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Improvement of accounting depreciation of non-current assets computed by the units of production method in mining

Abstract
Introduction. Methods of depreciation of non-current manufacturing assets based on the indicator of their expected lifespan do not fairly link the amounts of depreciation to the finished product. Also, they do not take into account the pace of operations and are inconsistent with the fundamental matching principle in accounting, which leads to unfair depreciation. This problem is reinforced due to the incorrect definition of the finished product from the perspective of its relevance to non-current manufacturing assets in use.
Purpose. The research is focused on the improvement of accounting for basic data and advances in the units of production method used for computing depreciation amounts related to non-current manufacturing assets at mining enterprises. The proposed improvements and advances are expected to contribute significantly to solving the problem of unfair depreciation.
Results. To solve the problem of unfair depreciation of non-current manufacturing assets at the mine, it is suggested to account extracted rock mass as a finished product. Furthermore, specific accounts for minerals and waste rock should be included into the chart of accounts.
The researchers suggest ways to improve the units of production depreciation method applied with regard to non-current manufacturing assets by assessing the value of assets used for the extraction of minerals and the value of the assets used for the extraction of the waste rock through a special ratio of minerals to the total rock mass.
Conclusions. Accounting in mining corporations provides aggregation of information related to untagged coal only if they consist of mines without enrichment plants and untagged coal with concentrated coal if they consist of mines and enrichment plants. Methods used for depreciation relevant to the national and international accounting standards do not take into account specific conditions of extracting industry.
To ensure fair depreciation of non-current manufacturing assets, the authors of the article have improved the units of production method by introducing a special ratio of the extracted minerals to the total rock mass. The improved method is expected to positively influence the accumulation of depreciation funds since it is more accurate and consistent with the real depreciation of non-current manufacturing assets.
Further research will be focused on the development of methodology for the correct finding of non-current assets in mining, as well as improvements in accounting for non-current assets transmitted from one mine to another within a single mining corporation.
Keywords: Accounting; Depreciation; Non-current Assets; Units of Production Method; Finished Product; Mining
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Удосконалення обліку амортизації основних засобів виробничим методом на гірничодобувних підприємствах

Анотація
У статті розглянуто проблему нарахування несправедливої амортизації на основні засоби виробничого призначення, яка на гірничодобувних підприємствах посилюється через некоректне визначення поняття «готова продукція». На прикладі гірничодобувних підприємств показано розбіжність між результатом видобутку, для отримання якого використовуються основні засоби, та обсягом готової продукції, яка враховується під час визначення амортизації виробничим методом. Запропоновано удосконалення обліку готової продукції гірничодобувного підприємства на основі визначення її структури та зв'язку з основними засобами, які були використані для її виробництва. З метою нарахування справедливої амортизації удосконалено формулу розрахунку амортизації виробничим методом на основі визначення вартості основних виробничих засобів, яка була використана для видобутку корисних копалин, та вартості основних засобів, яка була використана для видобутку порожніх порід, через введення спеціального коефіцієнту співвідношення видобутих корисних копалин до видобутої гірничої маси.
Ключові слова: облік; амортизація; основні засоби; виробничий метод амортизації; готова продукція; гірництво.

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Усовершенствование учета амортизации основных средств производственным методом на горнодобывающих предприятиях

Аннотация. В статье рассмотрена проблема начисления несправедливой амортизации на основные средства производственного назначения, которая на горнодобывающих предприятиях усугубляется из-за некорректного определения понятия «готовая продукция». На примере горнодобывающих предприятий показано расхождение между результатом добычи, для получения которого используются основные средства, и объемом готовой продукции, который учитывается при определении амортизации производственным методом. Предложено усовершенствование учета готовой продукции горнодобывающего предприятия на основе определения ее структуры и связи с основными средствами, которые были использованы для ее производства. Для начисления справедливой амортизации усовершенствована формула расчета амортизации производственным методом на основе определения стоимости основных производственных средств, которая была использована для добычи полезных ископаемых, и стоимости основных средств, которая была использована для добычи пустых пород, путем введения специального коэффициента соотношения добытых полезных ископаемых и добываемой горной массы.

Ключевые слова: учет; амортизация; основные средства; производственный метод амортизации; готовая продукция; горное дело.

1. Introduction

The main purpose of depreciation of non-current assets is reimbursement of costs and establishment of the funding base for further modernisation. In this context, an important issue of computing unfair depreciation on non-current assets for production purposes should be raised. Solving the problem entails the task of improving accounting rules regulating depreciation calculations related to non-current manufacturing assets to achieve fair depreciation amounts. This problem can be described as follows. Accountants do not always have a possibility to a direct relationship between non-current assets used in manufacturing and the generated income [1], i.e. the calculation of the value of non-current assets used in manufacturing and the amount of income during the reporting period is quite confusing.

The practice of the developed countries shows that four out of the five common methods of depreciation are based on the time indicator mirroring useful lifespan of fixed assets, and only the units of production method provides depreciation based on the quantity of manufactured products or the amount of rendered services measured in certain units. This method is used when depreciation itself and the lifespan of non-current assets depend directly on the quantity of produced units or the amount of rendered services regardless the number of years of their use supposed by experts while buying them and including into the balance sheet. For example, the units of production method is employed for depreciation of aircraft engines since their lifespan depends on the quantity of kilometres an aircraft has flown rather than on the approximate period of the use of engines. In terms of unpredictable demand for travels by air, which is prone to fluctuations, the use of aircrafts and therefore their engines as non-current assets will not be regular and indirectly associated with the passage of time. Therefore, the method of depreciation, which directly links depreciation charges to the generated income, is more appropriate in these cases than the methods associating depreciation charges with the lifespan of non-current assets.

Ukrainian Accounting Standard 7 «Non-current Assets» describes five depreciation methods, four of which, apart from the units of production method, are based on the lifespan indicator. Paragraph 23 of the Standard defines that non-current assets are depreciated through their useful lifespan. This fundamental statement provides a direct correlation between depreciation and lifespan of assets without consistency with units of production. It does not take into account cases where the useful lifespan may not be accurately determined and there is no feasibility for it if non-current assets are used for production purposes, as it is in the case of aircraft engines or mining equipment. Mining enterprises have a unique complex of non-current assets for the extraction of minerals which is determined by their individual mining and geological conditions for extraction. Such conditions strongly impact the actual depreciated value of non-current manufacturing assets and their lifespan regardless of the deadline of their useful lives considered by experts. Due to those specific features of extracting minerals, the units of production method of depreciation is used at mining enterprises to compensate the value of non-current manufacturing assets.

It is advisable to recall one of the fundamental accounting principles – the matching principle which declares an interdependence between the received income and incurred costs in financial statements. In our opinion, depreciation methods based on the time indicator showing the period of use of non-current manufacturing assets contradict the matching principle, because they account for amortisation expenses more related to the reporting period and not the received income, which means that depreciation expenses correspond to income indirectly through the time indicator. If the actual depreciation depends on the volume of manufactured products and the amount of rendered services, the application of depreciation methods including time indicators in the case will result in negative consequences.

If non-current manufacturing assets are depreciated with regard to units of production (production depreciation) before their period of use comes to the end (time depreciation), then, available depreciation funds will not allow full renovation of depreciated non-current assets at the moment of production depreciation. From the production depreciation perspective, the non-current asset is considered to be underestimated. Conversely, if a non-current asset is depreciated according to the units of production method after its period of use (after time depreciation), then the accumulated depreciation fund will be enough for renovation of non-current assets at the moment of time depreciation. However, from manufacturing perspective, there might be a lack of expediency, since, despite time depreciation, the non-current assets can be used further. Thus, from the production depreciation perspective, the non-current asset is considered to be overestimated at the moment of its period of use coming to the end.

For example, according to the US Bureau of Economic Analysis report in 2014, enterprises of the US mining industry, except for oil and gas corporations, accumulated approximately USD 6.9 billion in the depreciation fund (Sameer Bhardwaj, 2014) [2]. Let us suppose that the amount of depreciation is unfair, whereas the amount of fair depreciation deviates from it by 1%. Then, if production depreciation takes place before the time of depreciation, and the available amount of depreciation equal to USD 6.9 billion does not allow for renovation of non-current assets, mining enterprises across the country will require additional USD 69 million to change underestimated non-current manufacturing assets. The available amount of depreciation would be USD 6.969 billion. Conversely, if non-current assets are depreciated faster in the case of time depreciation approach compared with the production depreciation method, then the amount of money accumulated for

changing non-current assets would be USD 6.831 billion at the moment of time depreciation. In other words, non-current assets would be overestimated by USD 69 million flowing from assets in the balance sheet to input cash in the statement of cash flow and influencing indicators of financial position of enterprises as if non-current assets continued to be employed in manufacturing. Fair depreciation would allow mining enterprises to report assets increased by USD 69 million and cash flow decreased by this amount.

Therefore, in our view, the use of methods aimed at depreciation of non-current manufacturing assets and based on time indicators mirroring their useful lifespan regardless the quantity of products and the amount of services do not allow us to take into account possible fluctuations in operations and result in unfair depreciation when depreciation expenses are higher or lower than those enterprises would have in the case of their connection with the quantity of products and amount of services. In turn, unfair depreciation results in underestimated and overestimated non-current assets, which negatively influences their renovation and makes financial statement reports incorrect. Because of this, companies, especially in the mining industry, are to select units of production method providing fair depreciation amounts when depreciation expenses incurred through the use of non-current assets are in full consistency with the income generated after selling products and services.

When considering mining enterprises, issues related to the use of the units of production method for fair depreciation arise from the unclear understanding of the concept of finished product, which non-current assets were employed for and should be included into the depreciation model as an input.

The above provides strong evidence that advances in accounting for depreciation of non-current assets computed by the units of production method in mining enterprises are of great importance and are to be investigated.

2. Brief Literature Review

Depreciation as a process of systematic partial inclusion of the cost of non-current assets in operation expenses of the reporting period influences their amount and changes the level of operating income of the reporting period, the cash flow related to operating activities of the reporting period and the total assets of the company. Therefore, problems related to depreciation of non-current assets, including those in accounting, are often considered in the context of finding an optimal ratio between indicators of operational costs, cash flow and assets since those indicators serve as input data for calculating such financial ratios as liquidity, leverage and profitability while deciding on the issues of operations management and investments. To abovementioned problems are dedicated the works by S. Bhardwaj, 2014 [2]; Pham Van Dai, 2015 [3]; O. Lawrence , U. Okechukwu, 2013 [4]; W. Baxter, 2000 [5]; Ugo Chan, Lili Fan, Unhi U., 2014 [6]; Lan Sun, 2015 [7]; H. Usuf, K. Isa, 2014 [8]; H. Yana, S. Marta, 2014 [9]; Dai Fei, Mandgela Persi, Gang Fy, 2016 [10]; S. Aliberch, 2008 [11]. The issues of fairness and unfairness related to depreciation of non-current manufacturing assets are viewed mainly from the perspective of finding fair value of non-current assets as an input to compute further amounts of depreciation (R. Barker & S. Shulte, 2015 [12]; M. de Vincent-lama, Molina Sanches, J. Ramires-Sobrino, 2013 [13]; P. Andreyes, 2012 [14]; J. Bert, M. Pankin 2013 [15]; & Josang Pak, 2016 [16]; Roder Adkins & Dian Pakson, 2013 [17]; D. Batterfield, 2003 [18]; W. Li, 2012 [19]; S. Jackson, 2008 [20]); to securitise and hedge non-current manufacturing assets (T., Roland, 2011 [21]) and to identify the gap between depreciation computed for financial and tax accounting (S. Istrate, 2012 [22]; S. Jackson, T. Rodgers & V. Tattl, 2010 [23]). In their research works, the scientists consider fair value of non-current assets to be market value. Nevertheless, some researchers offer the concept of fair value of non-current assets and computing depreciation based on expenses over the whole life cycle when the amount of depreciation includes financial expenses on finding, buying, setting and repairing non-current assets during their lifespan (A. Albonica & C. Kalyvitis, 2014 [24]; X. Kupper & B. Pedell, 2016 [25]). The US Bureau of Economic Analysis has been dealing with the problem of computing fair value of non-current intangible assets held in companies to conduct research and perform innovation activities based on available data (S. Kim, 2016 [26]).

Numerous research works investigate the rational platform for choosing one of the available methods of depreciation. Different enterprises select variable models of depreciation depending on their managerial objectives, economic efficiency, suitability in use, compatibility with the average depreciation rates across the industry and the class of non-current assets (S. Deys, 2009 [27]; S. Jackson, T. Rodgers & B. Tuttle, 2010). US companies actively use methods of accelerated depreciation due to the possibility of making tax reports in a way which allows companies to have tax returns according to the tax regulations (T. Noland, 2013). It has been proved scientifically that the high initial value of non-current assets and their long lifespan result in the linear method of depreciation as the most efficient from the perspective of the minimal amounts of depreciation. However, in this case enterprises tend to increase market (fair) value of non-current assets even if they are revaluated during the period of their use (H.-U. Kuppera & B. Pedell, 2016 [25]). Limitation of the standard time methods of depreciation and rational improvement of accounting for depreciation, as well as redesign of depreciation model which is to be closely related to peculiarities of different industries, have been proved by recent development of the decelerated depreciation method appropriate for non-current assets used in pyroprocesses at metallurgical enterprises (S. Kima , W. Koa & S. Younb , 2016. Because of a long (about 40 years) period of use of those non-current assets, high setting-up costs and probability of unexpected operational costs, enterprises are interested in low amounts of depreciation and low cost of pyroprocesses at the beginning of their use.

Ukraine has a developed mining industry. Hence, many scientific works are devoted to the operating activities of mining companies, improvement of which leads to changes in managerial and financial accounting. These include recently conducted studies revealing specific technological processes at mining enterprises (M. Berezovoi, V. Malashkin & N. Rudenko, 2013 [32]), components of compatibility of the national coal (I. Kuzyk, 2012 [30]) and the ways of its improvement (N. Boiko, 2003), as well as the issues related to coal used for generation of electric power (Y. P. Korchevoy & G. Pivnyak, 2006 [33]).

Recent researches in the field of accounting, control and organisation of workflow in mining enterprises of Ukraine have been focused on environmental activity and the processes of waste rock utilisation (O. Bychkova, 2015 [31]), reuse of raw materials (V. Havrylenko & I. Yurkova, 2009), cost of production (O. Shatokhina, 2004) and production inventories (N. Boiko et al, 2003 [34]). Nevertheless, the issues related to the accounting of fair amount of depreciation of non-current manufacturing assets from the perspective of their actual use have not been considered by researchers.

3. Purpose

The research is focused on the improvement of accounting of basic data and advances in the units of production method used to compute amounts of depreciation related to non-current manufacturing assets at mining enterprises. The proposed improvements and advances are expected to significantly contribute to solving the problem of unfair depreciation.

4. Results

The process of accounting of depreciation of non-current manufacturing assets computed by means of the units of production method includes components such as accounting for initial data used for composing input indicators to determine amounts of depreciation, the depreciation model itself and final accounting of amounts of depreciation. The research is aimed at the improvement of the first to components related to accounting for initial data and redesigning the units of production depreciation model under conditions of mining enterprises.

As it has been stated above, the problem of computing and accounting of unfair depreciation of non-current manufacturing assets in mining enterprises is raised not due to the

employment of time depreciation methods instead of production ones, but due to clear identification of the structure of finished goods. Most mining enterprises use the units of production method to depreciate their non-current manufacturing assets. However, the concept of what finished goods are and how they should be accounted for remains unclear.

Accurately defined quantity of finished goods and their structure are both the initial accounting information and the input indicator in the depreciation model. Therefore, the correct accounting for finished goods at mining enterprises will result in the correct final financial result, paid taxes and managerial decisions related to the distribution of manufactured goods and pricing, which contributes to the amount of income generated during the reporting period.

The finished product is referred to as a product if its processing is complete and it meets technical specifications and quality standards [35]. If a mine considers extracting minerals, then, from organisational perspective, it is a structural unit of a mining corporation. However, from economic point of view, it is a complex of assets providing the extraction of finished products further transferred to another structural business unit, e.g. enrichment plant.

The problem is that finished products of a mining company as the corporation are different from finished products of a mine as a structural unit of the corporation. However, due to the transfer pricing, when the mine determines the price of its finished products for the enrichment plant as the next link in the production cycle of the corporation, the correctly defined amount of depreciation charges on non-current manufacturing assets of the mine becomes extremely important.

Actually, non-current manufacturing assets of the mine are used to extract rough rock mass consisting of minerals (untagged coal) and waste rock [28]. Minerals (untagged coal) are considered inventories (raw materials) for enrichment plant producing finished product (enriched coal) for the mining corporation. Waste rocks are residuals which are usually transported to the slagheap, however, they can be recycled in order to obtain useful components. Thus, extracted untagged coal is considered to be a finished product for the mine. At the same time, it is waste rock, being the real final product provided by the mine, which goes through all operations and causes depreciation of non-current assets. Consequently, the unit of production method takes into account only untagged coal to compute depreciation amounts and, therefore, leads to unfair depreciation. Also, in the case of cutting the mine field to ensure the lowest cost of extraction, economists consider the cost of rock mass per 1 ton, however accountants consider only untagged coal for non-current manufacturing assets which are to be depreciated. It decreases amortisation costs and results in faster depreciation of non-current assets compared to the accumulation of depreciation funds.

To compute amounts of fair depreciation for non-current manufacturing assets used at mines by means of the units of production method, we find it necessary to change some rules of accounting for finished product. Currently, information about untagged coal is aggregated in Account 26 «Finished Product» and about waste rock - in Account 02 «Assets for Responsible Conservation». Nevertheless, it does not contribute to the correctness of financial statements. We offer information about rock mass to be aggregated in Account 26 «Finished Product» so that it can be treated as the total amount of the finished product and taken as the input indicator to compute depreciation of non-current assets used for its extraction. In turn, Account 26 should have two subaccounts: 261 regarding information about extracted minerals and 262 containing information about waste rock. Accounting of rock mass as the finished product will require separate accounting process in each section of the mine [36].

The problem of unfair depreciation computed for non-current manufacturing assets due to specific treatment of finished product occurs at enrichment plants which process untagged coal and produce concentrated coal, sludge, waste rock and unfinished products. Concentrated coal (coal coke) is a type of coal containing more valuable components than coal. Despite the fact that sludge and waste rock are useful, they are transported to the slagheap. An unfinished product is a product of enrichment requiring further processing in the technological scheme [35]. Coke is a finished product. It can be considered to be the input indicator for the depreciation model. Thus, improvements should be made to financial accounting for the finished product across the entire mining corporation consisting of mines and enrichment plants aggregating financial reports separately.

To aggregate its financial statements, the enrichment plant accounts for untagged coal as inventories, concentrated coal as a finished product and sludge and waste rock as assets for responsible conservation. Accordingly, financial statements of the mine define the measurement of rock mass balances in the mine field with inventories being the main indicator for assessing mineral reserves of the mining corporation. Specific improvements related to the accounting of the finished product at mines are stated above. However, in the case of accounting on a scale of the mining corporation, information about concentrated coal is suggested to be included in Subaccount 261.1, whereas information related to sludge and waste rock should be part of Subaccount 261.2 Then, information about the finished product will be unified across the mining corporation in order to ensure fair amounts of depreciation for non-current manufacturing assets [36].

Clarifying the structure of the finished product for the mine, the enrichment plant and the mining corporation regarding amounts of fair depreciation computed for non-current manufacturing assets provides advances in the model describing the units of production method with some kind of assumptions appropriate for the coal mine:

$$TD = D_m + D_e , \tag{1}$$

$$D_m = Q_{am} \cdot \frac{(IV - SV) \cdot K_f}{Q_{pm}} , \tag{2}$$

$$K_f = \frac{Q_{am}}{TM} , \tag{3}$$

$$D_e = Q_{ae} \cdot \frac{(IV - SV) \cdot (1 - K_f)}{Q_{pe}} , \tag{4}$$

where TD - total amount of depreciation of non-current manufacturing assets;

D_m - depreciated value of non-current manufacturing assets used for the extraction of minerals;

D_e - depreciated value of non-current manufacturing assets used for the extraction of waste rock;

Q_{am} - total amount of extracted minerals;

Q_{pm} - planed amount of extraction of minerals;

IV - initial value of non-current manufacturing assets;

SV - salvage value of non-current manufacturing assets;

K_f - ratio of extracted minerals to rock mass;

TM - total amount of extracted rock mass;

Q_{ae} - total amount of extracted waste rock;

Q_{pe} - planed amount of extraction of waste rock.

Thus, the main idea of improvements related to the units of production method of non-current manufacturing assets depreciated under the conditions of specific structure of the finished product at mining enterprises to ensure fair depreciation amounts leads to suggestions relevant to the value of the non-current assets. They can be viewed in two aspects. The first aspect is the value of assets used for the extraction of untagged coal, while the second aspect is the value of the assets used for the extraction of waste rock. It becomes possible due to a specific ratio of the extracted minerals to the total rock mass. Further, costs incurred after non-current assets for the extraction of minerals which are to be depreciated should be included into the total cost of production, and costs incurred after non-current assets for the extraction of waste

rock being depreciated should be included into other operations cost. Obviously, it will result in an eased tax burden and more accurate consistency of the depreciation amount accumulated for the renovation of non-current manufacturing assets and output produced due to their employment.

5. Conclusions

1. The problem of unfair depreciation on non-current manufacturing assets has been defined. Methods of depreciation of non-current manufacturing assets based on the index of the expected time of their useful lives do not establish a link to the volume of products or services and result in contradiction with one of the basic principles of accounting. Also, they do not allow us to take into account the pace of operations and lead to unfair calculation of depreciation when depreciation costs are higher or lower than those that would be accrued in the case of their relationship with the volume of manufactured products or rendered services. Unfair depreciation, in turn, causes economic phenomenon of undervalued or overvalued non-current assets, which affects the process of their updating and distorts the assessment of the financial condition of the company.

2. The problem of unfair depreciation on non-current manufacturing assets in mining is reinforced by the incorrect definition of the finished product in terms of its relationship with the assets in use. It has been determined that non-current assets at mines are used for the extraction of rock mass, which consists of minerals and waste rock. However, to calculate depreciation of assets, accountants consider only minerals which make up between 30% and 40% of rock mass, which, in turn, leads to unfair depreciation.

3. To overcome the problem of unfair depreciation on non-current manufacturing assets at mines, we suggest to use Account 26 «Finished Product» to reflect information related to extracted rock mass and establish separate two subaccounts for minerals and waste rock.

4. In order to provide fair depreciation, it is supposed to be efficient to improve the formula for calculating depreciation by means of the units of production method based on determining the value of the assets that were used for the extraction of minerals and the value of the assets used for the extraction of waste rock and introduce a special ratio of extracted minerals to rock mass.

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