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## ECONOMIC JUSTIFICATION OF STAGES OF THE INVESTMENT PROJECT OF A MINING AND PROCESSING ENTERPRISE

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## ЕКОНОМІЧНЕ ОБҐРУНТУВАННЯ ЕТАПІВ РЕАЛІЗАЦІЇ ІНВЕСТИЦІЙНОГО ПРОЕКТУ НА ГІРНИЧО-ЗБАГАЧУВАЛЬНОМУ КОМБІНАТІ

**Purpose.** Development of theoretical recommendations regarding the commissioning of fixed assets of mining and processing enterprises in the implementation of investment projects based on the use of bank loans as a source of funding.

**Methodology.** Results of the study were obtained using the following methods: analysis - the study of theoretical approaches, which are the basis of the recommendations developed, and economic feasibility of the input sequence of the fixed assets; consolidation - in the formulation of the theoretical recommendations regarding the use of bank loans in the implementation of the mining and concentrating enterprises' investment projects and programs.

**Findings.** Analysis of theoretical approaches to the assessment of prospects for the development of mining and processing enterprises in modern conditions is made. Theoretical recommendations on economic justification for investment projects aimed at the renewal of fixed assets plant and energy efficiency are formulated. Methodical recommendations on the definition of loan payments during commissioning of mining and processing plant's fixed assets are developed. Ability to use the profits that the enterprise receives from the commissioning of fixed assets to repay the bank loan, reducing the repayment period of the loan and the amount of interest payments, is justified.

**Originality.** Theoretical recommendations regarding the sequence of commissioning of fixed assets in investment projects provide an opportunity to repay the loan from its own funds and combine profits earned by the commissioning of fixed assets. In this case it is advisable to choose a sequence of commissioning of fixed assets, in which the amount of interest on the loan, paid excluding extra profit, is minimal.

**Practical value.** The recommendations can justify the steps of realization of investment projects of the mining industry, to reduce the credit period and the amount of loan payments.

**Keywords:** *mining and processing combine, loan, investment, profits, fixed assets, methodical recommendations*

**Statement of the problem.** The main challenges that are faced in modern conditions by mining and concentrating combines are elimination of the consequences of the crisis in the industry, ensuring of the functioning and further development of combines, development and support of the image of financially sustainable and competitive producer of iron ore resources, the expansion of existing and the conquest of new markets and etc. However, there are factors that hinder development of production at combines, such as deterioration of fixed capital and the need for their modernization. This, in turn, requires significant capital investments and development of investment programs to upgrade fixed assets and energy saving. It should be noted that the mining and concentrating combines are part of a vertically integrated structures, so the main sources of financing are own funds and funds from investors. At the same time we cannot exclude borrowing as a source of financing of the above programs.

**Analysis of recent publications.** Studies based on theo-

retical approaches to assessing the prospects of development of mining and processing enterprises in modern conditions set forth in the works of V.Y. Nusinova, A.M. Turilo, I.E. Afanasiev, A.A. Turilo, I.V. Shishova [1–3].

The main tool for further development of enterprises and overcoming of crisis situations faced by mining and concentrating combines is capital investment [4, 5]. It should be noted that the priority areas for further combines development are modernization of fixed assets or capital construction of technological facilities, as one of the main factors that negatively affect the efficiency of the capital, is the worn out equipment [6]. The need to upgrade or replace obsolete equipment is underscored not only by scientists [7], but also provided in the Concept of the Ukrainian Coal Industry Development. [8].

One of the directions of further development of mining and processing enterprises, according to Konovalova O.V, Klimentkova T.V. and Vasiltsov E.V., is to update the worn portion of fixed assets or to modernize them, which will improve the competitiveness of products and increase production [9, 10].

Since some of the enterprises in the manufacturing process use the equipment, the deterioration level of which exceeds 60% [11]. It should be noted that during

2010–2012 years the level of depreciation of fixed assets is reduced (Fig. 1). This is due to the update of their worn parts.

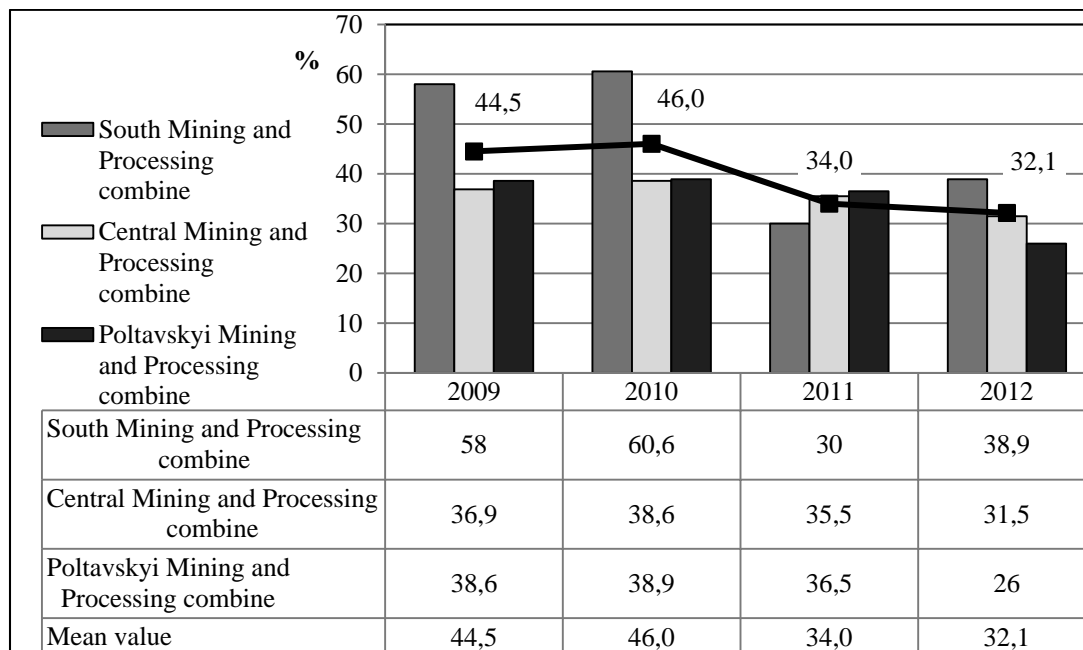


Fig. 1. Level of fixed assets depreciation at mining and processing enterprises

**Selection of the unsolved aspects of the problem.**

There are a number of questions that require further clarification, namely the improvement of theoretical approaches to the justification of sequences of commissioning of fixed assets subject to use of bank loans as a source of funding for implementation of investment programs.

**Formation of the objective.** The purpose of this paper is to develop methodical recommendations for economic justification of the sequences commissioning of fixed assets in investment projects for energy conservation programs or update obsolete equipment mining and processing enterprises. It is important to provide the opportunity to use borrowed funds as a source of financing and early repayment of credit from the profits, resulting from the commissioning of fixed assets.

**The main material.** In order to implement investment projects for energy saving and programs of renewal of fixed assets of mining and processing a combine gets loans from banks and step-by-step launches various types of equipment to generate more profits. It can be sent to the partial repayment of the loan. Thus, the borrowed funds are returned at their own expense, some of which is additional income earned as a result of commissioning of certain types of fixed assets.

It is necessary to determine the sequence of commissioning of various types of fixed assets, which will result in the part of the amount paid for credit without the additional revenue would be minimal. We will consider the general interpretation of this problem.

To implement energy efficiency programs and renewal of fixed assets of the plant *K* types of fixed assets should be launched over *T* years, bringing the total amount of

bank loans *CK* at *r* percent per annum. As a result, from fixed assets of *k* type enterprise receives additional revenue of  $\Delta\Pi_k$  (UAH), which is drawn for early repayment. Thus, mortgage payments *BK* consist of two parts: own costs (*BBK*) and additional revenue ( $\Delta\Pi$ ). It is necessary to determine the sequence of commissioning of fixed assets as a result of carried out to condition

$$BBK_{3AR} = \sum_{t=1}^T BBK_t \rightarrow \min, \quad (1)$$

where *BBK*<sub>3AR</sub> – total amount of own funds that combine paid on credit during the crediting period, without additional income; *BBK*<sub>*t*</sub> – amount of own funds to be paid by the enterprise for credit during the period (year) *t*, without additional profit; *t* – period (year) repayment of the loan,  $t = \overline{1, T}$ .

The enterprise receives first tranche of credit totaling *CK*<sub>*t*</sub> available for *T*<sub>*t*</sub> years at *r* per cent per annum, buying and commissioning of the first kind of fixed assets that allows to earn additional profit of  $\Delta\Pi_{1,t}$  (UAH), which is used for early repayment. Loan payments for the first year are calculated as

$$BK_1 = TK_1 + CK_1 \times r + \Delta\Pi_{1,1},$$

where *TK*<sub>*t*</sub> – body of the first tranche of credit, payable annually;  $\Delta\Pi_{1,t}$  – additional profits that the enterprise receives from the operation of fixed assets of the first type during the first year.

The body of the loan, which mining and processing combine pays for a specified term loans, is calculated by the formula

$$TK_1 = \frac{CK_1}{T_1}. \quad (2)$$

Mortgage payments, performed by combine in the first year, excluding the amount of additional profit is calculated by the formula

$$BBK_1 = TK_1 + CK_1 \times r. \quad (3)$$

If the condition is fulfilled:  $3K_t \geq TK_t + \Delta\Pi_t$ , where  $3K_t$  – a balance on the loan during the year  $t$ , then the payment on the loan is calculated as

$$BK_t = TK_1 + (CK_1 - (t - 1)TK_1 - \sum_{i=1}^{t-1} \Delta\Pi_i)r + \Delta\Pi_t,$$

where  $\sum_{i=1}^{t-1} \Delta\Pi_i$  – amount of additional profit that has been received as a result of the commissioning of fixed assets and sent for early repayment of credit, in previous years.

Loan payments without regard to the amount of additional profit

$$BBK_t = TK_1 + (CK_1 - (t - 1)TK_1 - \sum_{i=1}^{t-1} \Delta\Pi_i)r.$$

If during the period  $t$ , the balance on the loan  $3K_t$  is greater than or equal to body of credit, but at the same time the condition  $3K_t < TK_t + \Delta\Pi_t$  is fulfilled, the payment on the loan is calculated as

$$BK_t = TK_1 + (CK_1 - (t - 1)TK_1 - \sum_{i=1}^{t-1} \Delta\Pi_i)r + (3K_t - TK_t).$$

Balance of the loan is determined by the expression

$$3K_t = CK_1 - t \times TK_1 - \sum_{i=1}^{t-1} \Delta\Pi_i.$$

Loan payments without regard to the amount of additional profit

$$BBK_t = BK_t - \Delta\Pi_t. \quad (4)$$

If at time  $t$  the balance of the loan is less than the calculated (2) body of the loan, but more than the additional profit that the combine receives from the operation of the first type of fixed assets, mortgage payments are determined by the expression

$$BK_t = 3K_t(1 + r). \quad (5)$$

Loan payment without regard to the amount of additional profits that is directed to the repayment of the loan is determined (4).

If at time  $t$  the balance of the loan simultaneously less than the defined by the (2) body of credit and additional profit that gets mining and processing combine as a result of the introduction of the of fixed assets, the payment of the loan is calculated (5). Payment without the amount of additional income is zero, i.e. mining and processing combine pays loan balance only by the derived from the operation of new fixed assets and additional profit.

Let us consider payments on the loan as a result of combine receiving the second tranche for the purchase and commissioning of the second type of fixed assets. The total amount of the loan is  $CK_2$ , body of loan is calculated (2) and is  $TK_2$  (UAH), loan term –  $T_2$  years at  $r$  per cent per annum. Loan payments for the first year are calculated as

$$BK_1 = TK_2 + CK_2 \times r + \sum_{k=1}^K \Delta\Pi_k,$$

where  $\Delta\Pi_k$  – additional profit that gets mining and processing combine from the operation of fixed assets of  $k$  type in the first year,  $k = \overline{1, K}$ ;  $K$  – number of types of fixed assets placed in service as a result of energy efficiency programs and fixed assets of mining and processing combine.

Mortgage payment, performed by the combine during the first year of use of the second tranche of the loan, minus the amount of additional profit, is calculated (3).

If condition  $3K_t \geq TK_t + \Delta\Pi_t$  is fulfilled, the payment on the loan is calculated as

$$BK_t = TK_2 + (CK_2 - (t - 1)TK_2 - \sum_{k=1}^K \sum_{i=1}^{t-1} \Delta\Pi_{ik})r + \sum_{k=1}^K \Delta\Pi_k,$$

where  $\sum_{k=1}^K \sum_{i=1}^{t-1} \Delta\Pi_{ik}$  – amount of additional profit obtained as a result of the commissioning of  $k$  types of fixed assets and sent for early repayment, in recent years the use of the second tranche.

Loan payments without regard to the amount of additional profit are calculated by the formula

$$BBK_t = TK_2 + (CK_2 - (t - 1)TK_2 - \sum_{k=1}^K \sum_{i=1}^{t-1} \Delta\Pi_{ik})r.$$

If during the period  $t$ , the balance of the  $3K_t \geq TK_t$ , but at the same time the condition  $3K_t < TK_t + \Delta\Pi_t$  is fulfilled, the payment on the loan is calculated as

$$BK_t = TK_2 + (CK_2 - (t - 1)TK_2 - \sum_{k=1}^K \sum_{i=1}^{t-1} \Delta\Pi_{ik})r + (3K_t - TK_t).$$

Balance of the loan is determined by the expression

$$3K_t = CK_2 - t \times TK_2 - \sum_{k=1}^K \sum_{i=1}^{t-1} \Delta\Pi_{ik}.$$

Loan payments without regard to the amount of additional profit

$$BBK_t = BK_t - \sum_{k=1}^K \Delta\Pi_k.$$

If at time  $t$  the condition  $\Delta\Pi_t < 3K_t < TK_t$ , the payments on the loan are determined by the (4), and mortgage payments without regard to the amount of additional profit

$$BBK_t = BK_t - \sum_{k=1}^K \Delta\Pi_k.$$

If at time  $t$  the balance on the loan is simultaneously less than the defined body of credit and additional profit that the mining and processing combine gets as a result of the commissioning of fixed assets, the total amount of payments on the loan and payment amount without additional profit is defined analogously to the calculations, used for the first tranche credit. Calculations of body of credit, the total amounts of payments and benefits without additional profit that gets mining and processing combine provided commissioning  $k$  types of fixed assets, using more tranches are defined similarly to the calculations of the second tranche of credit.

The next step in solving this problem is to compile other options of fixed assets commissioning, which implies a change in the sequence of their introduction. In addition, for each of the options it is needed to calculate the total amount of own funds that mining and processing combine paid on credit during the crediting period, without additional profit, by (1).

Number of candidates to the introduction of new of fixed assets is calculated as

$$N = n!,$$

where  $n$  – number of tranches received by mining and processing combine for the acquisition of fixed assets from the implementation of programs of fixed assets renewal and energy conservation.

It is necessary to select one of the variants of fixed assets commissioning, in which the amount of own funds that mining and processing combine paid on credit during the crediting period, without additional profit, is minimal.

This method implies the need to practice the following steps:

1. Determination of fixed assets, which should be launched in the implementation of energy saving measures, modernization programs and other investment projects of mining and processing enterprises.

2. The economic rationale of the measures, set out in the previous paragraph: calculate the additional profit that will get mining and processing combine as a result of commissioning of the fixed assets.

3. Formation of  $N$  sequences of fixed assets commissioning.

4. Estimated total amount of own funds that combine paid on credit during the crediting period, without additional profit.

5. The choice of the sequence of commissioning of fixed assets of mining and processing enterprise with a minimum total amount of own funds that are paid for the loan without additional profit.

6. Implementation of the chosen sequence of commissioning of fixed assets of mining and processing enterprise.

#### Findings from this study and the prospects for further development.

1. Methodical recommendations on economic substantiation of the sequence of commissioning of fixed assets in investment projects for energy conservation and renewal of worn parts, plant and equipment, are developed.

2. Recommendations on the use of borrowed funds as a source of financing for investment projects and programs are formulated. Possibility of a phased commissioning of fixed assets, which allows an early redemption of loan from the profits and therefore reduces the amount of interest paid, is provided.

3. Formulated recommendations can be used by mining and processing combines in the scheduling of the commissioning of fixed assets in the implementation of investment projects.

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**Мета.** Розробка теоретичних рекомендацій стосовно послідовності впровадження в експлуатацію основних засобів гірничо-збагачувальних комбінатів

при реалізації інвестиційних проектів з урахуванням можливості використання в якості джерела фінансування банківських кредитів.

**Методика.** Результати дослідження отримані при використанні наступних методів: аналіз – при дослідженні теоретичних підходів, що є підґрунтям розроблених рекомендацій, та економічному обґрунтуванні послідовності впровадження в експлуатацію основних засобів; узагальнення – при формуванні теоретичних рекомендацій стосовно використання кредитів банку у процесі реалізації гірничо-збагачувальними комбінатами інвестиційних програм та проектів.

**Результати.** Виконаний аналіз теоретичних підходів щодо оцінки перспектив розвитку гірничо-збагачувальних комбінатів у сучасних умовах господарювання. Сформульовані теоретичні рекомендації стосовно економічного обґрунтування реалізації інвестиційних проектів, що направлені на оновлення основних засобів комбінату та енергозбереження. Розроблені методичні рекомендації відносно визначення виплат за кредитом при вводі в експлуатацію гірничо-збагачувальними комбінатами основних засобів. Обґрунтована можливість використання прибутку, який комбінат отримує при вводі в експлуатацію основних засобів, для погашення банківського кредиту, що уможливило скорочення періоду виплат за кредитом та зменшення суми процентних платежів.

**Наукова новизна.** Теоретичний підхід стосовно економічного обґрунтування послідовності введення в експлуатацію основних засобів у процесі реалізації інвестиційних проектів передбачає можливість погашення кредиту шляхом використання власних коштів комбінату та додаткового прибутку, що отриманий за рахунок введення в експлуатацію основних засобів. При цьому доцільно вибрати послідовність введення в експлуатацію основних засобів, при використанні якої сума відсотків за кредитом, що виплачується без урахування додаткового прибутку, мінімальна.

**Практична значимість.** Розроблені рекомендації дозволяють обґрунтувати етапи реалізації інвестиційних проектів підприємств гірничодобувної галузі, зменшити строк кредитування та суму кредитних платежів.

**Ключові слова:** *гірничо-збагачувальний комбінат, кредит, інвестиції, прибуток, основні засоби, методичні рекомендації*

**Цель.** Разработка теоретических рекомендаций относительно последовательности ввода в эксплуатацию основных средств горно-обогатительных комбинатов при реализации инвестиционных проектов с учетом использования в качестве источника финансирования банковских кредитов.

**Методика.** Результаты исследования получены при использовании следующих методов: анализ – при исследовании теоретических подходов, которые положены в основу разработанных рекомендаций, и экономическом обосновании последовательности ввода в эксплуатацию основных средств, обобщение – при

формулировке теоретических рекомендаций относительно использования кредитов банка в ходе реализации горно-обогатительными комбинатами инвестиционных проектов и программ.

**Результаты.** Выполнен анализ теоретических подходов к оценке перспектив развития горно-обогатительных комбинатов в современных условиях. Сформулированы теоретические рекомендации относительно экономического обоснования реализации инвестиционных проектов, направленных на обновление основных фондов комбината и энергосбережение. Разработаны методические рекомендации относительно определения выплат по кредиту при вводе в эксплуатацию горно-обогатительными комбинатами основных средств. Обоснована возможность использования прибыли, которую комбинат получает при вводе в эксплуатацию основных средств, для погашения банковского кредита, что позволяет сократить период выплаты кредита и уменьшить сумму, выплачиваемых процентов.

**Научная новизна.** Теоретический подход относительно экономического обоснования последова-

тельности ввода в эксплуатацию основных средств в ходе реализации инвестиционных проектов предусматривает возможность погашения кредита за счет собственных средств комбината и дополнительной прибыли, полученной за счет ввода в эксплуатацию основных средств. При этом целесообразно выбрать последовательность ввода в эксплуатацию основных средств, при которой сумма процентов по кредиту, выплаченных без учета дополнительной прибыли, минимальна.

**Практическая значимость.** Разработанные рекомендации позволяют обосновать этапы реализации инвестиционных проектов предприятий горнодобывающей отрасли, сократить срок кредитования и сумму кредитных платежей.

**Ключевые слова:** *горно-обогатительный комбинат, кредит, инвестиции, прибыль, основные средства, методические рекомендации*

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