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# ENVIRONMENTAL ASSESSMENT OF THE ACTIVITIES OF SECONDARY WASTE PROCESSING ENTERPRISES

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**Formulation of the problem.** Almost all types of human economic activity are associated with the generation of waste. Every year, the number of landfills increases, and the problem of environmental pollution with garbage does not lose its relevance. Secondary processing of waste, or recycling, allows not only to free up space in landfills, but also to attract the received raw materials for the manufacture of new goods. Its main advantages are the saving of natural resources and financial benefit.

When studying the aspect of the influence of the activities of enterprises on secondary processing of waste, the terms of decomposition of materials should be taken into account:

• paper – from several months to 2 years;
• food leftovers – from 2 to 6 months;
• metal (depending on the type) – from 10 to 500 years;
• plastic (depending on the type) – from 100 to 1000 years;
• glass – more than 1000 years.

All this, without further use and destruction, will accumulate in huge quantities for a long time, causing damage to the environment. The landfills themselves pose a serious threat to humans, as they are located in the open air and are subject to external influences. This leads to the release of toxic substances into the atmosphere, soil and groundwater.

Recycling of waste makes it possible to significantly improve the ecology of the planet, reduce production costs, at the same time make a large profit and get the opportunity to reduce the prices of goods. And in addition, we will be able to maintain the balance of the natural recovery of the earth's resources. If we do not start sorting waste and do not reuse it today, then in a couple of decades our planet will turn into one big landfill.

**Analysis of recent research and publications.** In Ukraine, waste processing is understood as the implementation of any technological operations associated with changing the physical, chemical, or biological properties of waste, with the aim of preparing it for environmentally safe storage, transportation, disposal [11]. That is, processing is a preparatory stage for carrying out further operations, in particular utilization (use of waste as secondary material or energy resources, incineration for the purpose of generating thermal or electrical energy) or disposal (carrying out operations with waste that do not lead to their use as secondary material or energy resources, in particular burial, incineration without production of thermal or electrical energy, etc.). As we can see, the legislative understanding of the concept of recycling in Ukraine and in the EU countries is somewhat different.

In 2020, about 52 million $m^3$ or about 10 million tons of household waste was generated in Ukraine (without taking into account data from the Republic of Crimea and the city of Sevastopol). Of these, only about 6.6% of household waste was processed and disposed of, of which: 2.48% was incinerated and 4.18% went to collection points for secondary raw materials and waste processing plants, all the rest were buried or taken to spontaneous landfills.

Compared to EU countries, the Ukrainian indicator of the level of SHW recycling is impressively low [12]. Unlike European countries, where a significant part of waste is subject to secondary processing, in Ukraine the effectiveness of the application of recycling methods is at the stage of study. That is, as a matter of fact, we do not have an industry for processing and disposal of waste [13].

In order to efficiently process waste, it needs to be sorted into fractions and preferably at the place of their generation. The cheapest method of sorting is sorting by place of formation, that is, separate collection. At the same time, there is practically no culture of separate collection of household waste among the population in Ukraine. Similar systems are implemented so sporadically that their practical benefit is close to zero [20]. According to various data, the service for separate collection of household waste is introduced in 800 to 1.200 settlements out of almost 30.000, and a quarter of the population is not covered by centralized household waste removal services at all [14].

The sorting of solid waste in Ukraine is provided by 25 waste sorting lines [16] that operate in Vinnytsia, the town of Murovani Kurylivtsi (Vinnytsia region), the villages of Bryshche (Volyn region), Dnipro, Kramatorsk (Donetsk region), Zaporizhzhia, Kropyvnytskyi, the city of

Chervonohrady, and the village of Yelihovychi (Lviv region), the villages of Abrykosove and Dobrozhanov (Odesa region), the villages of Plebanivka (Ternopil region), Sumy, Chernivtsi. There are also garbage sorting lines in Bila Tserkva, Obukhiv, Bucha, Irpen, Volodarka of the Kyiv region and in Kyiv (6 sorting lines) [4]. At the same time, the total share of sorted waste is very low. Thus, in 2021, only 4.2% of household waste went to recycling centers and waste processing plants [17].

Not only the lack of technology, but also legislative inconsistency hinders the proper processing of waste. Only on September 22, 2016, the processing and disposal of household waste was included in the types of activities that are subject to licensing [8]. On 05/25/2017, the licensing conditions for conducting household waste processing business activities were approved [3]. And only on October 27, 2017, the procedure for forming and setting the tariff for household waste processing services was approved [20].

On November 8, 2017, the Government of Ukraine approved the National Waste Management Strategy in Ukraine until 2030, which is based on the following principles:

− hierarchy of waste management, which provides for actions related to waste management in the following sequence: prevention of waste generation, preparation for reuse without preliminary treatment, waste processing, other types of utilization, including the use of waste as secondary energy resources, removal (landfill) only in the absence of an opportunity to complete the previous steps of the hierarchy;

− the transition to a closed cycle economy, which assumes that the volume of products, materials and resources is used in the economy as long as possible and the generation of waste is minimized;

− proximity, which provides for the reduction of potential risks from waste pollution by processing them as close as possible to the sources of generation;

− a warning, which, in the presence of evidence of an environmental risk, appropriate precautionary measures should be taken;

− joint responsibility, participation of state authorities, local self-government bodies, business entities, as well as the public when making decisions regarding the achievement of environmental policy goals;

− extended responsibility of the manufacturer, which provides for the responsibility of manufacturers and importers of products for accepting returned products and waste left after their use, as well as further waste management;

− self-sufficiency, which involves the creation of an integrated and adequate mayor networks of waste disposal and disposal facilities, which will enable the state or region to ensure independent disposal and disposal of its own waste [2].

It should be noted that Ukraine should continue to integrate and adapt EU waste management legislation in accordance with the Association Agreement with the EU. And it is also necessary to adopt and implement a number of legislative norms that will allow the introduction of complex waste processing. In particular, we are talking about waste processing as a separate industry and creating conditions for attracting investments that will allow the construction of waste processing facilities [4].

**The purpose** of the article is to study the impact of a secondary waste processing enterprise on the environment.

**Research materials and methods.** Our research was conducted on the example of a secondary waste processing enterprise located in the city of Vinnytsia, LLC «Podilska Sich». The main activity of the limited liability company «Podilska Sich» is: collection of safe waste.

Soils were collected from the sites of the «Podilska Sich» enterprise on the territory of the enterprise itself and beyond, using the envelope method from each site separately, and the samples were sent to the laboratory for determination of heavy metals in them.

Laboratory studies to determine the content of heavy metals in the soil were carried out in a certified and accredited laboratory – the Scientific and Measuring Agrochemical Laboratory of the Vinnytsia National Agrarian University.

Observations, records and measurements were carried out according to generally accepted methods:

− soil samples were taken from the 0–20 cm layer in accordance with SSU ISO 10381–1:2004;

− determination of the content of mobile forms of heavy metals (Pb, Cd, Zn, Cu) – after extraction with an acetate-ammonium buffer solution pH 4.8 by the method of atomic absorption spectrophotometry in accordance with SSU 4770.

Atomic absorption spectral analysis is a method of analysis that is carried out based on the selective absorption of light by atoms of a substance converted into an atomic gaseous state. Radiation from a light source, passing through vapors of a substance at frequencies that coincide with the frequency of transition of an electron from the main level to the one closest to it, is absorbed (resonance line), and its concentration in the sample is determined by the degree of weakening of the intensity of the spectral lines of the studied element. The intensity of light absorption by the atomic absorption method is determined by the Bouguer-Lambert-Behr law:

$$D = \lg(I_0/I) = klC \quad (1)$$

where D – the optical density (absorption); $I_0$ – the output intensity of the exciting light; I – the intensity of the light that passed through the sample; k – absorption coefficient; l – the thickness of the absorption layer; C – the concentration of the element to be determined. The absorption coefficient k, which is proportional to the probability of a resonance transition, does not depend on temperature.

A temperature of ~2000–3000 °C is required for sample atomization. In this temperature range, flame atomizers are used, electrothermal atomizers, but most often – flame atomizers that work on a mixture of acetylene and nitrous oxide. In this temperature range, more than 90% of atoms are not in an excited state, so other atoms and molecules cannot affect the absorption coefficient. This fact, along with the small number of absorption lines, determines the high selectivity of this method. The light source emits a line spectrum that contains the required line of the element to be determined.

Lamps with a hollow cathode, electrodeless gas discharge lamps, and a tunable laser are used as radiation

sources. A significant disadvantage of the atomic absorption method, compared to the atomic emission spectral analysis method, is the impossibility of simultaneous detection of several elements in the sample and the need for their sequential determination. The method of atomic absorption analysis, compared to other methods of atomic spectral analysis, is much simpler and allows determining up to 70 elements with a sensitivity of ~$10^{-4}$–$10^{-9}$% of the mass of not only low but also high concentrations in samples. Today, the method is considered one of the most selective, express, productive, accurate and, at the same time, relatively cheap methods.

To assess the degree of danger of a pollutant element, we used the hazard ratio of the pollutant element – the ratio between the concentration of the pollutant in the soil and their maximum permissible concentration. It is used to assess the degree of danger of a polluting element. Under normal conditions, the hazard ratio should be less than or equal to 1. It is determined by the formula:

$$HR = Ci/(MPCi) \geq 1 \quad (2)$$

where Ci is the concentration of the i-th pollutant, mg/kg; MPCi is the maximum permissible concentration of that pollutant, mg/kg.

**Research results.** The company «Podilska Sich» LLC was founded with the aim of solving one of the most global problems of today – the preservation of natural resources and the improvement of the ecological situation in Ukraine due to the implementation of the best world experience in waste management, stable collection of recyclable materials and disposal of hazardous waste.

The company is an active member of the All-Ukrainian Production and Environmental Association «UkrVtorma», which includes about 100 specialized procurement and processing enterprises located throughout Ukraine.

The Eco-Service company has many years of experience in the field of purchasing secondary raw materials: waste paper, glass containers and broken glass, polyethylene film, PET bottles, plastic, scrap metal, PVC waste.

Our highly qualified specialists have been providing a full range of licensed hazardous waste disposal services for more than five years in a row, in accordance with modern standards and requirements in the field of environmental protection.

The company's goal: to preserve natural resources and improve the environmental situation in Ukraine through the implementation of the best global experience in waste management, deep sorting of garbage, comprehensive environmental awareness and the use of innovative resource and energy saving technologies.

Tasks of the company:

- to create better conditions for the client, so that recycling is accessible and beneficial to everyone;
- ensure prompt and systematic removal of recyclables by own transport;
- to introduce innovative technologies for the elimination of landfills and the complete abandonment of the system of waste disposal at landfills;
- to provide large-scale environmental education among the population;
- teach everyone who wants to properly sort waste and hand over recyclables;
- to be a reliable, experienced and open company in its field.

Activities:

- collection of safe waste;
- mechanical processing of metal products;
- conducting investigations;
- wholesale trade in metals and metal ores;
- wholesale trade in waste and scrap;
- collection of hazardous waste;
- processing and removal of safe waste;
- processing and removal of hazardous waste;
- sawmill and planing production;
- production of wooden building structures and carpentry products;
- production of wooden containers;
- production of wood products;
- production of paper and cardboard;
- production of rubber products;
- production of other plastic products;
- forging, stamping, minting; powder metallurgy.

Studies of the impact of the enterprise «Podilska Sich» on the environment, including on soils and the content of toxic elements in them, were conducted at three experimental sites located within 500 m of the enterprise and directly on its territory (Fig. 1).


***Fig. 1. Sampling of soil***

Characteristics of research sites:

- soil sampling № 1 was carried out on the territory of the enterprise itself;
- soil sampling № 2 was carried out at a distance of 200 m from the enterprise in the intermediate area between the enterprise itself and the garbage collection point;
- soil sampling № 3 was carried out at a distance of 450 m from the enterprise, on the territory of the waste reception point.

Monitoring of the content of heavy metals in the soil of the «Podilska Sich»enterprise is shown in Table 1.

The results of the research showed that the content of Pb in the first experimental area within the limits of the enterprise itself was 0.31 mg/kg. Within the intermediate area between the enterprise itself and the waste reception point, at a distance of 200 m from the enterprise, the

Table 1

**Monitoring the content of heavy metals in the soil of the enterprise «Podilska Sich»**

| Experimental sites | Heavy metals, mg/kg | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Pb | | Cd | | Zn | | Cu | |
| | Actual content | MPC | Actual content | MPC | Actual content | MPC | Actual content | MPC |
| №1 | 0.31 | 6.0 | 0.03 | 0.7 | 1.01 | 23.0 | 0.21 | 55.0 |
| №2 | 0.94 | 6.0 | 0.31 | 0.7 | 2.08 | 23.0 | 1.41 | 55.0 |
| №3 | 0.76 | 6.0 | 0.09 | 0.7 | 1.93 | 23.0 | 0.97 | 55.0 |
| **Average** | **0.67** | **6.0** | **0.37** | **0.7** | **1.67** | **23.0** | 1.93 | 55.0 |

concentration of Pb in the soil increased and amounted to 0.94 mg/kg. At a distance of 450 m from the enterprise, within the waste reception point, the content of Pb in the soil decreased to 0.76 mg/kg. That is, significant changes in the concentration of Pb in the soil were detected at site № 2, which is not part of the location of the enterprise, but is intermediate, this is due to the fact that this site is part of a road where intensive traffic is carried out every day.

The study of Cd concentration at the first experimental site within the enterprise itself was 0.03 mg/kg. Within the intermediate area between the enterprise itself and the waste reception point, at a distance of 200 m from the enterprise, the concentration of Cd in the soil increased and amounted to 0.31 mg/kg. At a distance of 450 m from the enterprise, within the limits of the waste reception point, the Cd content in the soil decreased to 0.09 mg/kg. That is, significant changes in the concentration of Cd in the soil were detected at site № 1, which is not part of the location of the enterprise, but is intermediate. The accumulation of a higher concentration of Cd is also caused by the location of this site.

The results of the research showed that the Zn content at the first experimental site within the enterprise was 1.01 mg/kg. Within the intermediate area between the enterprise itself and the waste reception point, at a distance of 200 m from the enterprise, the concentration of Zn in the soil increased and amounted to 2.08 mg/kg. At a distance of 450 m from the enterprise, within the waste reception point, the content of Zn in the soil decreased and amounted to 1.93 mg/kg. There were no significant changes in the concentration of Zn in the soil of the experimental plots.

Studies have shown that the content of Cu in the first test area within the enterprise itself was 0.21 mg/kg. Within the intermediate area between the enterprise itself and the waste reception point, at a distance of 200 m from the enterprise, the concentration of Cu in the soil increased and amounted to 1.4 mg/kg. At a distance of 450 m from the enterprise, within the waste reception point, the content of Cu in the soil decreased to 0.97 mg/kg. Again, an intense increase in the concentration of Cu can be seen in experimental site № 2, in principle the same as the previous elements.

Experimental site № 1 has the lowest indicators of the content of heavy metals in the soil. The intensity of accumulation of heavy metals on the territory of the enterprise «Podilska Sich» is shown in Table 2.

The concentration of Pb on the territory of the enterprise does not exceed the state standards and is 0.31 mg/kg with a limit of 6.0 mg/kg, which is 19.3 times lower than the limit.

We calculated the hazard ratio of heavy metals in the soil on the territory of the enterprise «Podilska Sich». It is calculated as the ratio of the actual heavy metal content in the soil to the maximum permissible concentration of this metal. If the hazard ratio is less than one, this indicates safe environmental conditions. The smaller the danger coefficient, the better the situation is created. The hazard ratio of Pb was 0.05. This indicates safe environmental conditions in the soil for Pb on the territory of the enterprise.

In the studied area, no excess of Cd pollution was found relative to MPC, as its concentration was 23.3 times lower than the maximum permissible concentration. The hazard ratio was 0.04 (Fig. 2).

On the territory of the enterprise, no exceedance of the maximum permissible concentration of Zn was detected – 1.01 mg/kg at a limit of 23 mg/kg, i.e. 22.7 times less than the norm. The hazard ratio of Zn in the soil was 0.04. The content of Cu was 0.21 mg/kg in the first experimental area, which is 261.2 times lower than the maximum permissible concentration. The hazard ratio was 0.003.

Experimental site № 2 is located in the intermediate territory directly from the enterprise to site № 3 of the waste reception point at a distance of 200 m from the enterprise. The intensity of accumulation of heavy metals in the soil in this area is shown in Table 3.

Table 2

**The intensity of the accumulation of heavy metals in the soil on the territory of the enterprise «Podilska Sich»**

| Indicator | Units of measurement | MPC | Actual content | Hazard ratio |
|---|---|---|---|---|
| Pb | mg/kg | 6.0 | 0.31 | 0.05 |
| Cd | | 0.7 | 0.03 | 0.04 |
| Zn | | 23.0 | 1.01 | 0.04 |
| Cu | | 55.0 | 0.21 | 0.003 |

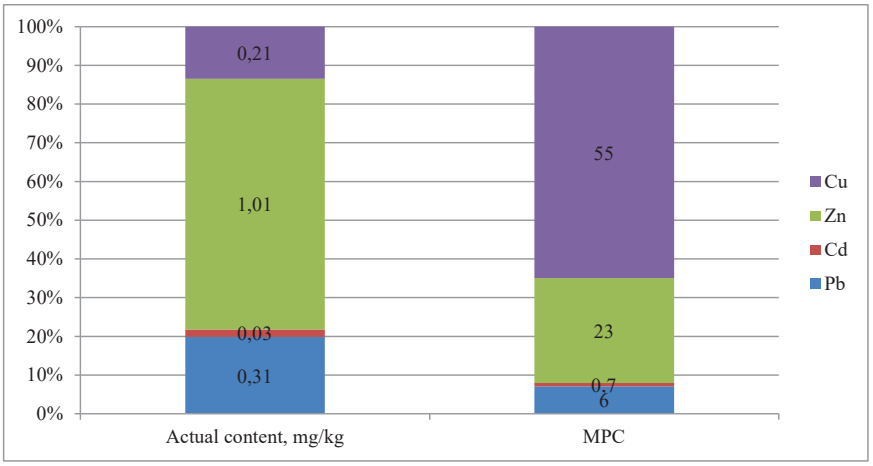


***Fig. 2. Intensity of accumulation of heavy metals on the territory of the enterprise «Podilska Sich» at experimental site №1***

Table 3

**The intensity of the accumulation of heavy metals in the soil in the territory of the intermediate section between the enterprise «Podilska Sich» and the waste reception point**

| Indicator | Units of measurement | MPC | Actual content | Hazard ratio |
|---|---|---|---|---|
| Pb | mg/kg | 6.0 | 0.94 | 0.15 |
| Cd | | 0.7 | 0.31 | 0.44 |
| Zn | | 23.0 | 2.08 | 0.09 |
| Cu | | 55.0 | 1.4 | 0.02 |

The hazard ratio of Pb in the soil of the experimental site, located 200 m from the enterprise at an intermediate location to the waste reception point, was 0.15, which is a safe indicator. The hazard ratio of Cd – 0.44, Zn – 0.09 and Cu – 0.02 are also safe.

Indicators of the content of heavy metals in the intermediate experimental area correspond to state regulations and are shown in Fig. 3.

The content of Pb, Cd, Zn and Cu in the soil did not exceed the MPC. Although it was the highest in the territories we studied.

The results of the conducted research are shown in Table 4 at experimental site № 3, where waste is directly accepted at a distance of 450 m from the enterprise itself.

The hazard ratio of Pb in the soil area of the waste reception point was 0.12, Cd – 0.12, Zn – 0.08 and Cu – 0.01. In all cases, it is significantly less than one, which indicates environmentally safe conditions.

Examination of the soil on the territory of the waste reception point did not show an excess of the maximum permissible concentrations (Fig. 4).

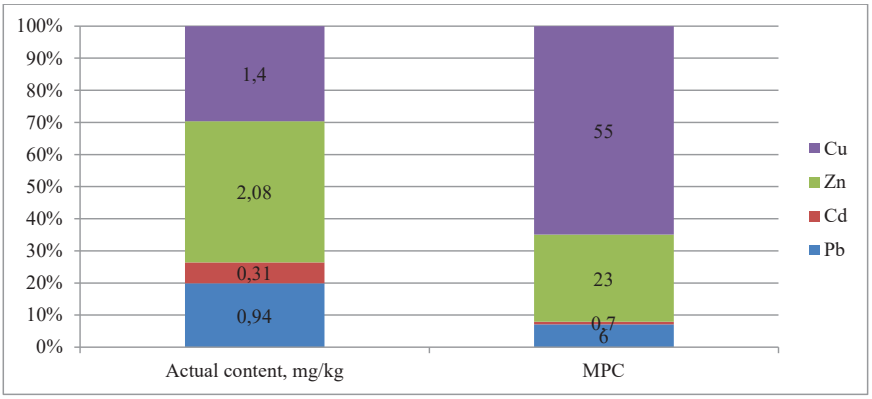


***Fig. 3. Intensity of accumulation of heavy metals at experimental site № 2, which is the median between the enterprise and the waste reception point***

Table 4

**The intensity of the accumulation of heavy metals in the soil on the territory of the waste reception point of the enterprise «Podilska Sich»**

| Indicator | Units of measurement | MPC | Actual content | Hazard ratio |
|---|---|---|---|---|
| Pb | mg/kg | 6.0 | 0.76 | 0.12 |
| Cd | | 0.7 | 0.09 | 0.12 |
| Zn | | 23.0 | 1.93 | 0.08 |
| Cu | | 55.0 | 0.97 | 0.01 |

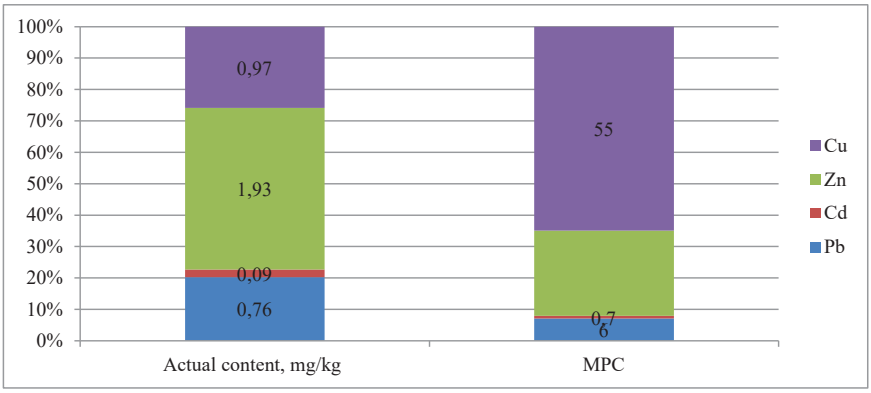


***Fig. 4. Intensity of accumulation of heavy metals at experimental site No. 3, which is a waste reception point***

Soil studies showed the absence of toxic soil contamination. The concentration of Pb and Cd is 7.89 and 7.77 times lower than the MPC, respectively. The content of Zn and Cu also did not exceed the standards and were 11.9 and 56.7 times lower than the MPC, respectively.

**Conclusions.** Studies have established the absence of toxic soil contamination. The concentration of heavy metals Pb, Cd, Zn, and Cu was below the MPC, which indicates that the enterprise «Podilska Sich» LLC for the processing of secondary waste does not harm the environment. The highest content of heavy metals was determined in the intermediate section between the enterprise and the point of reception of secondary raw materials, but at the same time the indicators did not exceed the MPC. The objective reason for the increase in the concentration of heavy metals in this area is the proximity of the highway, which is a direct source of heavy metal contamination of the soil. The indicator of the hazard ratio in the studied territories did not exceed 1, therefore, this ecotoxicological assessment of the soils of «Podilska Sich» LLP confirms the safety of the work of enterprises processing secondary waste.

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**Alieksieiev O.O., Vradii O.I., Kravtsov D.S. Environmental assessment of the activities of secondary waste processing enterprises**

**The purpose** of the article is to study the impact of a secondary waste processing enterprise on the environment. **Methods.** The methodological basis of this research is: empirical (field experiments and observations; measurement of indicators of the research object; theoretical (putting forward a hypothesis and forming conclusions based on research results; statistical; mathematical. **Results.** The concentration of heavy metals Pb and Cd below the maximum limit of 7.89 and 7.77 times, respectively. The content of Zn and Cu did not exceed the standards and were 11.9 and 56.7 times lower than the MPC. The results of the research showed that the content of Pb within the limits of the enterprise itself was within the intermediate range sites – the concentration of Pb in the soil increased to 0.94 mg/kg, the content of Pb in the soil decreased to 0.76 mg/kg. The concentration of Cd within the enterprise itself was 0.03 mg/kg the Cd concentration in the soil increased to 0.31 mg/kg, the Cd content in the soil decreased to 0.09 mg/kg. The results of the studies showed that the Zn content within the enterprise itself was 1.01 mg/kg. Within the intermediate area, the concentration of Zn in the soil increased and amounted to 2.08 mg/kg, within the waste reception point, the content of Zn in the soil decreased by 92.7% and amounted to 1.93 mg/kg. The Cu content within the enterprise was 0.21 mg/kg. Within the intermediate area, the Cu concentration in the soil increased to 1.4 mg/kg, within the waste reception point, the Cu content in the soil decreased by 69.2% and amounted to 0.97 mg/kg. **Conclusions.** Studies have established the absence of toxic soil contamination. The concentration of heavy metals Pb, Cd, Zn, and Cu was below the MPC, which indicates that the enterprise "Podilska Sich" LLC for the processing of secondary waste does not harm the environment. The highest content of heavy metals was determined in the intermediate section between the enterprise and the point of reception of secondary raw materials, but at the same time the indicators did not exceed the MPC. The objective reason for the increase in the concentration of heavy metals in this area is the proximity of the highway, which is a direct source of heavy metal contamination of the soil. The indicator of the hazard ratio in the studied territories did not exceed 1, therefore, this ecotoxicological assessment of the soils of «Podilska Sich» LLP confirms the safety of the work of enterprises processing secondary waste.

**Key words:** experimental site, heavy metals, environmental condition, maximum permissible concentration, hazard ratio.

**Алєксєєв О.О., Врадій О.І., Кравцов Д.С. Екологічна оцінка діяльності підприємств з переробки вторинних відходів на довкілля**

**Мета статті** – дослідження впливу підприємства з переробки вторинних відходів на довкілля. **Методи.** Методологічною основою даного дослідження є: емпіричні (польові експерименти та спостереження; вимірювання показників об'єкту дослідження; теоретичні (висунення гіпотези та формування висновків за результатами досліджень; статистичний; математичний. **Результати.** Концентрація важких металів Pb та Cd нижче ГДК у 7,89 та 7,77 раз відповідно. Вміст Zn та Cu також не перевищував нормативів та були у 11,9 та 56,7 раз нижче ГДК. Результати досліджень показали, що вміст Pb в межах самого підприємства становив 0,31 мг/кг. В межах проміжної ділянки – концентрація Pb у грунті зросла і склала 0,94 мг/кг, у межах пункту прийому відходів вміст Pb у грунті знизився склав 0,76 мг/кг. Дослідження концентрації Cd в межах самого підприємства становив 0,03 мг/кг. В межах проміжної ділянки – концентрація Cd у грунті зросла і склала 0,31 мг/кг. У межах пункту прийому відходів, вміст Cd у грунті знизився і склав 0,09 мг/кг. Результати досліджень показали, що вміст Zn в межах самого підприємства становив 1,01 мг/кг. В межах проміжної ділянки концентрація Zn у грунті зросла і склала 2,08 мг/кг, у межах пункту прийому відходів, вміст Zn у грунті знизився на 92,7 % і склав 1,93 мг/кг. Вміст Cu в межах самого підприємства становив 0,21 мг/кг. В межах проміжної ділянки концентрація Cu у грунті зросла і склала 1,4 мг/кг, у межах пункту прийому відходів, вміст Cu у грунті знизився на 69,2 % і склав 0,97 мг/кг. **Висновки.** Дослідженнями встановлено відсутність токсичного забруднення грунтів. Концентрація важких металів Pb, Cd, Zn та Cu була нижче ГДК, що говорить про те, що підприємство ТОВ «Подільська Січ» із переробки вторинних відходів не несе шкоди навколишньому середовищу. Найвищий вміст важких металів було визначено на проміжній ділянці між підприємством та пуктом прийому вторинної сировини, але при цьому показники не перевищували ГДК. Об'єктивною причиною збільшення концентрації важких металів саме на цій ділянці є наближення розташування до неї автодороги, що є прямим джерелом забруднення грунтів важкими металами. Показник коефіцієнту небезпеки на досліджуваних територіях не перевищував 1, отже дана екотоксикологічна оцінка грунтів «ТОВ Подільська Січ» підтверджує безпечність роботи підприємств з переробки вторинних відходів.

**Ключові слова:** дослідна ділянка, важкі метали, екологічний стан, гранично-допустима концентрація, коефіцієнт небезпеки.