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Model of Electricity Production in Cotton Networks

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ABSTRACT: In this article has analyzed the energy regimes and the consumption of electricity and gas, the quality indicators of raw cotton processed at the ginnery. A schedule of daily, monthly and annual consumption of electricity and gas consumption modes has been determined. The energy characteristics of the object and a histogram of the distribution of electricity and gas consumption per ton of processed raw cotton have been constructed. Besides, it has been shown summarized analytical results of the plant, based on empirical studies obtained for every day.

Key words: gas consumption, distribution of electricity, cotton-cleaning enterprises, energy modes of operation, gas consumption rates, energy saving.

I.INTRODUCTION

Energy modes of cotton ginning enterprises, electricity and gas consumption depend on the quality indicators of raw materials (cotton fiber). Electricity and gas consumption mode is usually characterized by daily, monthly and annual consumption. In accordance with this, experimental studies on the mode of operation and consumption of energy resources were carried out in "Okkorgon Cotton Industry" LLC, which belongs to "AVS Okkorgon Agro Cluster" LLC (between 2021 and 2022) [1-3].

II. LITERATURE SURVEY

It is known that the main indicator describing the unevenness of the daily load schedules is the inequality coefficient a, where the ratio of the minimum and maximum loads is equal. According to the analysis of the obtained data, the greatest inequality of the graphs is observed in the autumn and winter months. Electricity consumption by months of the year is affected by seasonality and composition of consumers. The description of electricity and gas consumption for a month (for July 2022) in "Okkorgon Paxta Sanoat" LLC, which belongs to AVS Okkorgon Agro Cluster" LLC, is presented in Figure 1 [1].

III. METHODOLOGY

The results show that the consumption of energy resources is affected by the following factors: moisture content of the cotton raw material coming out of the bundle (a, g/m^3); contamination of cotton raw materials coming out of the bundle (b, g/m^3); moisture content of raw cotton coming out of the gin (c, g/m^3); pollution of cotton raw materials coming out of gin (g, g/m^3); seed moisture (r, g/m^3); fiber moisture content (f, g/m^3).

Figure 1 shows the distribution histogram of the electricity consumption rate (N, kW·h/t) per processed ton of cotton.

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Table 1
Generalized analytical results obtained on the basis of empirical studies

Day, month, year	Temperature, t, ^{0}C	Moisture content of raw cotton coming out of the bundle, *a, g/m^3*	Contamination of raw cotton coming out of the bundle, *b, g/m^3*	Moisture content of raw cotton coming out of gin, *c, g/m^3*	Contamination of raw cotton from gin, *g, g/m^3*	Seed moisture, *r, g/m^3*	Electricity consumption, W, kW·h	Comparative energy consumption, N_e, kW·h /t
01.07.2022 y	72	10.7	9.4	8.3	1.4	8.1	7.9	46.3
02.07.2022 y	75	10.8	9.6	8.6	1.5	8.5	8.1	25.9
03.07.2022 y	85	12	14.6	10.9	2.1	9.6	8.9	41.6
04.07.2022 y	65	9.6	7.2	8.5	1	7.6	7	53.1
05.07.2022 y	87	10.1	7.5	8.6	2.1	8.7	8.4	45.9
06.07.2022 y	80	10.3	11.8	9	1.8	8.6	7.9	53
07.07.2022 y	65	9.5	7.6	8	1.2	7.8	7.6	57.5
08.07.2022 y	79	11.3	12.7	8.8	1.3	9	7.1	36.9
09.07.2022 y	80	11.1	14	9.7	2.6	8	8.1	21.2
10.07.2022 y	67	13.3	12.2	11.8	2.2	10.3	8.4	19.2
11.07.2022 y	68	14.2	13.3	13.1	3.3	8.7	10.6	23.8
12.07.2022 y	70	12.9	13	12.3	3.2	9.8	8.4	47.3
13.07.2022 y	74	12.3	12.4	11.8	3.1	8.4	8.1	65.1
14.07.2022 y	76	9.9	8.8	8.7	1.1	7.3	7.9	55.3
15.07.2022 y	72	10.7	9.4	8.3	1.4	8.1	7.9	46.3

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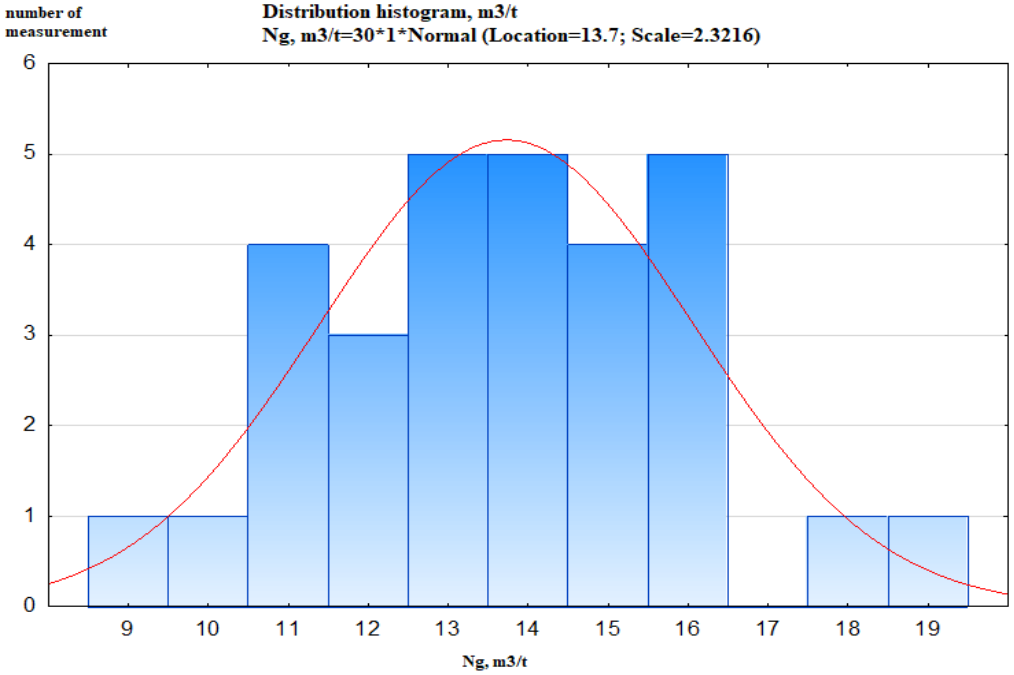

Fig. 1 Distribution histogram of natural gas consumption rate (Ng, m^3/t) per processed ton of cotton

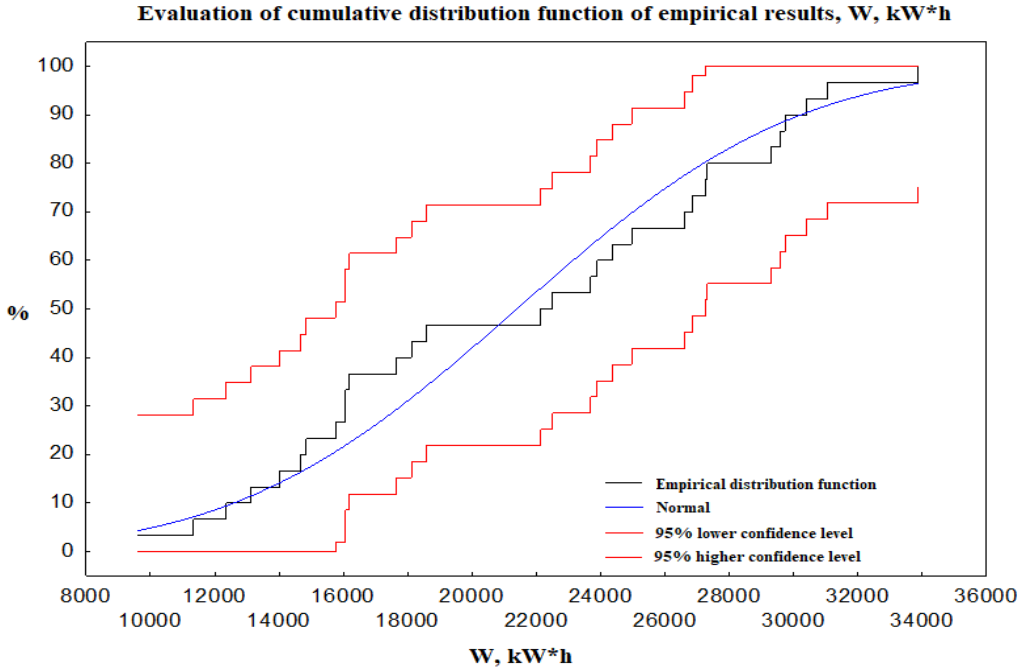

Fig. 2 Description of the evaluation of the cumulative distribution function of the empirical results of electric energy consumption (kW·h).

IV. EXPERIMENTAL RESULTS

Empirical results were evaluated based on formulas (1) - (5) and calculations were performed using the "Statistica" software package version 10.0. Accordingly, the variance estimate is determined by the following formula:

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$$S = \frac{\sum_{i=1}^{m}\left(Y_{1k} - \bar{Y}_k\right)^2}{m-1}, \quad (1)$$

all variances are drawn from samples of the same size m, then the degrees of freedom for all variances are the same and equal

$$df = m-1, \quad (2)$$

the average square of the effect is determined according to the following formula

$$M_S = \frac{S}{df}, \quad (3)$$

Student's test is used to test the hypothesis of equality of mathematical expectations given normal distributions with equal distributions in two samples [4-8].

It is known that when determining the value according to expression, the indicator of the criterion F is smaller than the table obtained by the level of significance q%, that is, the null hypothesis is accepted and the mathematical model of electricity consumption is considered sufficient at a certain level of reliability. Otherwise, it is rejected and the description (model) is recognized as not appropriate for the object.

Table 2 shows the results of the regression analysis, evaluating the effect of the mathematical model of electricity consumption.

Table 2
Regression analysis results

	Regression summary of electricity consumption: W, kW*h R= 0.4825492 R?= 0.2859465 Adjusted R?= 0.1310546 F(6.23)=1.7169 p < 0.16210 Standard error: 6354.6					
N=30	**b***	**Std. Error of b***	**b**	**Std. Error of b**	**t(23)**	**p-value**
Indicator			28524,58	18271,13	1,265985	0,195201
a, g/m3	-0,458672	0,778495	-1254,51	2916,79	-0,365057	0,452601
b, g/m3	-0,195486	0,495325	-223,56	452,59	-0,512394	0,520017
c, g/m3	0,295438	0,356485	1554,01	1832,04	0,896364	0,495268
g, g/m3	0,003659	0,485122	10,97	1960,54	0,011073	0,840054
r, g/m3	0,185858	0,295845	1298,06	2791,88	0,485341	0,614254
f, g/m3	-0,102121	0,374512	-896,5	2870,18	-0,279358	0,712351

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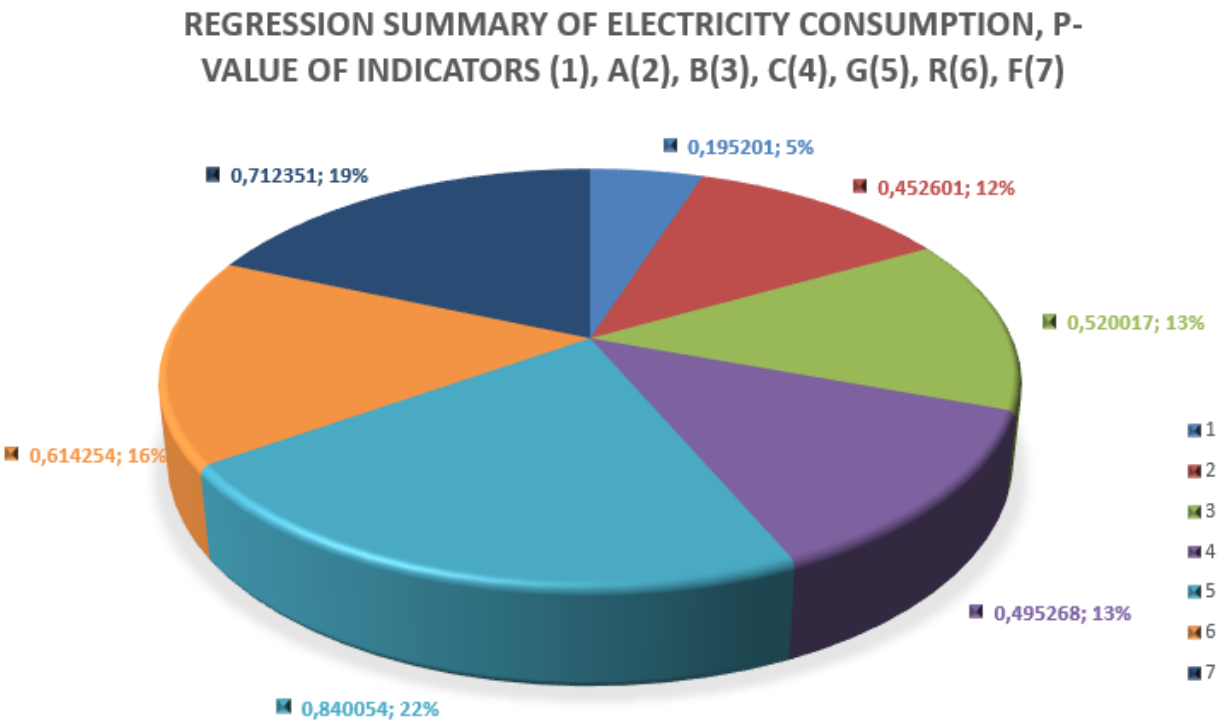

Fig. 3 Regression summary of electricity consumption, P-Value
1-indicators, 2-a, 3-b, 4-c, 5-g, 6-r, 7-f

In this case, Effect is the impact value of the contribution of each factor to the consumed electricity; Std. Error – standard error of effect evaluation; t (df) and p-value – t-criterion and level r value; t-test is used to test the hypothesis that the free term is equal to zero; F –F-criterion value; df –F- criterion is the number of degrees of freedom; p - level of significance; Coeff. - equation coefficients; Std. Err. Coeff. – standard error of coefficients (equation).

V. CONCLUSION AND FUTURE WORK

Thus, as a result of the performed regression analysis, the moisture content of the cotton raw materials coming out of the bundle (a, g/m^3), the contamination of the cotton raw materials coming out of the bundle (b, g/m3), the moisture content of the cotton raw materials coming out of the gin (c, g/ m^3), a model of electricity consumption (W, kW·h) was obtained as a function of contamination of cotton raw materials coming out of gin (g, g/m^3), seed moisture (r, g/m^3) and fiber moisture (f, g/m^3).

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