface is very large, which leads to an uneven drying of the raw cotton components. To increase the rate of heating the seeds, and to achieve uniform drying, it is necessary to organize the drying of the raw cotton in the loosened form, i.e. as far as possible reduce the diameter of the lump.

Below are the experimental and calculated data on the temperature variation of raw cotton components

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Table 4.Experimental and calculated temperature variation data components of raw cotton

| Diameter of the lump R = 0,7 m, air temperature 130$^0$C, initial humidity 17,4%; Drying time 360 sec. | | | | |
|---|---|---|---|---|
| Drying time (sec.) | Seed temperature | | Fiber temperature | |
| | Experimental | Calculated | Experimental | Calculated |
| 0 | 10,0 | 10,0 | 10,0 | 10,0 |
| 15 | 26,0 | 29,0 | 37,0 | 39,5 |
| 30 | 34,0 | 35,2 | 42,0 | 40,0 |
| 45 | 46,0 | 45,7 | 45,0 | 49,0 |
| 60 | 52,0 | 53,1 | 60,0 | 54,0 |
| 90 | 64,0 | 63,4 | 90,0 | 72,0 |

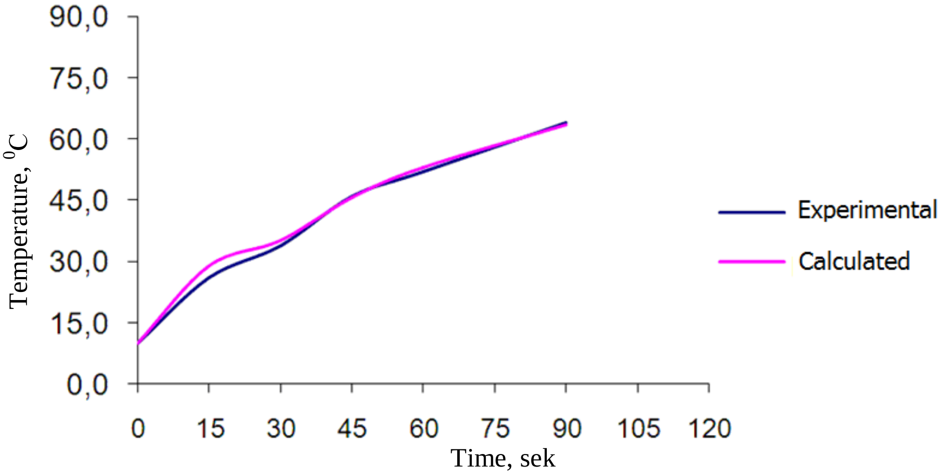


Fig.2. Dependence of the heating temperature of fiber and seeds on the radius clap of raw cotton

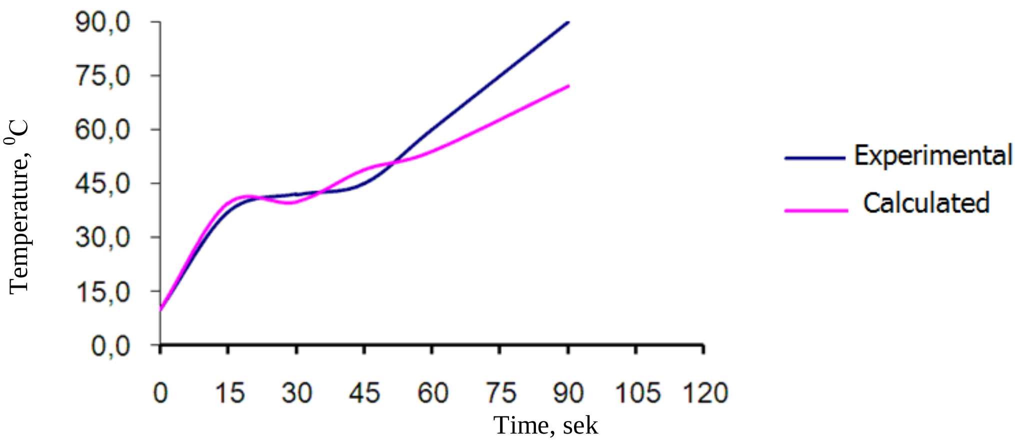


Fig.3. Change in fiber temperature.

The comparative analysis (Fig. 2 and Fig. 3) shows that the error in the calculated and experimental data is no more than 3-4%, which makes it possible to analyze the rate of heating of fiber and seeds in the form of a lump of raw cotton.

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Regularities of heat propagation between fibers and seeds are obtained for different diameters of a lump of raw cotton, temperature of drying agent and moisture content of raw cotton, depending on the intensity of the drying process. The obtained results can be used in the selection of optimal modes of drying of raw cotton in order to maximize quality preservation due to the uniformity of heating of their components.

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