www.revistageintec.net
ISSN: 2237-0722
revista GEINTEC
Gestão, Inovação e Tecnologias

Problems of Energy Saving at Grain Processing Enterprises

Palvan Iskandarovich Kalandarov[1]; Zieviddin Mamurovich Mukimov[2];
Sherkul Raxmanovich Rakhmanov[3]; Dilbaroy Amonbaevna Abdullaeva[4];
Aziz Maxkamovich Nigmatov[5]

[1]Doctor of Technical Sciences, Professor, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan.
[1]eest_uz@mail.ru

[2]Researcher, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan.
[2]t.automation@tiiame.uz

[3]Assistant Professor, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan.
[3]rsherkul@inbox.ru

[4]Assistant Lecturer, Tashkent Institute of Irrigation and Agricultural Engineers, Tashkent, Uzbekistan.
[4]sarvar7084295@gmail.com

[5]Assistant Lecturer, Tashkent Institute of Irrigation and Agricultural Engineers, Tashkent, Uzbekistan.
[5]a.nigmatov@tiiame.uz

Abstract

The article considers the problems of energy saving on the example of JSC "GALLA-ALTEG", where the main energy - intensive processes are the grinding of grain and intermediate products. The energy consumption of technological equipment, including mills for multi-grade grain grinding, is analyzed, the capacities spent on specific loads on the technological process systems, as well as the grinding of grain and intermediate products are studied. To reduce the power consumption, the technological processes of regulating them by humidity are considered.

Key-words: Grain, Humidity, Energy Saving, Automation, Electricity, Automation.

1. Introduction

One of the main indicators of grain processing enterprises is the energy efficiency indicator – that is, the absolute or specific amount of energy consumption required for the production of products established by regulatory documents. Let's consider this case on the example of JSC" GALLA-ALTEG".

The flour and grain industry is one of the most socially significant branches of the agro-industrial complex. An important task facing the employees of the flour milling industry is to improve the quality of finished products, taking into account the introduction of energy-saving technology. The issue of rational use of electricity at the enterprise is no less important today than the production of high-quality products [1].

At this flour milling enterprise, the main energy - intensive processes are the grinding of grain and intermediate products. The energy consumption for the technological process should be reduced primarily through the rational organization and management of the process of operation of technological equipment, if where the electricity costs are taken as 100 %, then the grinding process accounts for at least 70% of the total consumption.

Let's analyze the process of electricity consumption in the mill, the initial ones are presented in table 1.

Table 1 - Electricity consumption in the mill

№	Name	Work	Idling
1	Grain cleaning department	22%	13%
2	Shod rollers (6 systems)	20%	14%
3	Grinding and grinding (10-12 pairs of rollers)	25%	8%
4	Sieving on spills and borates (sieving on borates 6%)	16%	9%
5	Veiki	6%	6%
6	Transmissions	6%	6%
7	Elevators and augers	5%	4%
Total:		100%	50%

Table 2 - Norms of specific electricity consumption for flour mills kW, h per 1 ton of flour

Grinding	With mechanical transportation of products	With pneumatic transport of products
Multi-grade and 72% soft wheat	55-65	86- 102
Durum wheat to pasta flour	60-66	93-102
Single-grade 85%	48-55	67-77
Wallpaper	21-24	30-34

One of the main tasks of the processing industry enterprises at present is to save electric power resources. The development of an effective system that allows linking all the numerous processes and their parameters into a single whole, determining their mutual influence, and finding optimal flour production modes with maximum equipment productivity and minimum energy consumption is an important task [2].

The consumption of electricity by multi-grade grinding mills depends on many factors, among which the most important are: grain dumping, milling properties are determined by the yield and quality of flour, including flour of high grades (the highest and first), the consumption of electricity for the production of 1 ton of flour, which depends on the quality and condition of the grain — ash content, glassy, humidity, nature, density, size and alignment, weight of 1000 grains, strength and hardness of grain [3].

The hydrothermal processing (GTO) of grain is considered as an object of research, which is used in the technology of flour, cereals as a mandatory and highly efficient technological operation of preparing grain for processing. At the same time, hydrothermal processing of grain allows you to obtain products of pre-determined humidity and provides longer periods of safe storage.

To select the method, we use the well-known cold conditioning method, in which the grain is moistened with water at a temperature of 15...20 ºC, and then its cooling - isothermal exposure for a certain time. When cooling, moisture is distributed over the anatomical parts of the grain, accompanied by the following structural, mechanical and technological transformations:

- Swelling with the release of the heat of hydration;
- Loosening of the endosperm due to an increase in the specific volume;
- The development of microcracks in the endosperm;
- Weakening of the connection of the shells and the aleurone layer with the starch part of the endosperm due to the difference in the change in specific volumes during swelling.

2. Results of the Study

The results of the joint study once again confirmed the inefficient distribution of electricity and electricity consumption across systems [4], (Table. 3) with the capacity of a flour mill of varietal grinding of wheat with a capacity of 200 t/day, two sections are used, and the total capacity of the mill is 400 t / day.

Table 3 - Energy distribution in a mill with a capacity of 200 tons per day

№	Auxiliatel oborud	Work
1	Grain cleaning department	18%
2	Drannye sisteme	22.5%
3	Grinding system	11.5%
4	Grinding in / st V. T. h entoleitori	25%
5	Pneumatic transport	12.0 %
6	Sifting+ vymolny process	0.64%
7	Wake-up + aspiration	0.21%
8	Auxiliary equipment	10.0 %
Total:		100%

The electricity consumption for 200t/day during the year (working period of 300 days) reaches 7... 8 million kWh during pneumatic transport of grain and its grinding products. We also studied the capacities spent on specific loads on the technological process systems, as well as the grinding of grain and intermediate products.

Table 4 - Energy distribution across the drane systems in %

In I the system	In II the system	In III the system	In IYG the system	In IYF the system	In V the system
5,7	4,8	4,8	3,9	1,9	1,4

Table 5 - Energy distribution for the grinding of intermediate products in the grinding system, entoleitori in %

C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	Entolet
4.8	2.6	2.6	1.94	1.94	1.94	1.43	1.43	1.43	4.9

From the analysis of energy distribution, it is clear that the most important direction of development for the enterprise is to increase production efficiency and save all types of resources. Along with the increase in production volume, at the same time, the task of reducing the energy intensity of the production process becomes urgent [5].

The analysis shows that more than 13 types of equipment are used in the production of varietal flour at this enterprise, the total cost capacity is about 95-100%, and the load is about 70-75%. After analyzing the distribution of electricity, we found that a significant part of the production, up to 90 %, is precisely the energy consumption, and its transmission is about 9-10%. And here, first of all, efforts should be directed to saving energy and reducing its consumption.

It should be noted that, for specialists of flourmills, it is necessary to study more deeply and continue to develop modern technology of flour production in order to make it highly efficient, compact, economical and easy to maintain, as well as to create flourmills that can control and optimize the process themselves. For this purpose, the introduction of automation systems is one of the urgent tasks of production. A growing number of sensors and software replaces the manual control of the flour mill and helps to guarantee as well as ensure constant quality control.

Introduction of automation systems it is necessary to control the parameters of the technological process during grain storage and in the production of flour. The main energy-intensive sections in the mill are equipped with semi-automated control systems.

For this purpose, the following automation scheme and grain moisture control is recommended, which is shown in Fig. 1.

Figure 1 - Technological scheme of hydrothermal grain processing
in JSC " GALLA-ALTEK”
1-grain washing; 2-distribution auger; 3-capacitive hopper; 4-mixer auger;
5-humidity control device; 6-screw mixer;

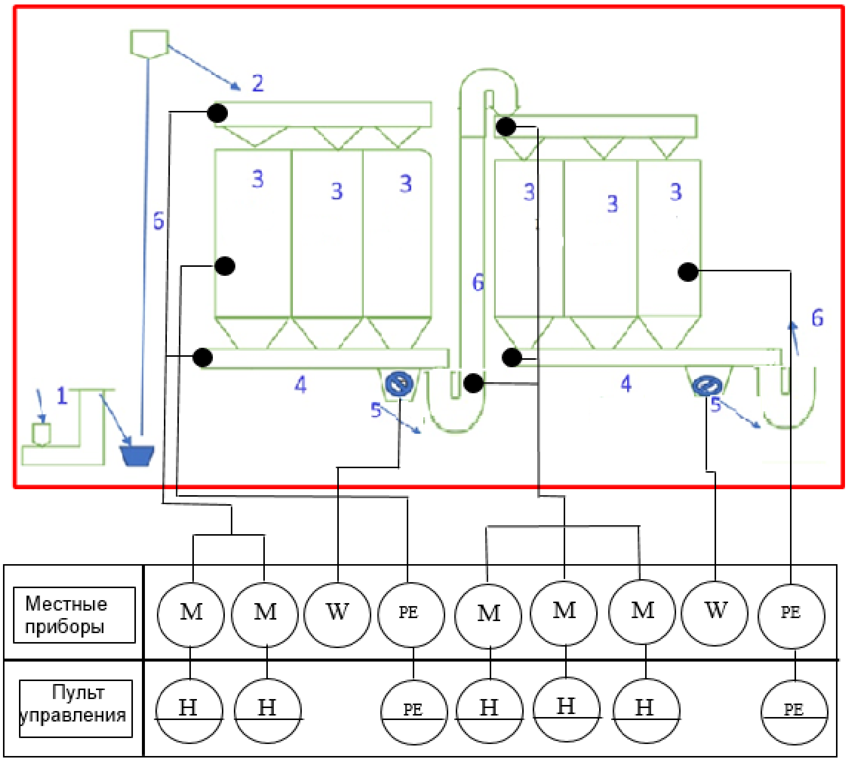
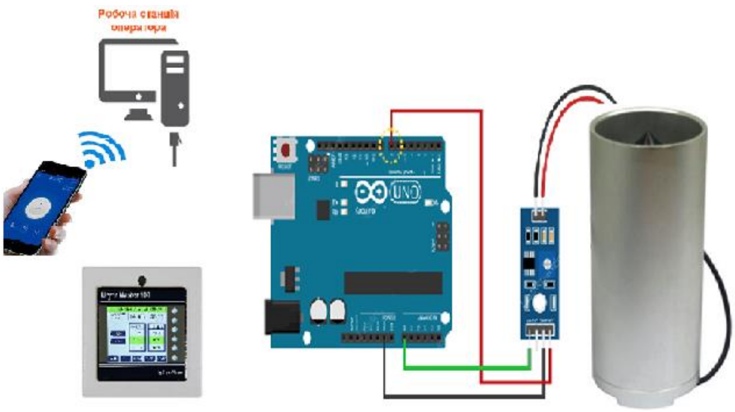


Figure 5 shows a grain moisture monitoring device between the first and second cooling, a moisture meter is used, a capacitive primary converter, which is a remote sensor of a cylindrical metal-ceramic structure made of titanium alloy, which allows it to be used on a conveyor belt or pipe (auger) for a long time without deterioration of its parameters in real time.

Figure 2 - A device for monitoring grain moisture in real time



ISSN: 2237-0722
Vol. 11 No. 4 (2021)
Received: 30.05.2021 – Accepted: 28.06.2021

Due to the above design feature of the primary converter, it is possible to use the sensor on the conveyor belt or screw for a long time without deterioration of its parameters with a minimum error of the measured value of the permittivity, and therefore the humidity value in the sample sample or the sample volume on the conveyor belt [7].

3. Discussion of Materials

High competition in the flour market requires special attention to the efficiency of management and technological processes at flour milling enterprises. Unfortunately, the grain dictates strict requirements for the quality of individual functions for regulating the performance of the line.

Hydrothermal treatment (GTO) allows you to directly change the initial properties of the grain (physico-chemical, structural-mechanical, biochemical, etc.). Due to the influence of moisture, temperature, as well as anti-aging, for example, the vitreousness of wheat grain decreases, the degree of loosening of the endosperm increases, under the influence of developing biochemical processes, chemical substances are redistributed along the anatomical parts of the grain. With correctly selected wheat GTO modes, the ash content of high-grade flour decreases, the flour yield increases by 1-2% or more [8, 9], and the main priority remains to improve the automatic regulation of the operating parameters of the technological process in complex branched schemes [10].

An important factor can also be considered the case when energy resources are spent when controlling the moisture content of grain, both during the period of receipt, storage, and also during the process of rejuvenation (humidification), especially the control of the moisture content of raw materials before processing [11].

The analysis of literary sources [12, 13, 14, and 15] shows that in scientific literature there is almost no information about the features of the process of moistening the grain of these crops and the energy costs for these needs, therefore, the study of the distribution of moisture in the grain during moistening is of particular wide interest. During hydrothermal processing, complex processes of physico-chemical and biochemical nature develop under the influence of changes in humidity and temperature in the grain. Thanks to them, the technological properties of the grain also change depending on its initial characteristics, the method, the mode of hydrothermal treatment and other factors, as a result of which it is possible to achieve good indicators of energy saving.

It should be noted that these advantages are achieved only under optimal conditions of grain humidification and conditioning, which require automation of the entire process of hydrothermal treatment [16].

Automation of the grain humidification process has become particularly important in today's conditions, when the number of grain producers has increased, and the size of grain batches delivered to the mill has decreased. The moisture content of the grain entering the grain cleaning during one shift varies significantly. Manual regulation of the humidification process with laboratory humidity control does not ensure the supply of grain with a given humidity to the first shingle system [17].

As a result, the uncertainty or error reaches large values, which requires constant adjustment of the grain grinding process. [18]. In this regard, the use of humidity control devices and its operation as part of automation and production processes that will allow us to neglect unnecessary losses of electricity, and in our opinion it is one of the urgent tasks of the enterprise [19].

4. Conclusions

The main energy - intensive processes are the grinding of grain and intermediate products. To solve this problem, it is necessary to regulate the humidification system. For this purpose, it is recommended to use a complex of an automated system, which should consist of the following main blocks: grain moisture measurement, grain flow measurement unit, as well as a microprocessor control and control device. It also needs to include a water control and monitoring unit. As a result, we will get an automatic monitoring and control system, which will allow us to apply an automated humidification system using high-precision meters of grain moisture, water consumption and grain, in general, it will make it possible to stabilize the output moisture of grain.

In turn, this approach to the automatic control system will allow the rational use of grain and increase the efficiency and energy saving of flour milling production, as well as obtaining maximum profit while meeting the demand for the company's products. Analyzing the distribution of electricity will lead to a decrease in both energy intensity and gross domestic product [20].

References

Ptushkin A. T., Novitsky O. A. *Automation of production processes in the field of grain storage and processing.* Moscow: Kolos, 1979, 335 p. (In Russ.)

M. P. Asmaev, Yu. F. Markov, S. A. Podgorny. *Automatic grain humidification at flour-milling enterprises.* Izvestiya VUZov. Food industry No. 1-2. 2005. pp. 45-51. (In Russ.)

Perekrest F. O. Improving the process of grain moistening in the technology of its grinding: Dis... cand. techn. science: 05.20.01-Zernograd, 2012. 181 p. (In Russ.)

Galkina L.S., Butkovskiy V.A., Ptuwkina G.E. *Technique and technology of flour production on complete equipment.* - Moscow: Agropromizdat, 1987. 190 p. (In Russ.)

P.I. Kalandarov., Z.M. Mukimov., O.S. Logunova. Analysis of hydrothermal features of grain fnd instrument desulphurization of moisture control. Tashkent state technical university named after Islam Karimov. *Technical science and innovation.* №1/2020. pp. 117-122.

Apanasenko, Sergey Igorevich. *Automation of humidity control of confectionery masses with the use of intelligent technologies.* (In Russ.) Dis... candidate of Technical Sciences: 05.13.06; - Moscow, 2010. 131 p.

A. B. Anisimov, F. Ya. Rudnik, B. P. Zagorodsky. *Improving the preparation of grain for grinding at small enterprises.* Bulletin of the Mordovian University Volume No. 28, No. 4, - 2018, pp. 603-623. (In Russ.)

S. Balakshin. *Electrification of mills.* “Steam plant are doomed in the millinindistru” Tomsk. 2020. 78 p. (In Russ.)

Kalandarov P. I., Makarov A. M., Aralov G. M., Features of grain moisture automated measurement in field conditions, *Izvestia VSTU*, 2021, no. 1, pp. 60–63. (In Russ.) https://doi.org/10.35211/1990-5297-2021-1-248-60-63 (In Russ.)

Kalandarov P. I., Logunova O. S., Andreev S. M., *Scientific bases of moisture measurement*, Tashkent, TIIMSH Publ., 2021, 174 p. (In Russ.)

Shtofer G. A., Gaisarova A. A. Features of the organization of energy-saving measures at the enterprise. *Economics of Construction and Environmental Management* No. 3 (76), 2020, pp. 28-33.

DOI 10.37279/2519-4453-2020-3-28-33 (In Russ.)

Ecological and economic aspects of the functioning of regional systems: monograph / Under the general editorship of Dr. of Technical Sciences, prof. N. M. Vetrova. - Simferopol, IT "ARIAL", 2019. 240 p. (In Russ.)

Abdyukaeva A. F., Ogorodnikov P. I., Pripadchev A.D. Device for grinding / Patent for invention No. 2263542 issued on 10.11.2005. (In Russ.)

E. S. Kolbina. A logistics approach to ensuring optimal storage conditions for grain crops. *Journal of Economy and Business*, vol. 5. pp. 14-16.

Matveev D.M. Current state of production and finance development of scientific and technological progress in agriculture / *European Researcher*. – 2014. – Vol.(81), № 8-2. P. 1532-1545. (In Russ.)

M. P. Asmaev, Yu. F. Markov, S. A. Podgorny. Automatic grain humidification at flour-milling enterprises. Izvestiya VUZov. *Food Technology*, No. 1, 2005, pp. 59-60. (In Russ.)

Iskandarov B. I., Kalandarov P. I. Analysis of the influence of factors on the result of measurements of material humidity at high frequencies. // *Magazine. Measuring equipment*. No. 7, - 2013, pp. 64-66.

Kalandarov P. I., Mukimov Z. M., Logunova O. S., Instrumentation for moisture control during hydrothermal treatment of grain and its processed products, *Pribory* [*Devices*], 2020, no. 11, pp. 16–21. (In Russ.)

Kalandarov P. I., Iskandarov B. P., *Measurement Techniques*, 2012, vol. 55, no. 7, pp. 845–848. https://doi.org/10.1007/s11018-012-0049-1

Kalandarov P. I. Matyakubova P. M. Gazieva R. T. *Drying and moisture control of grain and granular materials.* Publ., 2021. - T. “ TIIIMSH”. 179 p. (In Russ.).