Study of the Dynamics of Environmental Economic Indicators When Handling Industrial Waste

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Abstract. The article examines the theoretical and methodological foundations of the implementation of the concept of sustainable development and greening the economy, the functioning of industrial enterprises. It proposes the development of theoretical and applied-based foundations of metallurgical enterprises in the environmental field, through the development of an organizational-economic model for the revitalization of an enterprise based on the principle "technology - ecology - economy", using the example of PJSC "Nikopol Ferroalloy Plant", Ukraine. The involvement of raw materials of technogenic origin (waste slag and broken glass) in the production of non-autoclaved aerated concrete is economically feasible, since it contributes to reducing the cost of the material, as well as environmental sanitation.
The study of the five-year dynamics of the cost of the raw mix, taking into account the cost of electricity, indicates an increase in the cost of raw materials by almost two times in national currency, and a decrease in the cost in US dollars, which was due to a fall in the level of the national currency of Ukraine (hryvnia) by more than three times compared to the 2013 exchange rate. However, the economic efficiency of the use of waste in the production of aerated concrete is maintained, even an increase in the economic effect of their use is noted. When calculating indicators of the economic effect of waste disposal, taking into account the cost of maintaining dumps, a similar trend is observed when the salary share of the serving dump personnel changes.

1. Introduction

One of the strategic goals of public policy on sustainable development, on the way to harmonious development and environmental conservation, as a part of building environmental culture, is conservation of natural environment, including natural ecosystems, flora and fauna, that is possible due to provision of environmentally sound waste management, minimization of industrial impact on environmental components. It is necessary to solve these problems [1]:

a) Recovery of disturbed natural ecosystems;

b) Provision of environmentally sound waste management;

c) Conservation of natural environment, including natural ecosystems, flora and faunaж

d) Scientific and informational-analytical provision of natural environment conservation and environmental security.

Fredrich Engel formulated the problem of environmental "short-sightedness" of market economy: "We will not, however, be too seduced by our victories over nature. Each of these victories has, however, first of all those consequences that we expected, but second and third all other unforeseen consequences, which very often destroy the value of the first" [2, 3].

2. Relevance

People started to pay attention to environmental protection issues in the industrial field only at the end of 20th century. The majority of manufacturing enterprises were formed after the World War II, at the time of USSR industrialization. Experience with the strict central planning and environmental processes management in USSR and East Europe countries has demonstrated its inefficiency. Technogenic type of economic development took part in this type of the command economy, while the environmental crisis was developing. The majority of manufacturing enterprises were built in Soviet period, when there were no such environmental activities as equipping of slag heaps with impervious screens. It caused local introduction of huge amounts of pollutants to environment. Thus, using of economic mechanisms of direct state regulations causes reduction of environmental-economic efficiency of manufacturing enterprise.

However, only implementing of market mechanisms can lead economy to sustainable development. Market model in its pure form cannot lead economy to sustainable environmental-economic development as well. One of the most important market features is that it makes it possible to provide the most efficient use of resources because of the price signals about its scarcity. It is impossible to calculate actual social costs and benefits of environmental resources use through resources prices on the market because it is possible to materially evaluate social indicators, but it is impossible to make a manufacturer pay for it. As a result, there is inadequate assessment of scarce resources, the values of supply and demand, which causes undervalued incentives to efficient use of natural resources and environmental protection.

Market system is not interested in producing public goods. Shortsightedness is a significant market's problem. This system aims to get quick results and profit and does not take into account long-term damage and benefits. Nevertheless, in fact, preservation of the environment is very important not only in the short term. It is crucial to preserve natural environment in a longer perspective, as preservation of humans' environmental compartment for further generations is the main goal of environmental preservation [2].

Nowadays, despite existing shortcomings, State's role in preservation of natural environment is significant ant it will become more and more important in the future. The State establishes various standards in the area of environmental protection.

In many countries, there is a complex of administrative and market mechanisms in the area of environmental protection. Search for its optimal environmental-economic regulators is continuing.

Nowadays, enterprises are in stiff competition and constant lack of funding. They primarily seek to sacrifice the first nature in the pursuit of creation and conversion of the second nature (created by people), and their position is understandable. The State's role is increasing in such conditions. The State is trying to increase the level of environmental security provision along with sustainable environmental-economic development [2]. Health is the most important condition of further development of society, productivity and labor quality [1].

3. Scientific importance of the issue and brief literature review

Implementation of the concept of sustainable development, greening the economy and manufacturing enterprises functioning are possible, provided that theoretical part is clearly formulated and mechanisms of its implementation are elaborated. Let us consider the example of the world community where we can use the following mechanisms: 1. direct regulation due to legislative and control measures; 2. economic stimulation along with market mechanisms implementation; 3. mixed regulation that combines the above mechanisms [2, 4].

General environmental-economic aspects of regional industrial enterprise development and provision of economic security are considered in research papers [5-9]. Efficient waste management issues are considered in a paper of Knysh V.A., Nevskaya M.A., Nikolayeva K.V. Sagdeeva A.A. [10-11]. A paper of Lipenkov A.D. and Farafonov Y.J. [12] contains information about the mechanism of decreasing the amount of waste, and the necessity of waste cadaster and waste monitoring management (taking into consideration the financial part) is justified. Despite conducted researches,

theoretical-practical justification of waste management model due to development of management approach based on the principle of "technology – ecology – economy".

4. Purpose and objectives

The purpose of this paper is development of theoretical and practical basis of steel industry activity in the environmental area due to development of organizational-economic model of enterprise revitalization based on the principle of "technology – ecology – economy" using the example of Public joint-stock company Nikopol ferroalloy factory"

Tasks of the article:

1. To study the characteristics of metallurgical production and the relationship between environmental and economic problems.
2. Calculation of the cost of the raw mix for the production of aerated concrete.
3. Research of the cost dynamics of the raw material components of a gas-concrete mixture, taking into account energy costs
4. The calculation of the economic effect from the disposal of 1 ton of solid waste, taking into account the cost of the dumps

5. Theoretical part

The activity of any enterprise aims at making a profit. At the same time, a number of issues related to the environmental impact of enterprises should be resolved. Waste-free technologies are almost absent, so a large amount of waste is generated in various areas. One of the industries with a significant accumulation of waste is metallurgy. The metallurgical complex includes enterprises for the production of steel, ferroalloys and others. More than 20 ferroalloy enterprises operate in the CIS. Most of them were founded in the middle of the 20th century; therefore, a significant amount of waste or so-called by-products of production was accumulated on their territory.

It diverts significant funds from the main production. The composition of such waste contains a significant amount of valuable elements. Therefore, waste can be recycled for extracting valuable elements or used in various fields of economic activity, for example, in the production of building materials [13-15]. There is a relationship between the solution of environmental and economic problems. Therefore, pollution of environmental components by industrial wastes entails an increase in the cost of storing and disposing of waste, the elimination of its pollution [16-18]. The main economic damage caused by the storage of waste is the rejection of arable land, which further aggravates the problem of food supply of the population, increases the cost of production and land reclamation.

The disposal of accumulated waste will also allow resource conservation in the building materials industry, which arises due to the gradual depletion of mineral reserves [19]. According to S. V. Strashuk (2009), the production of non-autoclaved hardening aerated concrete using secondary resources is advisable to be placed near the raw material base and technological infrastructure, namely, cement plants, metallurgical plants (ferroalloy slags) [20].

6. Practical value, suggestions and results of introductions, results of experimental studies

The authors [20, 21] developed a technology for producing non-autoclaved aerated concrete with the involvement of the waste complex - dump slag produced by ferrosilicon manganese PJSC "Nikopol Ferroalloy Plant", Nikopol, Dnipropetrovsk region, Ukraine and broken glass.

To substantiate the economic efficiency of the use of this technology, the cost of the raw mix is calculated using and without technogenic waste. The calculation of the economic efficiency of using non-autoclaved aerated concrete with the addition of a complex of industrial waste was made at average market prices at the time of technology introduction - in 2013 and in the 5-year trend taking into account economic changes in the country.

The cost calculation was based on price measures of the main raw materials of the aerated concrete mixture: cement, sand, metallurgical slag dump, broken glass, naphthenate soap, PAP-3 aluminum powder. Electric energy consumption was taken based on grinding about 1 t / h of slag using a Horizon

disintegrator.

The dynamics of the cost of the raw material components of the aerated concrete, taking into account the cost of electricity (spent on grinding waste) in the national currency of Ukraine (hryvnia), is indicated in Figure 1.

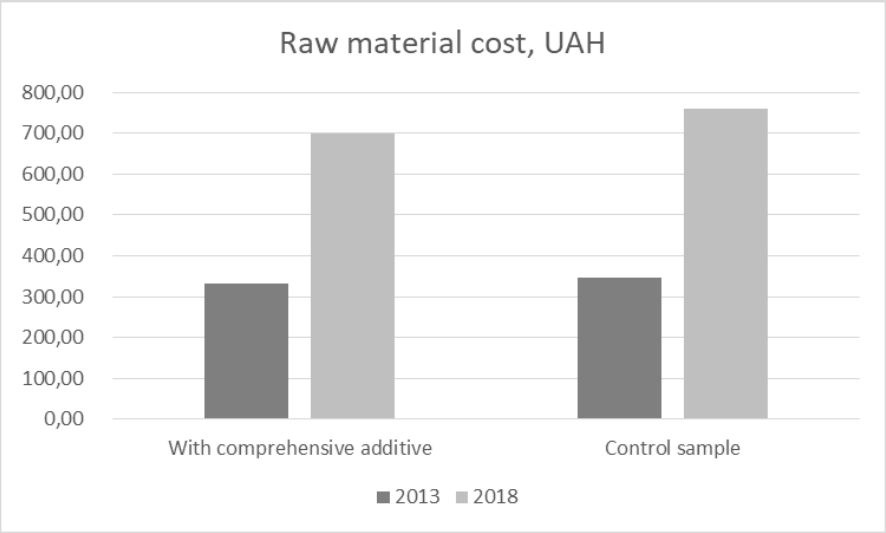

Figure 1. The dynamics of the cost of the raw material components of the aerated concrete mixture, taking into account the cost of electricity, hryvnia.

However, it is impossible to ignore the study of the dynamics of the cost of the raw components of the aerated concrete mixture, taking into account the cost of electricity for a more objective assessment, are given in international units of measure (US dollars), presented in Figure 2.

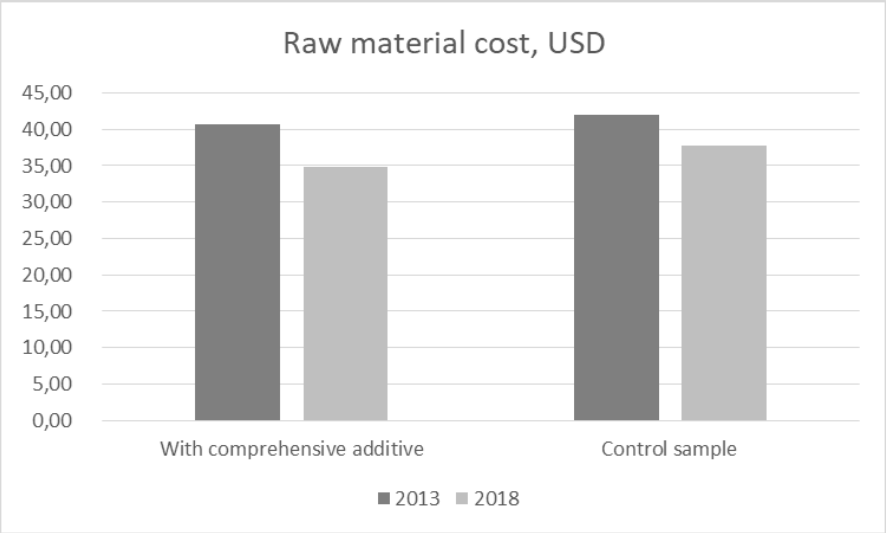

Figure 2. The dynamics of the cost of raw components of the aerated concrete mixture, taking into account the cost of electricity, US dollars.

If we compare the data obtained in the national currency of Ukraine (hryvnia, Figure 1) and in US dollars (Figure 2), then there is a radically different dynamics. Therefore, the decrease in the cost in US dollars is not due to a reduction in the price of energy resources and raw materials, but only due to a fall in the level of the national currency (hryvnia) more than three times compared with the 2013 exchange rate indicators.

From a market point of view, this trend will entail the interest of foreign investors in the development of production capacities in Ukraine, but often they will be technologies for obtaining a primary product, often having a significant impact on the state of environmental components.

Only by maximally striving to reduce the waste of production, which is achieved, both by reducing the amount of waste and by involving production by-products into the new technological cycle, the harmonious development of society is possible. Another great scientist V.I. Vernadsky [22] indicated that only reasonable human activity would allow the biosphere to be transformed into the noosphere. Only by preserving the environment of human living in the most harmonious state possible sustainable development of society with a high quality of life. The economic effect from the disposal of 1 ton of solid waste, taking into account the cost of maintaining the dumps [23] is calculated by the formula:

$$(n_1/a)(C_1+n_2*C_2-C_3)=Э_{sp} \quad (1)$$

Where C_1 and C_3 are the cost of the raw mix from traditional and recyclable raw materials, UAH;

C_2 - the annual cost of maintaining the dumps, UAH;

n_1 - coefficient taking into account the share of costs for this type of material in the total costs of raw materials and materials;

n_2 - coefficient taking into account the partial or complete elimination of dumps; n2 = 0.3–1;

a - the specific consumption one of the indicators.

An example of the calculation of one of the indicators. Accordingly, the cost of raw materials for the mixture with the use of waste and without the use of waste is 333.41 and 345.18 hryvnia. The annual costs of maintaining the dumps are in the wages of 5 security guards, who work in shifts in the amount of UAH 1 147.00 / month [23] is 68 820 UAH.

The coefficient that takes into account the share of the cost of this type of material in the total costs of raw materials and materials is accounted for in shares and amounts to 0.0008.

The coefficient taking into account the partial or complete elimination of dumps (n_2) is taken in the minimum value of 0.3.

For the specific consumption of recycled raw materials per unit of raw mix, we take the value in shares equal to 0.024.

Calculated by the value of this value.

The economic effect from the disposal of 1 ton of solid waste, taking into account the cost of maintaining dumps, is 665.58 UAH.

Taking into account the consumption of 15.41 kg of ferroalloy slag production per 1 m^3, it turns out that the production of 65 m^3 of aerated concrete allows to utilize 1 ton of slag.

7. Conclusions

As a result of the study, the following data was obtained:

1. The involvement of raw materials of technogenic origin (waste slag of PJSC "Nikopol Ferroalloy Plant" and cullet) in the production of non-autoclaved aerated concrete is economically feasible, since it contributes to reducing the cost of the material, as well as improving the environment.

2. The study of the five-year dynamics of the cost of the raw mix, taking into account the cost of electricity, indicates an increase in the cost of raw materials almost twice in the national currency, and a decrease in the cost in US dollars, which was due to a drop in the level of the national currency (hryvnia) more than three times compared to the 2013 exchange rate. However, the economic efficiency of the use of waste in the production of aerated concrete is maintained, even an increase in economic effect is noted.

3. The study of the five-year dynamics in calculation of the indicators of the economic effect of waste disposal, taking into account the cost of maintaining the dumps, there is a similar trend as with changes in the cost of the raw mix against the background of the change in the share of wages of staff serving dumps in the total share of costs. Thus, one of the tasks of the work was solved, namely, the scientific-qualified management of material, resource and energy saving through the development of a

management approach based on the principle “technology - ecology, economy”.

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