

ТЕХНОЛОГІЇ ЕНЕРГОЗАБЕЗПЕЧЕННЯ

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CURRENT TRENDS OF ENERGY CONSUMPTION CHANGE IN MANUFACTURE OF IRON ORE PRODUCTS

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СУЧАСНІ ТЕНДЕНЦІЇ ЗМІНИ ЕНЕРГОВИТРАТНОСТІ ПРИ ВИРОБНИЦТВІ ЗАЛІЗОРУДНОЇ ПРОДУКЦІЇ

Purpose. On the basis of research of technical and economic indicators of mining and processing production to develop the model of formation and management of energy saving at the mining enterprises.

Methodology. During this research the methods of the technical and economic analysis for an assessment of a modern energy consumption at the mining and processing enterprises, specification and synthesis – for identification of the factors influencing volumes of consumption of energy resources, system analysis – for generalization of the theoretical and methodological principles of formation of power consumption optimum level of mining and processing production products were used.

Findings. The offered model of organizational and economic energy saving at the mining enterprises allows to increase effective management of this process significantly. For definition of the directions of a correcting of organizational and economic and technical and technological actions for energy saving and improvement of system of material stimulation of the personnel of the mining enterprise it is necessary to carry out the monitoring of use of energy resources allowing to estimate expediency of further implementation of energy saving projects and appropriate technologies on natural and cost indexes and also will provide introduction of rational system of motivation of energy saving.

Originality. Consists in system approach application in the expenses management of energy resources at the mining enterprises. At the operating level of management of the mining enterprise methodical ensuring motivation of the personnel of separate structural divisions to energy saving which is based on use of coherence of social and economic interests of the employer and hired worker is considered and allows to reach the maximum economy of energy resources of the enterprise taking into account the period and standards of their planning.

Practical value. The developed model allows to define the actual expenses of energy resources and effectively to operate their use by production of iron ore production in the conditions of limited financial opportunities of the domestic enterprises.

Keywords: *energy resources, energy consumption, energy saving, product cost, material stimulation, mining enterprises*

Formulation of problem and its connection with important scientific and practical tasks. One of basic problems of domestic economy is that there is high power capacity of GDP, that according to the data of the International power agency makes 0,89 kg of conditional fuel on 1\$. This index in 2,6 times exceeds the level of power capacity of the developed countries of the world (0,34 kg are on 1 dol. of the USA) [1]. Mining industry of industry is one of most consumers of energy. On ore mining and processing enterprises are used electric power, diesel fuel, energy of explosives (SR), natural gas, technical water main-

ly. The decision of the indicated problem is envisaged by the legislation of Ukraine, in particular, by Law of Ukraine "On an energy-savings" [2], and also by the urgent necessity of providing of competitiveness of ore mining and processing production.

Analysis of researches and publications. Principal reasons of high through power capacity of products in the mining and metallurgical complex (MMIW) of Ukraine is a technological ramshackleness of basic productive processes, excessive wearing out of the fixed assets (over 65 fully exhausted the term of working lifespan), subzero efficiency of auxiliary productions, foremost, power economy, weak use of secondary energy sources, low level of automation

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and computerization of productive and organizationally-administrative processes. During the last decade of MMIW of Ukraine an about 27 gross domestic product and over 40 currency receivables provide a production [3]. Thus, it is necessary to notice that most mining enterprises of GDP of Ukraine for long time of economic crisis in 90th of the past century worked without realization of native reconstruction, proceeding in an equipment, introduction of progressive technologies and norms. In this connection, Ukraine substantially falls behind from the leading countries of the world after power capacity of metallurgical products that are produced. At present the MMIW of Ukraine are the most power capacity industries of economy. However it should be noted that lately the inefficient consumption of fuel and energy resources becomes more perceptible comparatively with the front-rank countries of the world [4]. Energy resources consumption for manufacturing by Ukrainian metallurgical enterprises substantially exceeds the energy consumption of foreign producers starting from the first redistributions. The most substantial difference in power capacity of the basic types of products of ferrous metallurgy takes place at the production of agglomerate (27%) cast-iron (34%) and rolled products (78%) At that, the energy the capacity of rolled products take into account the energy resources costs on mining and processing of iron-stone, production of coke, agglomerate, iron smelting and steel. The production of rolled products with taking into account expense/pl coefficients on all degrees of metallurgical process in the countries of European Union makes 825 kg, in China – 853 kg, in Ukraine –1110 kg. So the power capacity of domestic rolled products is 34% higher than in the developed countries of the world [4].

Accentuation of earlier unsolved questions of general issue. The problem of energy-savings was examined by many foreign and native scientists who formed theoretical and methodological bases of its decision [5–8]. At the same time, at present, there is need in studying the problem of increasing of efficiency of the use of power resources ore mining and processing production, and also realization of additional scientific researches with account for its specific usage at mining enterprises more thoroughly.

Formulation of article aims (formulation of the problem). The state of energy supply researches on mining enterprises indicate that the charges of power resources substantially influence on competitive positions of native producers on the markets of products that contains iron. The presence of a big quantity of factors of influence motivates the necessity basic researches focus on the decision of the problem of energy-savings at MMIW.

Basic material. One of basic indexes of iron-ore sub industries competitiveness is the production cost of output and primary ore distillation. The average cost of output of iron-stone in Ukraine is approximately \$15–20 for tn, when headings production cost (with Fe of 65 %) is over \$30–35 for tn. For comparison, the production cost of iron-ore raw material (at 67% Fe) of world producers (Australia and Brazil) at present is about \$20 for tn. Costs on the production of Ukrainian enterprises substantially differ in a worst side as in comparison with leading world producers of analogical products. One of the most important constituents of production costs of mining enterprises is power costs, which specific gravity differed: from 9 to 12% for enterprises with the underground method of output, and from 4 to 35% for enterprises with the open pit mining (table 1).

Table 1

Specific gravity of power resources in productive cost of iron-ore production in Ukrainian mining enterprises in 1990–2010

Enterprise	Specific gravity of energy resources, %					Rejection, %			
	1990	1995	2000	2005	2010	1990/ 1995	1995/ 2000	2000/ 2005	2005/ 2010
Enterprises with the underground ore mining									
PJSC “KZRK”	9,02	10,42	10,17	9,42	10,12	+13,44	-2,46	-7,96	+6,92
PJSC “Evraz Sukha Balka”	8,76	9,17	8,63	9,07	9,78	+9,78	-6,26	+4,85	+7,26
PJSC “ZZRK”	9,97	10,63	9,58	10,79	11,63	+6,2	-10,96	+11,21	+7,22
Enterprises with the open pit mining									
PLC “Poltava OMDP”: - pellets	8,79	19,67	20,38	24,81	26,08	+55,31	+3,48	+17,86	+4,87
PJSC “Pivnichnyi OMDP” - headings - pellets	11,5 10,3	21,9 21,3	22,46 23,01	25,23 24,75	24,34 22,07	+47,49 +51,64	+2,49 +7,43	+10,98 +7,03	-3,66 -12,14
PJSC “Tsentralnyi OMDP” - headings - pellets	11,3 10,97	22,9 30,1	21,04 20,8	25,83 25,30	26,17 25,09	+50,66 +63,56	-8,84 -44,71	+18,54 +17,79	+1,29 -0,84
PJSC “Pivdennyi GOK” - headings - agglomerate	13,9 4,45	26,5 8,9	28,85 20,21	32,09 24,15	34,18 28,46	+47,55 +50,01	+8,15 +55,96	+10,1 +16,31	+6,11 +15,14
PJSC “Inguletskiy OMDP” - concentrate	17,4	29,6	34,56	31,47	32,79	+70,11	+14,35	-9,82	+4,03

Such high percentage of power resources in iron-ore production cost is stipulated by increasing of its production volumes in Ukraine carried on, mainly, due to open pit mining of poor magnetite quartzites with low assay of commercial component in ore (iron magnetic), its deep concentrating of fine-divided quartzites and rich ores by the me-

thod of agglomeration. The process of ore dressing and poor iron-stones enriching is characterized by the large electric power consumption and materials, especially at crushing and growing of reches. Combined electric power consumption by enterprises in 2010 is 3% of general energy consumption of iron-ore industry of the country. From the

general volume of electric power consumption on output of iron-stone and production of headings there is 64%, production of agglomerate – 21%, producing of pellets – 15%.

Almost all MMIW of Ukraine were projected, using the principle of “power available per worker”, but not “energy saving”. And as a result, the energy costs resources during the production process of iron production exceed the analogical indexes at foreign enterprises. The rate of change of these indexes within the period 1990–2010 substantially differs depending on the method of iron-stone output (fig.1–3), it also causes some differences in the predictive data of mining production until 2015.

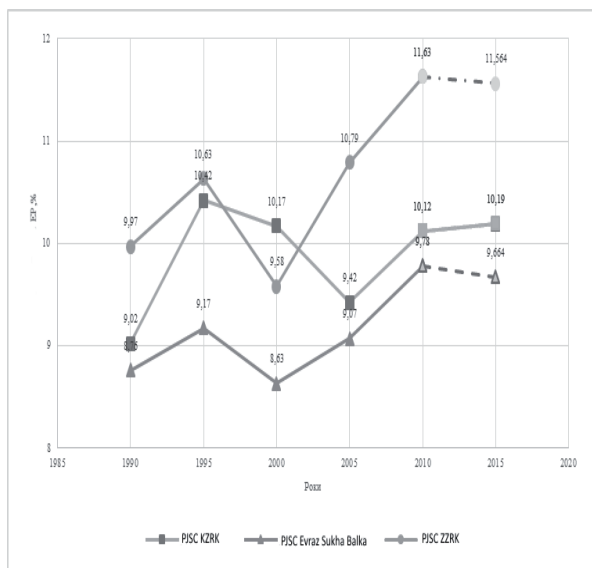


Fig. 1. Specific gravity dynamics of ERAS in the headings production cost within the period 1990–2010

Power resources which are necessary for iron-ore production are divided into two large groups: fuel and power charges. Whereas fuel includes: natural gas, diesel fuel and petrol, and power charges are electric power, technical water and flows.

Combined consumption of electric power in Ukraine in 2010 made 11,7 bln kW*h the enterprises of iron-ore industry or 2% of general energy consumption in the country. From the general volume of energy consumption on the iron-stone output and headings production is 62%, on the production of agglomerate – 21% and pellets production – 17%. The middle unit costs of electric power in iron-ore enterprises of Ukraine – 45–50 kW by hours on 1 ton of the obtained and reworked ore and 125–130 kW*h on 1 tn of the obtained headings.

At ore mining and processing enterprises, where the end product is iron-ore pellets, the power-capacity of output and processing of iron-stone equals 60–65 kW*h/of tn ore, and on MMC, where finish good is an iron-ore concentrate, this index presents 35–40 kW*h/of tn ore. Thus, in the pattern of consumption of power resources in a value term electric energy occupies most specific gravity (table 2).

There is the burning problem of increasing of world, and as result and internal prices on electric power, fuel and gas – key constituents of power-capacity of iron-ore pro-

ducts of MMC of Ukraine. A price advance on natural gas for 5 last years is 550%, on electric power – 300%.

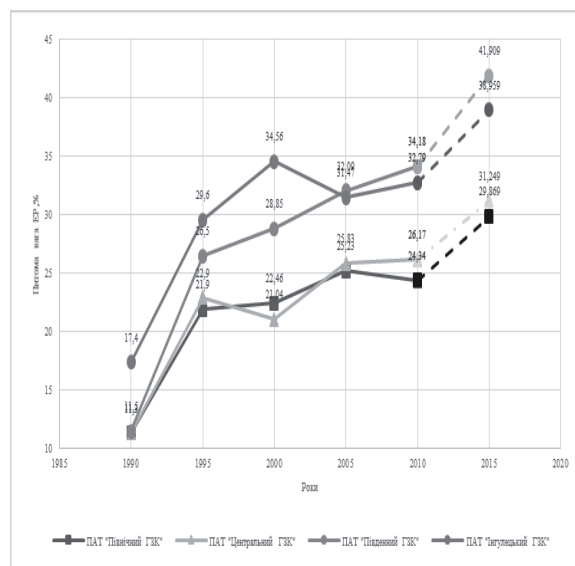


Fig. 2. Specific gravity dynamics of ERAS in the headings production cost within the period 1990–2010

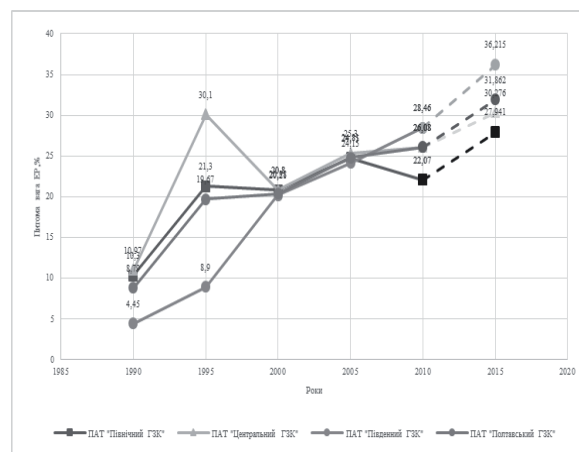


Fig. 3. Specific gravity dynamics of ERAS in the pellets production cost within the period 1990–2010

According to the plans of Cabinet of ministers of Ukraine the price on electric power to 2015 as it is planned to be increased minimum at 1,3 times, fuels –1,6 and to gas –1,8 to the level of 2011, that at the present specific costs for power resources on the production of payable ore will result to uncompetitiveness of swingeing majority of iron-ore enterprises. For Ukraine as for one of the most energy dependent states, a world price increase on power resources will require the revolutionary changes of the power politics and concern all economy of country without exception.

At modern tendencies maintenance of price increasing for power resources and relative maintenance of overall production which contain iron till 2015 in Ukraine on the average the electric power costs per 1 ton of payable products will grow approximately on 12% monetary, and gas charges – twice in relation to the level of 2012, that is confirmed by the got characteristic curves.

Table 2

Approximate structure iron ore products costs at MMC Krivoy Rog

Enterprise	Production costs, thous. UAH., %						
	Material	Including electricity	Remuneration	Social payments	Amortization	Other operating	Total
PJSC "Pivnichnyi OMDP"	804333	257029	161196	64399	67313	229740	1326981
	60,61	19,37	12,15	4,85	5,08	17,31	100,00
PJSC "Tsentralnyi OMDP"	455055	137815	137866	52924	45070	164806	855721
	53,17	16,11	16,11	6,18	5,27	19,26	100,00
PJSC "Pivdennyi OMDP"	729812	195373	144319	56381	90106	120072	1140690
	63,98	17,13	12,65	4,96	7,90	10,53	100,00
PJSC "Inguletskyi OMDP"	799790	336298	115467	45637	121191	198945	1284109
	62,28	26,19	9,23	3,56	9,44	15,49	100,00
GOK "ArselorMittall Krivoy Rog"	794956	200575	134986	50978	109696	23820	1114436
	71,33	36,00	12,11	4,58	9,84	2,14	100,00
Total	3186468	1127090	626341	244830	378528	725473	5164719
	61,70	21,82	12,13	4,74	7,33	14,05	100,00

Thus, the decline of level of energy consumption in present is one of the most necessary conditions of production development – primarily ore mining and processing enterprises, as most energy consuming, as provides the decline of unit cost and assists the substantial cutback of the investment spending related to the production of additional amount energy resources, in the scales of national economy.

At the same time the improvement of the use of energy resources conduces to the increase of the productivity to labour and increase of volume of output of products, results in the improvement of structure energy to balance due to the cutback of the unproductive spending and losses, that confirms actuality and necessity of decision of these questions at planning and working mine of minerals.

On the basis of undertaken studies by us the offered chart of providing of corresponding management level of an energy-savings at mining enterprises (fig. 4), that allows to determine priority directions of adjustment of organizationally-economic and technical and technological measures in relation to an energy-savings with application of the rational system of material stimulation of personnel of enterprise.

At operating level of management an economic and technical department and management of mining enterprise watch informative streams for realization of monitoring of the use energy resources with the aim of estimation of expediency of further realization of energykeeping projects and corresponding technologies on natural and cost indexes, and

also improvement of the system of motivation of energy-savings taking into account socio-economic interests of workers.

After all the directions of adjustment of organizationally-economic and technical and technological measures are determined in relation to an energy-savings and system of material stimulation of personnel of enterprise. The key constituent of the organizationally-economic providing of the effective use of power resources is an improvement of the system of motivation of energy-savings on domestic enterprises. For this reason, the system of material stimulation from position of motivation of economy of resources, first of all, on expensive iron ore enrichment works enterprises needs substantial adjustment with the aim of her rapid adaptation to the specific of market conditions.

Conclusions and prospects of further researches.

The given results allow to form effective control system by an energy-savings on all technological processes of output and processing of mineral raw material at mining enterprises. At the same time, the offered chart needs a further improvement with the aim of taking into account of changeability of financial possibilities of domestic enterprises and necessity of substantial technical and technological rearmament of ore mining and processing production in accordance with the modern requirements of International organization from standardization (of International Organization for Standardization). This organization is worked out the major standards, that regulate prior direc-

tions of industrial and economic activity, that form proof competition position of modern industrial enterprise. To key characteristics of the use of power resources efficiency at enterprise a presence and introduction attribute, in particular, in the productive process of standard of ISO

50001:2011 is “System of power management” in a complex from ISO 14001: 2004 “Systems of ecological management”; ISO 9001:2008 “Systems of management of quality. Requirements” and OHSAS 18001:2007 “Systems of management of safety of labour are Requirements”.

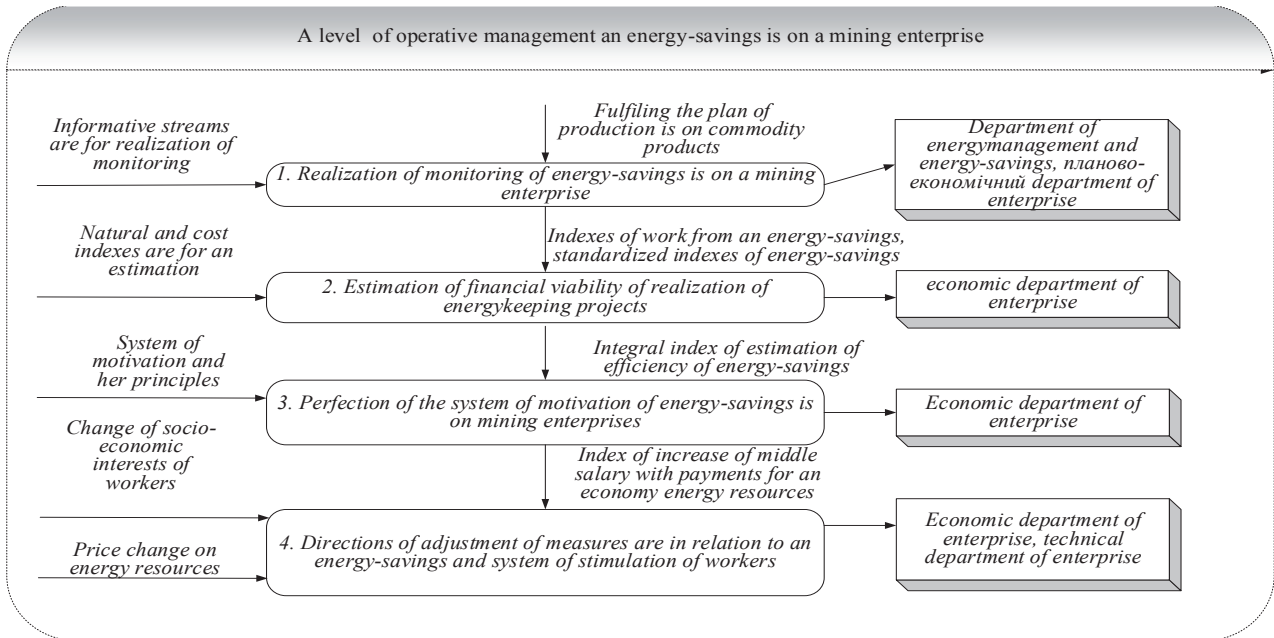


Fig. 4. Chart of the organizationally-economic providing of operating level of management of energy-savings on a mining enterprise

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Мета. На підставі дослідження техніко-економічних показників гірничо-збагачувального виробництва розробити схему формування та управління енергозбереженням на промислових підприємствах.

Методика. Під час проведення даного дослідження використовувались методи техніко-економічного

аналізу для оцінки сучасного стану енергоспоживання на гірничо-збагачувальних підприємствах, деталізації та синтезу – для виявлення факторів, що впливають на обсяги споживання енергетичних ресурсів, а також системного аналізу – для узагальнення теоретико-методологічних засад формування оптимального рівня енергоемності товарної продукції гірничо-збагачувального виробництва.

Результати. Запропонована схема організаційно-економічного забезпечення енергозбереження на гірничорудних підприємствах дозволяє суттєво підвищити ефективність управління цим процесом. Проведені дослідження енерговитратності при виробництві залізорудної продукції дозволяють оптимізувати показники виробничої програми гірничорудного підприємства на основі оцінки ефективності використання енергетичних ресурсів, а також приймати оперативні управлінські рішення з урахуванням резервів гірничого виробництва.

Наукова новизна. Полягає в застосуванні системного підходу в контексті управління витратами енергетичних ресурсів на гірничорудних підприємствах. Це дозволяє досягнути економічної стабільності при оптимальному рівні енергоспоживання, балансу енергії між її витратами та одержаними виробничими результатами на рівні не вищому за норми питомих витрат палива та енергії, вирішення завдань щодо прогнозування цінних коливань на паливно-енергетичні ресурси із забезпеченням умов для швидкої адаптації гірничорудних підприємств до суттєвих змін цін на енергоресурси.

Практична значимість. Розроблена схема дозволяє визначати фактичні витрати енергоресурсів та ефективно управляти їх використанням на оперативному рівні управління енергозбереженням на гірничорудному підприємстві в умовах обмежених фінансових можливостей.

Ключові слова: енергетичні ресурси, енергоспоживання, енергозбереження, собівартість продукції

Цель. На основании исследования технико-экономических показателей горно-обогатительного производства разработать схему формирования и управления энергосбережением на промышленных предприятиях.

Методика. Во время проведения данного исследования использовались методы технико-экономического

анализа для оценки современного состояния энергопотребления на горно-обогатительных предприятиях, детализации и синтеза – для выявления факторов, влияющих на объемы потребления энергетических ресурсов, а также системного анализа – для обобщения теоретико-методологических принципов формирования оптимального уровня энергоемкости товарной продукции горно-обогатительного производства.

Результаты. Предложенная схема организационно-экономического обеспечения энергосбережения на горнорудных предприятиях позволяет существенно повысить эффективность управления этим процессом. Проведенные исследования энергозатратности при производстве железорудной продукции позволяют оптимизировать показатели производственной программы горнорудного предприятия на основе оценки эффективности использования энергетических ресурсов, а также принимать оперативные управленческие решения с учетом резервов горного производства.

Научная новизна. Состоит в применении системного подхода в контексте управления затратами энергетических ресурсов на горнорудных предприятиях. Это позволяет достичь экономической стабильности при оптимальном уровне энергопотребления, баланса энергии между её затратами и полученными производственными результатами на уровне не высшем за нормы удельных затрат топлива и энергии, решение задач относительно прогнозирования ценовых колебаний на топливно-энергетические ресурсы с обеспечением условий для быстрой адаптации горнорудных предприятий к существенным изменениям цен на энергоресурсы.

Практическая значимость. Разработанная схема позволяет определять фактические расходы энергоресурсов и эффективно управлять их использованием на оперативном уровне управления энергосбережением на горнорудном предприятии в условиях ограниченных финансовых возможностей.

Ключевые слова: энергетические ресурсы, энергопотребление, энергосбережение, себестоимость продукции

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