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# Experimental research for paddy and rice

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**ABSTRACT**:In this article describes experimental methods for determining the bulk density of granular materials, in particular the bulk density of grain crops, as well as their specific heat capacity, which is one of the main thermo-physical characteristics. The results of the conducted experiments and the results are in comparison with the values given in the literature.

**KEYWORDS**: Grain, Paddy, Rice, Heat capacity, Heat quantity, Thermo-physical properties, Device, Heater, Heat Generator, Tripod.

## I.INTRODUCTION

At present, after harvesting winter wheat, cereals, legumes and other crops are sown. Due to insufficient provision of farms with energy-efficient, energy-saving drying devices, grain drying is carried out in the field, which leads to a decrease in the quality of drying of grain products.

As a result, the creation of energy-saving drying devices on the basis of the during processes study of heat exchange drying and the thermophysical properties of grain products is of particular relevance.

## II. RELATED WORK

To improve the quality of grain drying, it process is necessary to study the heat exchange. To study heat transfer processes in drying plants and natural conditions, it is necessary to know the thermo-physical properties of grain crops.

The literature gives the specific heat values of wheat grain, in particular rice. The heat capacity of wheat grains is determined between the heat capacity of the dry matter and the heat capacity of water, and the heat capacity of the dry matter is 0.37 kcal / (kg · ℃) [1]. Specific heat of rice and chaff is 0.782 kJ / (kg · ℃) and 1.2 kJ / (kg · ℃), respectively [2]. However, there is little information of the heat capacity embankment of paddy and rice.

For the experimental study of the thermo-physical properties of granular, hard materials, a literature review [3,4,5,6,7,8,9] was made.

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## III. OBJECT AND METHODS OF RESEARCH

This article focuses on experimental studies of specific heat at atmospheric pressure, ambient temperature and humidity of various materials known in the form of pellets and granular rice product in filling in a definite amount.

The article gives a method for the experimental determination of the heat capacity of rice products grown in the Izbaskan district of the Andijan region.

It is known that the amount of heat ΔQ absorbed or isolated when they heat bodies (samples) is heated, is proportional to the temperature change Δt and their mass m:

$$\Delta Q = c \cdot m \cdot \Delta t \qquad \textbf{(1)}$$

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where, the coefficient of proportionality of c-called specific heat, and its value depends on the type of material.

In this experiment the coefficient of specific heat of various materials in the form of pellets (grain) is determined.

In any case, the pellets, the samples are weighed and heated to a certain temperature $t_1$and then flooded with water with temperature $t_2$whose masses are also determined by weighing. After thorough mixing, due to the heat exchange of the pellet and water, it reaches the total temperature $t_m$.

In this case, the amount of heat released by the pellet (sample) $\Delta Q_1$:

$$\Delta Q_1 = c_1 \cdot m_1 \cdot (t_1 - t_m) \quad \textbf{(2)}$$

where, $m_1$ –is the mass of the pellet, $c_1$ –is the specific heat of the pellet, is equal to the quantity absorbed by the water $\Delta Q_2$:

$$\Delta Q_2 = c_2 \cdot m_2 \cdot (t_m - t_2) \quad \textbf{(3)}$$

where, $m_2$ –is the mass of water.

Here it is assumed that the coefficient of specific heat of water-$c_2$is known, the temperature-$c_2$is equal to the vapor temperature. The value of the unknown-$c_1$ can be calculated from the experimentally measured values of$t_m, t_2, m_1$and$m_2$using the formula:

$$c_1 = c_2 \cdot \frac{m_2(t_m - t_2)}{m_1(t_1 - t_m)} \quad (4)$$

The vessel of the calorimeter also absorbs some of the heat released by the pellet. Consequently, the heat capacity of the calorimeter will be:

$$c_k = c_2 \cdot m_k \quad (5)$$

Thus, the water equivalent of the calorimeter-$m_k$vessel is taken into account in the calculations. The amount of heat shatter calculated by formula (3) is more accurate.

$$\Delta Q_2 = c_2(m_2 + m_k)(t_m - t_2) \quad (6)$$

And taking into account this formula (4) is transformed to the following form:

$$c_1 = c_2 \cdot \frac{(m_2+m_k)(t_m-t_2)}{m_1(t_1-t_m)} \quad (7)$$

## IV. RESULTS OF THE RESEARCH

For the experimental determination of the coefficient of specific heat of rice, an experimental setup was used, cited also by Germany, "LD Physics Leaflets"[10] (Fig. 1).

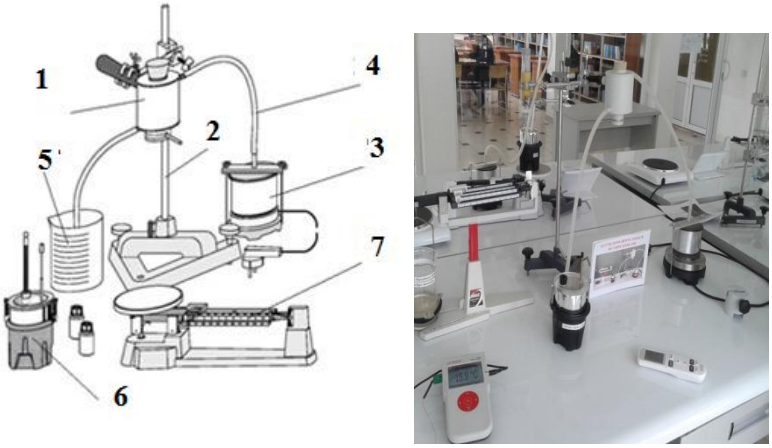


Figure 1. Experimental installation "LD Physics Leaflets"
1- heater; 2-tripod; 3-steam generator; 4- silicone hoses; 5-beaker; 6 - Dewar vessel; 7-scales (310g).

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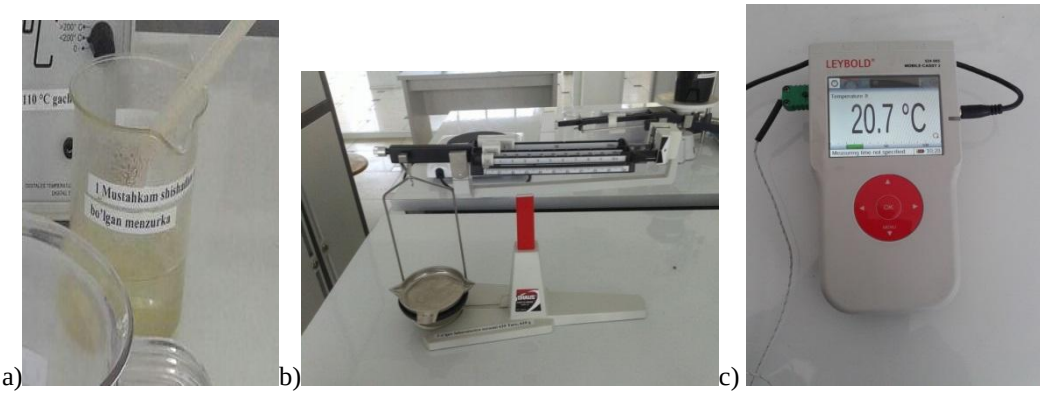
To check (reproducibility) of the experimental setup, a certain amount of backfilling of granular materials of copper, lead and glass was investigated. Convinced in the coincidence of the experimental data with the literature data, they began to determine experimentally the coefficient of specific heat of rice in a certain amount in the form of a backfill.

Before the beginning of the main experiment, we determine the mass, volume, density of standards (lead, copper, glass) and rice in a certain amount in the backfill. To determine the mass of the samples, a "OHAUS CENT-O-GRAM MODEL 311" scale was used, and to determine the volume of the beaker samples, with a volume of 150 ml (Fig. 2).




a) b) c)

Figure 2. Measuring instruments used in the experiment.
a-beaker; b-scales of the "OHAUS CENT-O-GRAM MODEL 311" type (310 g); c-temperature sensor with NiCi-Ni.

During the experiment, sample temperatures were measured with a NiCi-Ni thermocouple (thermal sensor) and a digital value was obtained with the help of "LEYBOLD" yes (Fig. 2).
Samples of standards, paddy and rice are shown in Fig.3


a) b) c)
d) e) f) g)

Figure 3. Samples of standards, shala and rice.
a-glass; b-copper; c-lead; g-shala (sort of "Devzira"); e-shala (sortof "Alanga"); f-rice (sort of "Devzira"); g-rice (sort of "Alanga").

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**Experimental installation and experiment.**
Figure 1 shows the experimental setup.

**The order of the experiment.**
Install the heater-1 on a tripod-2, fill with water steam generator-3, carefully close the device and use silicone tubes-4 to connect it to the upper hose connector of the heater steam input. We fix the silicone tube in the lower inlet (steam outlet) to the hose connection of the heater and put the other end into the beaker-5. We make sure that the silicone hoses are securely fastened in all connections. Now fill the sample chamber of the heater with sample pellets as close as possible and tightly close it with a stopper. We connect the steam generator to an electric oven, and then heat the pellet (sample) onto the heater for (80-85) minutes, passing a steam through them. During this time we determine the mass of the empty vessel Dewar-6 and then pour in it a certain mass of water. Close the Dewar vessel with the casing and insert a thermometer or a temperature sensor, respectively. We measure the water temperature t2. We open the lid of the Dewar vessel and move it aside, release the mesh with the samples in the Dewar vessel, drop the samples, the temperature of which is 100 ° C, into the sample grid, close the lid and mix the samples thoroughly with water, until the water temperature ceases to decrease, mixture. In addition, we determine the mass of the sample. Thus, we repeat the experiment with other samples. The obtained experimental results are recorded in Table 1.

**Table 1**

Measured values necessary for determining the specific heat of samples(at a humidity of W = 10% for paddy and rice)

| The name of the sample (backfill) | Volume, · ***10−3*** | mass $m_1$, gram | water mass$m_2$, **грамм** | gramsTemperaturesample$t_1$, $^0$C | Water temperature $t_2$, $^0$C | Mixture temperature $t_m$, $^0$C |
|---|---|---|---|---|---|---|
| Copper | 30 | 197,6 | 150 | 100 | 19 | 27,2 |
| Lead | 25 | 197,1 | 150 | 98 | 18 | 21 |
| Glass | 40 | 76,3 | 150 | 98 | 18 | 28,5 |
| Paddy (sort of "Devzira") | 202 | 14,8 | 100 | 74,7 | 19,6 | 22,8 |
| Paddy (sort of"Alanga ") | 230 | 15 | 82,5 | 72 | 22,2 | 27 |
| Rice (sort of "Devzira") | 269 | 15 | 100 | 72 | 22 | 24 |
| Rice (sort of "Alanga") | 203 | 25 | 50 | 97 | 22,2 | 35,8 |

It is known that the water equivalent $m_k$ = 0,3g, the specific heat $c_2$ =**4,19 кJ/(кg·$^0$C).**
Based on the data obtained, sample densities were determined, the results of which are given in Table 2.

Table 2

The density of backfill samples (at a humidity of W = 10% for shal and rice)

| Name of the sample | Copper | Lead | Glass | Paddy(sort of "Devzira") | Paddy(sort of " Alanga ") | Rice (sort of "Devzira") | Rice (sort of "Alanga")) |
|---|---|---|---|---|---|---|---|
| Density of backfill, kg / m3 | 6587 | 7884 | 1907 | 426 | 486 | 904 | 1060 |
| Note: The bulk density of clay is (1400-1700), of natural moist sand (1500-1600) kg / m3 [11]. | | | | | | | |

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Table 3 gives the values of the specific heat of substances (samples) calculated by formula (4) and their correspondence with the data given in the literature is satisfactory only for standards.

Table 3

The experimentally determined values of the specific heat and the corresponding values obtained from the literature (at a moisture content W = 10% for paddy and rice)

| Name of the sample | Experimentally determined value sample $C_1$, j / (kg • ℃) | The resulted value of the sample in the literature $C_1$, j / (kg • ℃) | Note (literary source) |
|---|---|---|---|
| Copper | 357 | 367 | [10] |
| Lead | 144,4 | 133 | [10] |
| Glass | 670,3 | 656 | [10] |
| Paddy(sort of "Devzira") | 1531 | over 370 | [1] |
| Paddy(sort of "Alanga ") | 2458 | over 370 | [1] |
| Rice (sort of "Devzira") | 1166 | 782 | [2] |
| Rice (sort of "Alanga")) | 1862 | 782 | [2] |

## V. CONCLUSION

1. Specific heat capacities of the samples were investigated from the material type and it was established that their values are much less than the heat capacity of water.

2. The correspondence of reference samples (lead, copper, glass) with the literature data given by "LD Physics Leaflets" to say that the experiment was put in the right way.

3. Specific heat capacity of embankment of paddy and rice of "Devzira" and "Alanga" varieties is determined within the accuracy limits of the error. According to the experimental data obtained, it is determined that the heat capacity of the grain mound depends on the type and grade of grain.

4. The specific heat capacities of embankment of paddy and rice of "Devzira" and "Alanga" varieties can be used for natural drying and for drying of small-sized, energy-efficient devices. The experimentally determined value of the heat capacity of the grain embankment makes it possible to calculate the amount of heat, the value of the latter determines the required energy for the process of grain drying in devices [12].

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