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SYSTEM OF ENERGY MANAGEMENT OF ELECTRICITY CONSUMPTION IN THE CONCENTRATION PLANT "ELACITE MED"

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ABSTRACT

The concentration plant "Elacacite med", situated in the village of Mirkovo, has yearly consumption about 270 millions tones. About 30% of the cost price of production are used for payment of electrical energy. Since 2000 in the plant works a system for control and reading of electricity consumption. The system is developed and is introduced by the collective from the UMG "St. Ivan Rilski" under the guidance of Prof. M. Menteshev.

On the base of the gained experience from exploitation of this system in this report are made proposals for expansion the ranges of utilisation of the available data. It is proposed to create a data base of generalised indexes and daily analysing of obtained results of specific energy consumption for a tone processed ore, for average night and day value of energy consumption in typical workshops and for the whole plant.

GENERAL PRINCIPLES FOR BUILDING OF ENERGY MANAGEMENT SYSTEM

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An energy management system in a plant is build in order to decrease the expenses for consumed energy. Decrease of the expenses is made in two ways: using the opportunities of rate for payment of electrical energy and by increasing of energy effectiveness.

Before development of the energy management system in particular plant it is necessary to make the energy odit (investigation). Energy odit is made in order to decrease quickly and effective the expenses for energy bearers and abstain from the unwarranted expenses for implementation of non-effective activities.

The results of energy odit could stay on the paper if a system of energy management (control system of energy resources) with corresponding responsibilities, rights and obligations of the participants, ways of financing and estimation of results is not created.

The aim on present development is to help the governing body of the "Elacite med" to decrease the expenses of energy consumption by using of opportunities of rate for payment of electrical energy. A part of proposed activities are carried out in the concentration plant, but are not controlled strictly every day. This opportunity exists because the automated system for control and reading of energy consumption works in the plant.

ANALYSIS OF THE ENERGY CONSUMPTION OF CONCENTRATING PLANT "ELACITE MED"

The analysis of the energy consumption is made on the base of the written data by the control system of energy consumption. A year period of energy consumption is investigated. Data, read by the microprocessor system, are grouped in some units:

- "ELCAITE MED" – read values for the bushings "Murgana" and "Galabets" (110 kV) are summed and it is the whole energy consumption and financial expenses of the concentrating plane;
- MAIN CORPUS - read values for the terminals Main corpus I and II (6 kV) are summed;
- WATER AND WASTE DEPARTMENT – read values of terminals Pump Station I and II and terminal "Kalievo" (20 kV) are summed;
- CCT – the values of terminals CCT I, II and III (6 kV) are summed.

The values of the consumption of active energy and expensed for payment in three-phase zones, workshops and total plant for selected year are given in table 1. The prices of electrical energy are 0.076 lv/kW – daytime and 0.016 lv/kWh night-time and 0.112 lv/kWh –peak energy.

The biggest consumer of electrical energy is the Main corpus, where is concentrated the greatest part of production – grinding, regrinding, flotation, compression and drying. The Main corpus consumes 77.7% of the year active energy. Other consumers are the workshop CCT (12.4%) and Water and waste department (9.42 %). The rest Workshops of the plant consume very little part (0.46%) what means that

attention of the control and activities to consumption decrease should be paid on the workshops situated in the Main corpus, CCT and Pump Stations.

During treated period ware consumed about 12 000 thousand tones ore, that means the specific consumption of electrical energy is 23.21 kWh/ton. The average consumption of electrical energy is 0.076 lv/kWh.

Table 1. Consumed electrical energy and expenses

		"Elacite med"	Main Corpus	CCT	Water and waste dept.
El. energy	Total Thous.kW/h	278 547	216 447	34586	26 228
	peak energy Thous.kW/h	66 111	3 697	6 829	5 194
	Daytime Thous.kW/h	116 033	89 933	14616	10 955
	Night-time Thous.kW/h	96 403	72 817	13141	10 079
Expenses	Total Thous.lv	21 316	16 736	2 549	1 926
	peak energy Thous.lv	8 066	6 551	833	634
	Daytime Thous.lv	8 819	6 835	1111	833
	Night-time Thous.lv	4 431	3 30	605	459

In a selected month are processed 997 thousands tones ore and is read consumption 23 167 000 kW/h which means the specific consumption is 23.23 kWh/ton. The average price of consumed electrical energy is 0.076 lv/kWh.

In table 2 are shown the daily quantities processed ore, daily consumption of electrical energy and achieved daily specific consumption. According to the expectation the greatest specific consumption 25.07 kWh/ton is achieved in a day with minimal quantity of processed ore, and the smallest specific consumption is achieved in a day with approximately maximal consumption. The difference between the maximal and minimal specific consumption is about 3 kWh/ton.

Table 2. Achieved specific consumption of energy

Day	Processed ore, Ton/day	Electrical energy, kWh/day	Specific consumption, kWh/ton
1	30 727	770 332	25,07
2	33 047	742 163	22,45
3	35 300	791 943	22,43
4	32 829	764 037	23,27
5	31 004	732 767	23,63
6	30 986	727 021	23,46
7	35 063	787 000	22,44
8	34 443	765 079	22,21
9	33 583	757 194	22,54
10	34 440	775 077	22,50
11	33 446	783 705	23,43
12	30 453	762 951	25,05
13	31 618	761 602	24,08
14	32 072	786 803	24,53
15	34 516	799 616	23,16
16	34 611	773 684	22,35
17	34 524	782 609	22,66
18	34 018	785 128	23,08
19	33 258	790 412	23,76
20	33 027	790 016	23,92
21	32 169	815 905	24,89
22	33 051	783 843	23,72
23	32 305	736 274	22,79
24	33 953	765 191	22,54
25	33 687	779 157	23,13
26	33 815	775 649	22,94
27	34 915	787 247	22,55
28	33 618	760 531	22,62
29	33 462	776 106	23,19
30	33 127	757 854	22,88
Average	33 236	772 230	23,23
Month indexes	997 067	23166900	23,23

When about 30 000 tones ore are processed it should be calculated that the daily consumption increases with about 100 000 kWh, respectively the expenses increases with 7 600 lv/day.

For the month period are processed the schedules for every day and the daily energy consumption and average price of consumed electrical energy are calculated. The average indexes, days with maximal and minimal energy consumption and days with achieved maximal and minimal price of consumed electrical energy are determined. Obtained results are given in table 3.

Table 3. Achieved average price of energy consumption

	"Elacite med"	Main Corpus	CCT	Water and waste dept.
Average consump. KWh/day	795 554	612 968	77106	101 485
Average price lv/kWh	0,07654	0,07739	0,07474	0,07233
Maximal consump. KWh/day	838 134 0,07696	633 268 0,07742	95 223 0,07736	117 433 0,07335
Min.cons. KWh/day Price lv/kWh	744 277 0,07648	563 367 0,07754	53 213 0,07601	73 409 0,06708

Max.price lv/kWh	0,07848	0,07951	0,08017	0,08839
Consump. KWh/day	750 238	609 320	74 359	97 643
Min.price lv/kWh	0,07477	0,07641	0,06969	0,06451
Consump. KWh/day	768 780	582 935	80 004	91 236

Analysis of the data shown in table 3 show that because of near regular load schedule of the Main corpus, the average daily price of consumed electrical energy in "Elacite med" varies with ±2.5 %. Variation of the average daily price in CCT is form + 7.2 % to –6.8%, and in Water and Waste department from +22.2% to –10.9 % from the average prices. The explanation is that in these workshops are made purposeful activities for consumption in zones with lower prices of electrical energy. The missing of dependencies between achieved prices and daily-consumed quantity of electrical energy shows that these activities are nod made strictly every day.

From the made analysis follows that it is necessary to build a system for energy management, which first to observe every day the following indexes:

1. Achieved specific consumption for the last day and night.
2. Achieved average price of consumed electrical energy for the last day and night separately for the workshops CCT and for Water and Waste department and for the whole plant.

Proposals for improvement of energy management in "Elacite med"

The analysis of consumption of electrical energy shows that main attention should be paid on the daily maximal loading of mills in the Main corpus.

It is necessary to improve the work organisation in the workshop CCT and to estimate the opportunities for turning off during the evening peak. The same concerns to the pomp stations. There compulsory should be made turning off during the evening peak and the aim is part of daily consumption to be made in the night.

For this purpose is necessary every day to print and analyse the data for energy consumption of these workshops in the time of morning and evening peaks separately and to calculate the average prices of consumed electrical energy in workshops. The achieved specific consumption for passed day should be calculated for the whole plant.

It is necessary to make these calculations every day in order to analyse objectively the reasons for eventual successes or unsuccesses, because after the time the real conditions are forgotten.

Using of program product EXCEL at the energetic department should preserve the following data:

1. Date (day and night)
2. Produced quantity of concentrate.
3. Processed ore
4. Consumed electrical energy, kWh
5. Expenses for payment of the consumed energy, lv.
6. Consumed electrical energy by the three zones, total by the plant, by the Main corpus, by CCT and by Water and waste department, kWh.
7. Expenses for payment of consumed electrical energy by the mentioned above days, lv
8. Achieved specific cost of consumed electrical energy during the day and night, total for the plant, for Main corpus, for CCT and for Water and waste department, lv/kWh.

Analysis and prognosis of electrical energy processes could be made using these data in the future.

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