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ECONOMIC SUSTAINABILITY OF POLYMERIC WASTE RECYCLING ENTERPRISES IN URBANISTIC ENVIRONMENT**ЕКОНОМІЧНА СТІЙКІСТЬ ПІДПРИЄМСТВ З РЕЦИКЛІНГУ ПОЛІМЕРНИХ ВІДХОДІВ В УМОВАХ УРБАНІСТИЧНОГО СЕРЕДОВИЩА****Zlotenko O.B. / Злотенко О.Б.***post graduate student / аспірант**Khmelnsky National University,**Khmelnsky, Instytutska 11, 29000**Хмельницький національний університет,**Хмельницький, вул. Інститутська, 11, 29000*

Abstract. *The article is devoted to the analysis of the economic safety of the enterprise for recycling of waste polymer materials in the context of the development of urban infrastructure. The main factors that influence the functioning and development of the enterprise are determined. A mathematical model describing the dependence of the volume of service provision and the production of goods from recycled polymer on the investment norm was investigated. The ways of further improvement of the mathematical model for the estimation of the level of economic security of the enterprise are determined.*

Key words: *recycling, polymer waste, economic safety, investments.*

Introduction.

The problem of recycling domestic and industrial waste requires an effective solution, as evidenced by signs of environmental pollution, crisis conditions in the housing and communal sector, threats to health and life of people.

In Ukraine annually about 50 million cubic meters of garbage are formed, which is transported to polygons with a total area of more than 160 thousand hectares [1], which, in addition to environmental problems, leads to significant economic losses. This necessitates the simultaneous solution of environmental and socio-economic tasks, taking into account existing managerial and technological capabilities [2].

One of such management decisions may involve inclusion an investment component in the tariffs for garbage disposal, which should be used to develop new efficient technologies and technical means for the disposal of domestic and industrial waste [3]. Among possible means of raising funds for the development of waste processing enterprises [4] are considered: priority state lending; state subsidies for reducing interest on bank investment loans; grants from the State and local budgets, environmental funds; privileges for replenishment of working capital of waste processing enterprises.

The main text.

Given the availability of different sources of investment, it is important to provide the most rational conditions for the creation, operation and sustainable development of recycling companies. In this case, it is necessary to take into account the specifics of such enterprises, which is their close connection with all housing and communal services [5].

In modern conditions, sustainable development of the enterprise is associated with the level of its economic security. This is especially the case with the recycling



company of polymer waste, since its economic and social performance is dependent on the vital needs of people. The level of economic security of an enterprise is determined by its state in which it is protected from external and internal threats and capable of sustainable development.

A characteristic feature of the housing and communal services enterprises is a large proportion of fixed assets subject to intense wear and tear, and as a consequence, requires significant depreciation charges for repairs and maintenance. Under conditions of insufficient investment, such enterprises become unprofitable, which creates a threat and indicates a low level of their economic security.

Financial sources of enterprises are own funds, as well as assigned, borrowed and involved. Own resources include depreciation, provision for future losses and payments, and net profit. The main sources of profit of a company for the recycling of polymer waste can be the payment of the population and enterprises for the services rendered for the removal of waste and the funds from the sale of products produced from recycling. Borrowed resources in the form of loans are quite limited due to financial instability and low investment activity in the field of waste recycling. The attracted resources may be the form of payables, which entails an increase in risks for the enterprise. When raising funds in the form of expenditures of the state (local) budget there are also threats to the economic security of enterprises due to the low level of expenditures and arrears on intergovernmental transfers.

The specificity of enterprises for recycling polymer waste is that their operation is related to the use of special transport and road infrastructure. Therefore, the quality of managerial, logistic solutions and the general state of the municipal infrastructure of the settlement also determine the degree of hidden threats to the processing enterprise.

Existing technologies for the processing of polymer waste - combustion, pyrolysis, milling and agglomeration are outdated and do not ensure the production of the required quality from secondary raw materials. In addition, such waste recycling is accompanied by significant energy losses and pollution by the combustion products and the thermal decomposition of polymers. The purchase of new, usually imported, technological lines and recycling equipment is associated with the need to attract substantial investments, which is also associated with certain risks for enterprises.

Thus, the current level of economic security of enterprises for the recycling of polymer waste is very low and corresponds to the conditions of sustainable development under the existing risks. Solving this problem requires the development of a mechanism to increase the level of economic security of enterprises, which will allow the necessary financial resources. At the same time, the search for such sources and the assessment of the risks of the enterprise associated with their involvement, is crucial.

Among the factors that determine the company's economic security, one must take into account random factors, such as: the emergence of new technologies for recycling polymer waste; sharp changes in the social, political and financial spheres of the state and the world; emergence of new types of polymer waste; natural disasters and so on.

Taking into account the close connection of processing enterprises with the



communal economy of settlements, as well as a significant part of state regulation in this area, the executive bodies, both national and local, should play a leading role in ensuring their economic security.

Recycling companies for polymer waste can be involved in the process of collecting polymer waste, processing it as well as selling products from recycled material. Therefore, in a market economy, financial sustainability and economic security of enterprises depend on the ability to ensure its functioning and sustainable development in a competitive environment.

In order to assess the level of economic security of a recycling company for polymer waste, one can use the method proposed in [5], describing the scope of services and the production of goods by function:

$$\frac{dy(t)}{dt} = mlp(y)y(t), \tag{1}$$

where $p(y)$ – the value of demand for services and products of the enterprise; m – investment rate, l – rate of acceleration; $y(t)$ – volume of services and goods; t – time.

Equation (1) can be transformed to a form:

$$\frac{d^2 y(t)}{dt^2} = ml \frac{dy(t)}{dt} p(y) \left[\frac{1}{\frac{dy(t)}{dp(y)} \frac{p(y)}{y(t)}} + 1 \right], \tag{2}$$

or

$$\frac{d^2 y(t)}{dt^2} = ml \frac{dy(t)}{dt} p(y) \left[\frac{1}{E_p(y)} + 1 \right]. \tag{3}$$

where $E_p(y)$ – demand elasticity function relative to price.

By absolute magnitude $E_p(y)$, one can judge about the elasticity of demand. If $|E_p(y)| < 1$ so, demand is elastic. In the case when $|E_p(y)| > 1$, demand is inelastic.

In the work [5] the linear dependence between demand and the volume of services is used:

$$p(y) = b - ay(t). \tag{4}$$

Substituting (4) into (1) we obtain:

$$\frac{dy(t)}{dt} = ml[b - ay(t)]y(t), \tag{5}$$

Simplify the equation (5):

$$\frac{dy}{dt} = ml(b - ay)y, \tag{6}$$

Convert (6) to the form:

$$\frac{dy}{(b - ay)y} = ml dt, \tag{7}$$

We integrate the left and right sides of equation (7) in some time interval:



$$\int_{y_0}^y \frac{dy}{(b - ay)y} = ml \int_0^t dt . \tag{8}$$

As a result of integration we obtain:

$$y = \frac{by_0}{ay_0 - (ay_0 - b)e^{-bmlt}} . \tag{9}$$

To analyze the impact of the rate of investment on the volume of services and production of goods, we will make appropriate calculations using the formula (9). Figure 1 shows the results of calculating the dependence of volumes of services and goods on time at different values of the rate of investment.

$$a1 := 2 \quad b1 := 2 \quad c1 := 2 \quad l1 := 2$$

$$y(m1, t) := \frac{b1}{a1 + c1 \cdot a1 \cdot e^{-b1 \cdot m1 \cdot l1 \cdot t}}$$

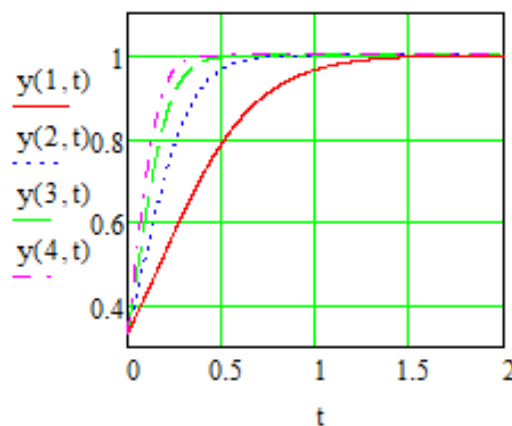


Fig. 1. Dependence of volumes of services and goods on time at different values of the investment rate

Summary and Conclusions.

As can be seen from Fig. 1, with an increase in the investment rate, the time to achieve a steady level of service delivery and production of goods from the recycling company of polymer waste is reduced. In turn, this leads to improved performance and sustainable development of the company and its level of economic security.

For a full analysis of the level of security of an enterprise, it is necessary to consider not only the size of investments, but also many other factors, such as: the nature of the source of funding; the situation on the global and local financial markets; current financial position of the enterprise and others. In addition, to improve the mathematical model of enterprise development, one can establish a nonlinear relationship between the demand and the number of services and products that adequately reflect the modeling object.

References:

1. Назаренко О. В. Утилізація відходів як перспективна галузь національної економіки / Назаренко О. В., Решетняк Н. Б. // Екологічна безпека. – 2016. – № 27 (1199). – С.38-42.
2. Губанова О. Р. Узагальнення методичних підходів до оцінки збитків від



розміщення твердих побутових відходів на сміттєзвалищах / Губанова О. Р., Хлобистов Є. В. // Глобальні та національні проблеми економіки. – 2017. – Випуск 15. – С.435-439.

3. Мельниченко О. А. Державне управління поведженням з твердими побутовими відходами: узагальнення надбань української науки [Електронний ресурс] / Мельниченко О. А., Радькова О. С. // Державне будівництво. – 2017. – № 1. – Режим доступу: <http://www.kbuapa.kharkov.ua/e-book/db/2017-1/doc/1/02.pdf>.

4. Гончаров О. О. Механізми державного регулювання у сфері поведження з відходами / Гончаров О. О. // Вісник Національного університету «Юридична академія України імені Ярослава Мудрого» (Серія «Економічна теорія та право»). – 2014. – № 3. – С. 172-183.

5. Горошкова Л. А. Математичні методи управління детермінантами економічної безпеки житлово-комунального господарства / Горошкова Л. А., Волков В. П. // Управління проектами та розвиток виробництва. – 2015. – № 3(55). – С.69-87.

References:

1. Nazarenko O.V., & Reshetnyak N.B. (2016). Utylizatsiia vidkhodiv yak perspektyvna haluz natsionalnoi ekonomiky [Utilization of waste as a promising branch of the national economy] in *Ekolohichna bezpeka* [Ecological safety], issue 27, pp. 38-42.

2. Gubanova O.R., & Khlobistov E.V. (2017). Uzahalnennia metodychnykh pidkhodiv do otsinky zbytkiv vid rozmishchennia tverdykh pobutovykh vidkhodivna smittiezvalyshchakh [Generalization of methodical approaches to the estimation of losses from the placement of solid household waste in landfills] in *Hlobalni ta natsionalni problemy ekonomiky* [Global and national problems of the economy], issue 15, pp. 435-439.

3. Melnichenko O.A., & Radkova O. S. (2017). Derzhavne upravlinnia povodzhenniam z tverdymy pobutovymy vidkhodamy: uzahalnennia nadban ukrainskoi nauky [Online]. [State regulation of solid household waste management: generalization of the achievements of Ukrainian science] in *Derzhavne budivnytstvo* [State building], issue 1. Available at <http://www.kbuapa.kharkov.ua/e-book/db/2017-1/doc/1/02.pdf>.

4. Goncharov O.O. (2014). Mekhanizmy derzhavnoho rehuliuвання u sferi povodzhennia z vidkhodamy [Mechanisms of state regulation in the field of waste management] in *Visnyk Natsionalnoho universytetu «Yurydychna akademiia Ukrainy imeni Yaroslava Mudroho»*. (Seriiia «*Ekonomichna teoriia ta pravo*») [Bulletin of the National University "Legal Academy of Ukraine named after Yaroslav Mudryi" (Series "Economic Theory and Law")], issue 3, pp. 172-183.

5. Goroshkova L.A., & Volkov V.P. (2015). Matematychni metody upravlinnia determinantamy ekonomichnoi bezpeky zhytlovo-komunalnoho hospodarstva [Mathematical methods of managing the determinants of economic security of housing and communal services] in *Upravlinnia proektamy ta rozvytok vyrobnytstv* [Project Management and Production Development], issue 3 (55), pp. 69-87.

Анотація. Стаття присвячена аналізу стану економічної безпеки підприємства з переробки відходів полімерних матеріалів в контексті розвитку урбаністичної інфраструктури. Визначені основні фактори, які впливають на функціонування та розвиток підприємства. Досліджена математична модель, яка описує залежність обсягів надання послуг та виробництва товарів із вторинної сировини від норми інвестицій. Визначені шляхи подальшого удосконалення математичної моделі для оцінки рівня економічної безпеки підприємства.

Ключові слова: переробка, полімерні відходи, економічна безпека, інвестиції.

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