

METHODS OF ECOLOGICAL AND ECONOMIC EVALUATION OF ORE-MINING WASTE UTILIZATION

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The existing methods of ecological and economic evaluation of utilization of concentration wastes at ore-mining enterprises are analyzed and their weaknesses are identified. The author's ecological and economic evaluation of concentration waste utilization at ore-mining enterprises is presented. The essence of the economic evaluation taking into account ecological factors and the way it improves the economic effect is revealed. The imperfect character of existing methods of economic and ecological evaluation of the technological development of mining enterprises is proved. The prospects of waste utilization in the activity of ore-mining enterprises are stressed. The imperfection of existing technologies of processing mineral raw materials is shown to be the main reason for negative influence on ecology.

Keywords: ecology, economics, evaluation, wastes, reuse.

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МЕТОДИКА ЕКОЛОГО-ЕКОНОМІЧНОЇ ОЦІНКИ ВИКОРИСТАННЯ ВІДХОДІВ ЗБАГАЧЕННЯ ГІРНИЧОРУДНИХ ПІДПРИЄМСТВ

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Проаналізовано наявні методи еколого-економічної оцінки використання відходів гірничорудних підприємств та виявлено їх недоліки. Наведено власну еколого-економічну оцінку використання відходів збагачення гірничорудних підприємств. Розкрито сутність економічної оцінки з урахуванням екологічних факторів та її вплив на підвищення економічного ефекту. Доведено неефективність наявних методів економічної та екологічної оцінки процесів технологічного розвитку гірничорудних підприємств. Підкреслено, що використання відходів збагачення є перспективним напрямом діяльності гірничозбагачувальних підприємств. Показано, що саме недосконалість наявних технологій переробки мінеральної сировини є причиною негативного впливу на екологію.

Ключові слова: екологія, економіка, оцінка, відходи, повторне використання.

МЕТОДИКА ЭКОЛОГО-ЭКОНОМИЧЕСКОЙ ОЦЕНКИ ИСПОЛЬЗОВАНИЯ ОТХОДОВ ОБОГАЩЕНИЯ ГОРНОРУДНЫХ ПРЕДПРИЯТИЙ

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Проанализированы существующие методы эколого-экономической оценки использования отходов горнорудных предприятий и определены их недостатки. Представлена собственная эколого-экономическая оценка использования отходов обогащения горнорудных предприятий. Раскрыта сущность экономической оценки с учетом экологических факторов, а также влияние ее влияние на повышение

экономического эффекта. Доказана неэффективность существующих методов экономической и экологической оценки процессов технологического развития горно-рудных предприятий. Подчеркнуто, что использование отходов обогащения является перспективным направлением деятельности горно-обогатительных предприятий. Указано, что именно несовершенство существующих технологий переработки минерального сырья является причиной отрицательного влияния на экологию.

Ключевые слова: экология, экономика, оценка, отходы, повторное использование.

The increase in volumes of extraction and processing of natural raw materials by ore-mining enterprises provides more complex conditions of extraction that, therefore, leads to an increase in the costs of the final product and ecological load on the environment. The imperfection of the technology of iron-ore concentration leads to a growth of wastes in arithmetic progression, expansion of territory of their storage, has negative impact on the ecosystem and the health of the people.

The relevance of the chosen topic is confirmed by the practice and experience of many foreign enterprises, which improved the business image in the market due to utilization of concentration waste. The problem of economic evaluation of the use of technogenic raw materials was investigated by many scientists, both in Ukraine and abroad. A weighty contribution to the solution of this issue was made by domestic and foreign scientists, such as: H. Ilina, V. Borysova, I. Zhavoronkova, L. Kholodenko, E. Nersesyan, M. Pevzner, L. Varava, Clive L. Spash [1 – 8].

Those studies, which were carried out in the sphere of economic evaluation of the processes of rational use of natural raw materials and opportunities to use concentration wastes can be considered incomplete and complex, and as the situation is changing both in economy, and in the environment, all these changes, are the purpose of the research. Previous researches were only concentrated on the economic effect and reduction of the damage caused by the main production. The existing methods of evaluation of resource-saving technologies do not take into account the whole spectrum of social and environmental factors affecting the results of this evaluation, so it is important to find the ways to improve the environmental safety of production.

The aim of the research is the development of theoretical thesis and methodical and practical recommendations on improving the economic evaluation of the use of concentration wastes of mining enterprises with regard to environmental factors and the efficiency of use of resources.

The lack of a unified economic approach to the evaluation of the options of technological development of mining enterprises, taking into account social and environmental impacts, as well as the integrated use of natural resources as an integral current mechanism, determines the need for a comprehensive fulfilling of the tasks, which have allowed obtaining an additional source of resources through the use of waste of production and, most importantly, to prevent an ecological disaster, which is equal in scale to the situation at Chernobyl NPP.

The most known minerals on the Earth are located in Ukraine. According to the State Fund of Geology the value of the explored mineral resources in our country comes to 7.5 trillion dollars. 96 kinds of mineral resources can be found in the Ukrainian land, 70 of them are being mined. For 100 years of extraction of deposits of Kryvbass, Ukraine has received 6 billion tons of iron ore. If we compare production in other countries with one particular basin, these are huge volumes, which are unique in the world [5].

A large amount of waste is the most objective

indicator of the imperfection of the technological scheme, therefore, it is necessary to ensure the creation and widespread application of technical means and technologies for the integrated and more complete extraction of useful components of ore, as well as the use of low-waste and non-waste technologies.

The activities of mining and processing enterprises involve, as shown in the studies [9], mining, processing and concentration of mineral resources, resulting in formation of waste dumps and tailings, which store the waste of concentration. In the mining industry the area occupied by each of the tailings makes hundreds of hectares, and their height is tens of meters. One of the major and still unresolved environmental problems arising during the operation of ore-mining enterprises is discharge of dust from the surfaces of the dehydrated sediment, in the territory adjacent to them. As it is densely populated, dust causes diseases of the respiratory organs and eyes of the people who live and work there. The economic damage caused to the rural economy through the dust of a tailings dump is about a billion of hryvnias, but the long-term consequences are not even taken into account.

Therefore, quite a lot of circumstances influence taking effective administrative decisions on improving the technological development of the mining enterprise. This article presents the evaluation of the impact factors, which show the extent to which it is feasible to use wastes of ore-dressing plants to obtain additional volumes of the main products and materials for the related construction industry.

Today, most of the waste is created by the branches of the mineral raw materials complex, including mining and processing enterprises. The total volume of waste in these industries is 70 – 75 %. Only 6 – 7 % of the waste is reused. The Figure below shows the situation that has developed due to the fact of non integrated use of natural resources (25 – 30 % make the extracted useful component, 70 – 75 % is the waste or unrecycled useful components) [10].

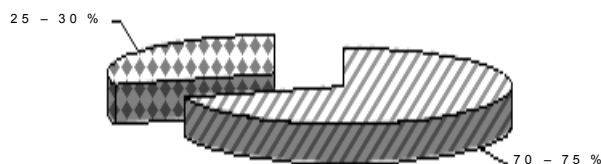


Fig. The pie chart of the use of natural resources

Experience indicates that the majority of waste of the mineral raw materials complex can be used with considerable economic effect.

The calculation of the effect of the introduction of waste recycling technologies at mining and processing plants, is given below and recommended for individual cases, taking into account the peculiarities of this industry:

$$E = P_1 + P_2 + \sum V_{\text{envir}} + \sum V_{\text{waste}} - \sum V_{\text{module}}, \quad (1)$$

where P_1 is profit from the sale of the additional volume of basic products, UAH;

P_2 is profit from selling by-products, UAH;

$\sum V_{\text{envir}}$ is the amount of savings resulting from lower fines for pollution of the environment, UAH;

$\sum V_{\text{waste}}$ is the amount of savings from the reduced cost of waste, UAH;

$\sum V_{\text{module}}$ is the amount of expenses related to the launch of the waste recycling module, UAH.

Below there is a list of indicators, which make it possible to determine the most efficient mode of the activity of the enterprise that produces and enriches natural raw materials, namely to make a decision on how to improve the technological process and use concentration waste.

The index of savings of natural raw material ($K_{\text{raw mat.}}$), through the use of waste, looks as follows:

$$I_{\text{raw mat.}} = Q_{\text{waste}} / Q_{\text{natur.}}, \quad (2)$$

where Q_{waste} is the amount of waste that is recycled, t;

Q_{natur} is the volume of mining and processing of natural raw materials, t.

The choice of technology of production must comply with the criterion of:

$$0 < I_{\text{raw mat.}} < 1.$$

The index of cost savings on transportation of raw material for further processing ($I_{\text{trans.}}$) is equal to:

$$I_{\text{trans.}} = V_{\text{trans.waste}} / V_{\text{trans.natur.}}, \quad (3)$$

where $V_{\text{trans.waste}}$ is expenses on delivery of the waste, UAH;

$V_{\text{trans.natur.}}$ is expenses on delivery of the natural resources, UAH.

The criterion for the decision will be:

$$0 < I_{\text{trans.}} < 1.$$

The index of cost savings from the reduced negative environmental impact takes the form of:

$$I_{\text{envir.}} = V_{\text{module}} / V_{\text{maint.}}, \quad (4)$$

where $V_{\text{maint.}}$ is expenses on the maintenance of waste, UAH;

V_{module} is the cost of putting the waste recycling the module in operation, UAH.

The criterion for the choice of the technology is:

$$0 < I_{\text{envir.}} < 1.$$

The index of cost savings from the payment of fines

for environmental pollution is calculated as:

$$I_{\text{pol.}} = V_{\text{mandat.}} / V_{\text{exp.}}, \quad (5)$$

where $V_{\text{mandat.}}$ is expenses of the payment of fines and mandatory payments, UAH;

$V_{\text{exp.}}$ is environmental expenditures, UAH.

In accordance with it, the criterion will be:

$$0 < I_{\text{pol.}} < 1.$$

The index of cost savings due to the elimination of the primary stages of raw materials processing is as follows:

$$I_{\text{neces.}} = V_{\text{neces.}} / V_{\text{primary}}, \quad (6)$$

where $V_{\text{neces.}}$ is expenditures on the necessary stages of waste handling, UAH;

V_{primary} is expenditures on the primary stage of natural raw material processing including production, UAH.

Hence the criterion is:

$$0 < I_{\text{neces.}} < 1.$$

The index of production diversification is:

$$I_{\text{div.}} = N_{\text{before}} / N_{\text{after}}, \quad (7)$$

where N_{before} is the number of units of the name of the product before the improvement of the technological process;

N_{after} is the number of units of the names of the product after the improvement of the process of technological development and recycling of waste.

In accordance with it, the criterion is:

$$N_{\text{after}} \rightarrow \text{ax.}$$

The index of changes in quality of the basic products constitutes:

$$I_{\text{qual.}} = Fe_{\text{before}} / Fe_{\text{after}}, \quad (8)$$

where Fe_{before} is the content of the basic useful component, before the improvement of technology, %;

Fe_{after} is the content of useful component in the main product after improvement of the technological process due to the use of technogenic raw materials. Thus,

$$Fe_{\text{after}} \rightarrow \text{ax.}$$

In order to take into account the changes of ecological and economic assessment of the processes of technological development of mining enterprises it is necessary to adjust the value of the indicator of the economic effect from the introduction of technologies on processing of technogenic raw materials in the generalized coefficient.

The generalized coefficient is calculated as follows:

$$I_{\text{general}} = \sum_{i=1}^n \frac{I_{sh,i}}{\sum_{i=1}^n I_{sh,i}} \Rightarrow$$

$$\sum I_i = I_{\text{raw mat.}} + I_{\text{trans.}} + I_{\text{envir.}} + I_{\text{pol.}} +$$

$$+ I_{\text{neces.}} + I_{\text{div.}} + I_{\text{qual.}} \quad (9)$$

where I_{sh} is share of the index, which is available in the process of expert evaluation.

$$E_T = \sum_{t=1}^T \frac{E_t}{(1 + i)^t} \times j_{\text{gen}} \quad (10)$$

where E_t is the economic effect of the waste-recycling technology, UAH;

T is the period of mining of raw material sources, the number of years;

t is the year sequence number;

i is the rate of discount.

The economic effect of taking into account the saving of natural raw materials due to the waste recycling, savings on transportation of raw materials for further processing, cost savings from the payment of fines for pollution of the environment, as well as the increase of the volume of production of the main produce is an adequate indicator, which takes into account the peculiarities of the process of technological development. Thus, the economic and environmental evaluating of the use of ore-mining concentration waste is adapted to the modern problems of the regions where mining and processing of mineral resources is carried out.

Analyzing the above-mentioned, the following conclusions can be made:

1. Ore mining is carried out in more complex than before mining and geological conditions, which result in the constantly growing cost of raw materials, the increased amount of production waste, which can easily be reused for the production of additional iron ore products.

2. Existing methods of economic and environmental evaluation of options for the technological development of mining enterprises are imperfect. In this study a complex technique of ecological and economic evaluation of the processes of technological development of the mining industry enterprises is proved, which takes into account all the factors of the negative impact on the environment and the people who live in it.

The problem of reuse of concentration waste of ore-mining enterprises is a promising area of investment. This is the future of the economy, which can already now bring a lot of profit. Besides, recycling of waste has a positive impact on ecosystems and human health due to the decrease of their volume.

References: 1. Ільїна Г. В. Сучасні виміри проблеми відповідальності в екологічній етиці у контексті управління сталим розвитком / Г. В. Ільїна // Економіка розвитку. – 2012. – № 4 (64). – С. 25–29. 2. Борисова В. А. Екологізація підприємницької діяльності / В. А. Борисова. – Суми : Довкілля, 2004. – 128 с. 3. Жаворонкова И. П. Экономические вопросы улучшения использования минерально-сырьевых ресурсов / И. П. Жаворонкова. – М.: Наука, 1973. – 200 с. 4. Холоденко Л. Б. Экономическая эффективность использо-

вания промышленных отходов и методы ее определения : дис. ... к. э. н. : 04823007219 / Леонид Борисович Холоденко. – К., 1981. – 175 с. 5. Нерсисян Э. К. Экономическая эффективность рационального использования минерально-сырьевых ресурсов (на примере горнодобывающей промышленности) : дис. ... к. э. н. : 04821235758 / Нерсисян Эдуард Константинович. – М., 1982. – 168 с. 6. Певзнер М. Е. Экология горного производства / М. Е. Певзнер, В. П. Костовский. – М.: Недра, 1990. – 235 с. 7. Варава Л. Н. Экономическая оценка использования отходов горно-обогатительного производства с целью получения строительных материалов в условиях ГО Ков Кривбасса : дис. ... к. э. н. : 08.00.05 / Варава Лариса Николаевна. – Кривой Рог, 1992. – 176 с. 8. Clive L. Spash. Influencing the perception of what and who is important in ecological economics / L. Spash Clive // Ecological Economics. – 2013. – Vol. 89 (May 2013). – P. 204–209. 9. Федорченко А. О. Вдосконалення оцінки економічної ефективності процесів технологічного розвитку гірничорудних підприємств / А. О. Федорченко // Економічний простір. – 2008. – № 20/2. – С. 241–246. 10. Максимов С. В. Економічний та екологічний аспекти використання відходів на гірничо-збагачувальних комбінатах / С. В. Максимов, А. О. Федорченко // Вісник Криворізького технічного університету. – 2007. – № 19. – С. 270–274.

References: 1. Ільїна Г. В. Сучасні виміри проблеми відповідальності в екологічній етиці у контексті управління сталим розвитком / Г. В. Ільїна // Економіка розвитку. – 2012. – № 4 (64). – С. 25–29. 2. Борисова В. А. Екологізація підприємницької діяльності / В. А. Борисова. – Суми : Довкілля, 2004. – 128 с. 3. Жаворонкова И. П. Экономические вопросы улучшения использования минерально-сырьевых ресурсов / И. П. Жаворонкова. – М.: Наука, 1973. – 200 с. 4. Холоденко Л. Б. Экономическая эффективность использования промышленных отходов и методы ее определения : дис. ... к. э. н. : 04823007219 / Леонид Борисович Холоденко. – К., 1981. – 175 с. 5. Нерсисян Э. К. Экономическая эффективность рационального использования минерально-сырьевых ресурсов (на примере горно-добывающей промышленности) : дис. ... к. э. н. : 04821235758 / Нерсисян Эдуард Константинович. – М., 1982. – 168 с. 6. Певзнер М. Е. Экология горного производства / М. Е. Певзнер, В. П. Костовский. – М.: Недра, 1990. – 235 с. 7. Варава Л. Н. Экономическая оценка использования отходов горно-обогатительного производства с целью получения строительных материалов в условиях ГО Ков Кривбасса : дис. ... к. э. н. : 08.00.05 / Варава Лариса Николаевна. – Кривой Рог, 1992. – 176 с. 8. Clive L. Spash. Influencing the perception of what and who is important in ecological economics / L. Spash Clive // Ecological Economics. – 2013. – Vol. 89 (May 2013). – P. 204–209. 9. Федорченко А. О. Вдосконалення оцінки економічної ефективності процесів технологічного розвитку гірничорудних підприємств / А. О. Федорченко // Економічний простір. – 2008. – № 20/2. – С. 241–246. 10. Максимов С. В. Економічний та екологічний аспекти використання відходів на гірничо-збагачувальних комбінатах / С. В. Максимов, А. О. Федорченко // Вісник Криворізького технічного університету. – 2007. – № 19. – С. 270–274.

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