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Satbayev University

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ИЗВЕСТИЯ

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RECYCLING OF PRODUCTION WASTE AND ENVIRONMENTAL IMPACT ASSESSMENT

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Abstract. In this article, a method of agglomeration annealing in the production of porous aggregates is proposed. Prerequisites were also created for expanding the permissible limits of changing the chemical composition of industrial waste suitable for the production of the unit, ensuring high performance of the thermal installation, complete mechanization and automation of the entire production. It is noted that the main advantage of agglomeration processing of lead waste and the production of sinter based on them is the small size of the unit. In the research work, the method of quantitative characterization of the flora of epiphytic lichens was used to determine the effect of atmospheric pollution on green plants in the environment, in such a bioindication study it was found that the use of lichenology techniques for black trees often found in the southern regions of the country. The main method of passive indication of lichens is the observation of changes in the relative number of lichens. For this purpose, measurements of the projection coverage of lichen were carried out on test sites selected at the site of air pollution by lead waste, where the average values of the projection coverage for the studied lichen zone were obtained. Such research work was carried out by measuring

the protruding lichen coatings on trees growing on another, in order to comparatively assess air pollution in the locations of production facilities.

Keywords: ash, slag, lead, zinc compounds, atmosphere, pollution

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ӨНДІРІС ҚАЛДЫҚТАРЫН ҚАЙТА ӨҢДЕУ ЖӘНЕ ҚОРШАҒАН ОРТАҒА ӘСЕРІН БАҒАЛАУ

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Аннотация. Бұл мақалада кеуекті агрегаттарды өндіруде агломерациялық күйдіру әдісі қаластырылды. Сонымен қатар агрегат өндіруге жарамды өнеркәсіп қалдықтарының химиялық құрамының өзгеруінің рұқсат етілген шектері кеңейтілетіні, жылу қондырғысының жоғары өнімділігі қамтамасыз етілетіні, бүкіл өндірісті толық механикаландыру және автоматтандыру үшін алғышарттары жасалды. Қорғасын қалдықтарын агломерациялық қайта өңдеудің және олардың негізінде аглопорит алудың негізгі артықшылығы агрегаттың шағын габариті болып табылатыны баяндалды. Зерттеу жұмысында атмосфераның ластану деңгейінің қоршаған ортадағы жасыл өсімдіктерге әсерін анықтауда эпифитті қыналар флорасына сандық сипаттама әдісі пайдаланылды, мұндай биоиндикациялық зерттеуде еліміздің оңтүстік аймақтарында жиі кездесетін қаратал ағаштарына лихенология әдістемесін пайдалану тиімді болып табылды. Оны пайдаланудың ыңғайлылығы ағашта өсетін қыналар түрлеріне нақты анықтама беруді қажет етпейтіндігімен түсіндірілді. Қыналардың пассивті индикациясының негізгі әдісі қынаның салыстырмалы санының өзгеруін бақылау болып отыр. Ол үшін қынаның проекциялық жамылғысын өлшеу ауасы қорғасын қалдығымен ластанған жерде таңдалынып алынған сынақ алаңдарында жүргізіліп, мұнда қыналардың зерттеу

аймағы үшін проекциялық жамылғысының орташа мәндері алынды. Мұндай зерттеу жұмыстары өндіріс орындары орналасқан жердегі ауаның ластануын салыстырмалы түрде бағалау мақсатында басқа, ауасы ластанбаған учаскеде өсетін ағаштардағы қыналардың проекциялық жабындарынада өлшеулер жүргізу арқылы жүзеге асырылды. Атмосфера ауасының ластану көрсеткішін флористикалық биоиндикация әдісімен бағалауда ауасы ластанған және ластанбаған жер аймақтарында 10 қаратал ағаштары таңдалынып алынады, оларда өсетін қыналар фрутикоза, жапырақты және қабыршақ түріндегі ерекшеіктеріне топталып бөлінеді. Мақалада мұндай лихенологияқ индикациялау ағаш діңінің қыналармен жабылу дәрежесін бағалау арқылы жүзеге асырылғаны толық баяндалды.

Түйін сөздер: күл, қож, қорғасын, мырыш қосылыстары, атмосфера, ластау

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ПЕРЕРАБОТКА ОТХОДОВ ПРОИЗВОДСТВА И ОЦЕНКА ВОЗДЕЙСТВИЯ НА ОКРУЖАЮЩУЮ СРЕДУ

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Аннотация. В данной статье предложен метод агломерационного отжига при производстве пористых агрегатов. Также были созданы предпосылки для расширения допустимых пределов изменения химического состава промышленных отходов, пригодных для производства агрегата, обеспечения высокой производительности тепловой установки, полной механизации и автоматизации всего производства. Отмечено, что основным преимуществом агломерационной переработки свинцовых отходов и получения на их основе аглопорита является малогабаритность агрегата. В исследовательской работе был использован метод количественной характеристики флоры эпифитных лишайников при определении влияния уровня загрязнения атмосферы на зеленые растения в окружающей среде, в таком биоиндикационном исследовании было обнаружено, что использование методики лихенологии для черных деревьев, часто встречающихся в южных регионах страны. Удобство его использования объясняется тем, что он не требует четкого определения видов лишайников, растущих на дереве. Основным методом пассивной индикации лишайников является наблюдение за изменением относительного числа лишайников. Для этого измерения проекционного покрытия лишайника проводились на испытательных площадках, отобранных в месте загрязнения воздуха отходами свинца, где были получены средние значения проекционного покрытия для исследуемой зоны лишайников. Такие исследовательские работы проводились путем проведения замеров выступающих покрытий лишайников на деревьях, растущих на другом, незагрязненном участке, с целью сравнительной оценки загрязнения воздуха в местах расположения производств. При оценке показателя загрязнения атмосферного воздуха методом флористической биоиндикации в зонах с загрязненным и незагрязненным воздухом выбираются 10 черных деревьев, в которых произрастающие лишайники группируются по особым признакам в виде фрутикозы, лиственных и чешуйчатых. В статье подробно изложено, что такая лихенология проводилась путем оценки степени покрытия ствола дерева лишайниками.

Ключевые слова: зола, шлак, свинец, соединения цинка, атмосфера, загрязнение

Introduction

By this time, only a tenth of the ash and slag had been put into economic circulation, of which less than 4 % of phosphogypsum and coal enrichment wastes and one fifth of non-ferrous metallurgy slag, mining wastes are not processed. In particular, more than 200 million tons of waste phosphogypsum, 600 million tons of metallurgical slags, residues of flotation enrichment of non-ferrous and rare metal ores, residues of pyrite, phosphate and titanium-containing vanadium slags require special attention (Wozniak et al., 1994).

Today, each inhabitant of the planet produces about 20 tons of raw materials annually, but with the consumption of 800 tons of water and 2.5 kW of energy, about 90–98 % of them are accumulated as waste. The share of household waste per person does not exceed 0.3–0.6 tons per year, and the remainder is industrial waste (Daribayev et al., 2023).

As a result of the activities of the lead production plant established in Shymkent city in the 30s of the last century, to date, about 2 million tons of slag has been removed. After the plant's closure, these toxic wastes are the source of the main pollution of the environment (soil, groundwater, and air) (Bagova et al., 2021). Lead and zinc compounds are also dangerous to humans because of their high toxicity and ability to accumulate in the body. Lead poisoning ranks first among occupational intoxications of workers in the manufacturing sector (Bagova et al., 2021). Lead (Pb) is a natural element found in the earth's crust, and mainly because of its ductility and corrosion resistance the repeated use of lead in the twentieth century, including leaded gasoline, lead-based paint and welding water pipes, has led to increased risk of human exposure to lead (Jianbo et al., 2020).

Research materials and methods

Wind directions and speeds are of great importance for the propagation of harmful substances rising into the air of the atmosphere from residual accumulative sources of pollution. This is due to the fact that due to the wind speed dangerous meteorological conditions arise, the pollution of atmospheric air increases sharply. Because when the wind speed is insignificant, such wind is called environmentally hazardous wind, which prevents the vertical rise of harmful substances emitted into the atmospheric air, and, conversely, presses on the surface of the earth. This leads to high levels of atmospheric pollution. But the environmental hazard is that the wind speed is different for each pollution source and depends on the parameters of the pollution sources.

The value of the radius of distribution of harmful substances, covering the territory on which the diagram of dispersion of pollution sources in the atmospheric air is depicted, is determined depending on the parameters of pollution sources, hydro meteorological conditions and terrain features.

According to the data of the Hydro meteorological Center of Turkestan Region «Kazgidromet», the main source of air pollution is the closed joint-stock company «Yuzhpolimetal» in Shymkent city. The dispersion of all harmful substances rising from these sources of pollution into the air of the atmosphere conditionally depends on the following factors:

the stratification index of an area depends on the coefficient a and the distribution of harmful substances rising from there into the air of the atmosphere in the vertical and horizontal directions;

to the temperature of the area in which the pollution source is located;

depends on the wind speed of that area.

Due to the heterogeneity of soils in the territory of Kazakhstan, the stratification coefficient here is 160.

According to the World Bureau of Metals Statistics, global lead production was 11.1 million tons in 2016, and lead slag production exceeded 5.5 million tons (De'an et al., 2019). Lead smelting slag is a hazardous waste containing heavy metals (Cr, Ni, Cu, Zn, As and Pb), and its improper disposal can cause irreparable damage to the ecosystem (Zhongzhong et al., 2022).

Lead (Pb) is a highly toxic, non-degradable heavy metal with a bluish-gray color with an atomic number of 82, a molecular weight of 207.2, a density of 11.34 g/cm^3 with a melting point of 621.43 F. and can be easily formed, molded and used to make alloys by mixing with other metals (Amit et al., 2021).

The amount and direction of the spread of waste rising from the production tailings into the atmospheric air is closely related to the hydrometeorological character of the area. The hydrometeorological character of Shymkent city is presented in Table 1 below.

Table 1 coefficients and meteorological characteristics that determine the dispersion of pollutants in the atmosphere of the Shymkent city.

№	Description	Digital size
1	The coefficient dependent on atmospheric stratification, a.	160
2	Terrain coefficient in the city.	1
3	The average temperature in the hottest month of the year, deg. S.	27
4	The average temperature in the coldest month of the year, deg. S.	1,7
5	The average annual wind rose, %: North North East East South-East South South-west West North-West	 9,4 16 16,8 21,3 10,2 8,6 10,7 7
6	The degree of repetition in the range of 5% of the wind speed, M/s.	3,0

To determine the concentration of ore enrichment wastes in the air of the atmosphere and the limits of their dispersion to the MPC value, it is first necessary to determine the maximum concentration of these harmful substances in cm. It can be calculated by Formula (1):

$$C_M = \frac{M \cdot A \cdot F \cdot n \cdot m \cdot \eta}{H^{\frac{4}{3}}} \cdot K, \qquad (1)$$

Where: M - amount of ore enrichment residue lifted into the atmospheric air, measured in g/sec; A - stratification coefficient (A = 160); F - waste shrinkage parameter (F = 3 for enrichment residue); n - factor depending on the value of v, which is a parameter of the average wind of the year ($\upsilon_м$ = 3.0 m/s); η - terrain, where the residual storage is located (η = 1); H - the height of the residual tailings storage location (H = 12 m); K - diameter and parameter that depends on the storage volume . It is determined by the formula (2):

$$K = D/8V_1, \qquad (2)$$

Where: D is the diameter of the surface of the warehouse where the enrichment waste is stored (D = 300 m); V_1 is the volume of air mixed with dust rising from the surface of the warehouse where the waste was stored. The volume of air mixed with this dust is determined by the formula:

$$V_1 = \frac{\pi D^2}{4} \cdot \omega_0^2 = \frac{300^2}{4} \cdot 3 = 211{,}95 \text{ мг/м}^3. \qquad (3)$$

In this regard, the coefficient K is determined by the formula:

$$K = \frac{300}{8 \cdot V_1} = \frac{300}{8 \cdot 211{,}95} = 0{,}177. \quad (4)$$

The wind speed $\upsilon'_м$, which depends on the coefficient n reflecting the distribution of harmful substances rising from the storage surface into the atmospheric air, is determined by formula (5):

$$\upsilon'_м = 1{,}3 \frac{\omega_0 \cdot D}{H} = 97{,}5 \quad (5)$$

On summer days, wind speeds of up to 21 m/s are expected in land areas of Shymkent city, at such wind speeds the amount of slag dust rising from the surface of the warehouse, where lead slag waste is stored, reaches 8.7 g/s. As a result of the activities of the Shymkent city lead plant, about 2 million tons of technogenic waste in the form of lead-containing slag was collected. Waste from lead production contains a large number of toxic compounds of heavy metals, such as lead, zinc, and cadmium, which are dangerous sources of environmental pollution (Turebekova et al., 2021).

As a rule, the highest concentrations of lead in the atmospheric air are observed in winter, which is associated with additional emissions of combustion products into the atmosphere. Bad weather during this period of the year contributes to the accumulation of lead in the lower layers of the atmosphere. Lead enters the body through the gastrointestinal tract and respiratory system, and then spreads throughout the body through the blood (Bagova et al., 2021). The maximum concentration of slag dust rising into the atmospheric air is:

$$C_М = \frac{8{,}7 \cdot 200 \cdot 1 \cdot 1}{27{,}473} 0{,}177 = 11{,}21 \text{ мг/м}^3 \quad (6)$$

The maximum distance at which there is a maximum concentration of slag dust rising into the atmosphere on windy days from the surface of the warehouse where the slag waste of the lead plant is stored, X_m, is determined by the formula:

$$X_m = \frac{5-F}{4} \cdot d\ H \quad (7)$$

where the unit d, υ ' m > 2, in the absence is determined by the formula:

$$d = 16{,}1 \cdot \sqrt[2]{\nu'} = 400 \quad (8)$$

Consequently, X_m = 400 m

Air pollution is one of the major hazards to human health and the environment around the world. Most air pollutants are in solid, liquid and gaseous phases (Kelly and Fussell, 2015). Anthropogenic metal pollution can lead to increased stress in affected organisms, but it can be difficult to distinguish anthropogenic effects from natural changes in environmental conditions (Hamdy et al., 2019). The southeastern side of the wind-driven sanitary protection zone of the lead plant slag waste storage site extends into the Kazygurt region neighborhood (Johan et al., 2020). A satellite image of this residual storage area is shown in Figure 1, and a cartographic representation of wind-driven slag dispersion diagrams from the surface of the slag storage area in atmospheric air is shown in Figure 2.

Name of the object: Slag storage facility

Object code: 0001

Pollutant:

Slag dust pollutant code: 2946

Polluting object: Slag storage facility

Maximum concentration, mg/m3: 11,21

Relief factor: 1

Results revealed by the method of calculating the concentration of harmful substances.

Fig. 1 satellite map of the slag dump

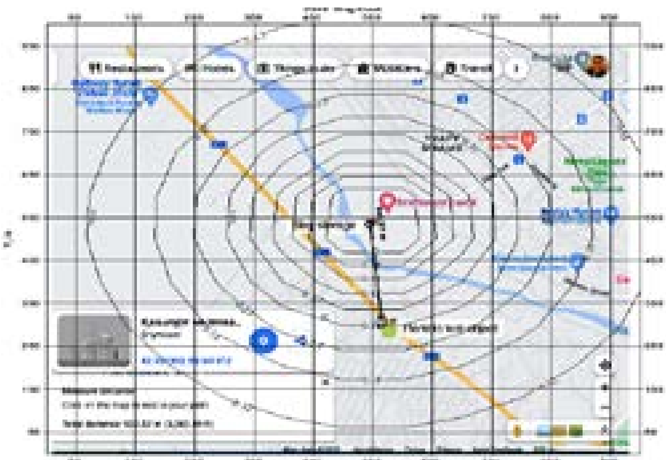

Fig. 2 map of dispersion of slag dust rising into the air from the tailings

Dissipation of the ore enrichment residues lifted into the atmospheric air to the MPC level is carried out at a distance X, m, whose concentration at dangerous wind speeds is determined by the formula:

$$C = S_1 \cdot C_m \qquad (9)$$

Where S_1-dimensional coefficient, determined depending on the ratio x/xm and the coefficient F, determined by the formula:

$$S_1 = \frac{X/X_m}{3{,}58\left(\frac{X}{X_m}\right)2 - 35{,}2\left(\frac{X}{X_m}\right) + 120} \qquad (10)$$

Using this formula, Figure 3 shows diagrams showing the area of slag dust dispersion at the floristic test point to the southeast, where the wind often blows from the surface of the residual repository. Here we can see that the concentration of slag dust at the site where the floristic test was conducted at a distance of 934 m exceeds the normal norm.

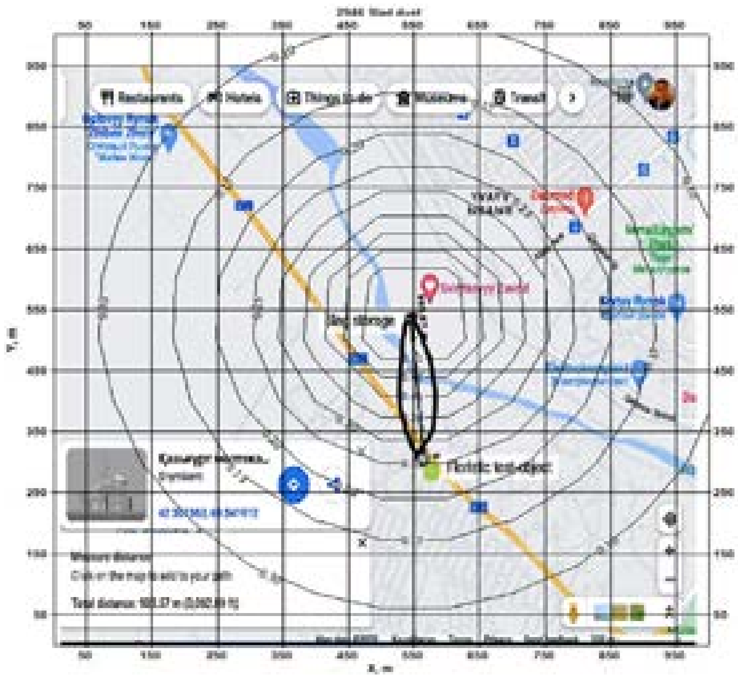

Fig. 3 dust removal diagram rising into the air from the slag storage

When determining the impact of the level of atmospheric pollution on green plants in the environment the method of quantitative characterization of the flora of epiphytic lichens is used, in such bio indication study the most effective is the use of the method of lichenology of Karatal trees, which is common in the southern regions of the country. The convenience of its use is due to the fact that it does not require a clear identification of lichen species growing on the tree (Bagova et al., 2021). The main method of passive lichen indication is the observation of changes in the relative number of lichens. For this purpose, measurements of lichen projection coverage are made on test plots selected in the place of air pollution, where the average values of projection coverage for the lichen area under study are taken. Such research work is carried out for the purpose of comparative assessment of air pollution in the locations of industries, in addition, measurements are made of the projection coverages of lichens on trees growing in the area with unpolluted air. When assessing the air pollution index by floristic bio indication, 10 Karatal trees are selected in areas with polluted and unpolluted air, and the lichens growing on them are grouped according to the special characteristics of fruticose, foliage and scale. This lichenology is carried out by assessing the degree of coverage of the tree trunk by lichens. To conduct bioindication, a 10 cm x 10 cm frame (grid) is placed on the more lichen-covered part of the bark at the height of 30-150 cm of the tree trunk and the percentage of the total area of the frame is counted.

The frequency (coefficient) of lichen occurrence in tree trunks can be determined by looking from the bottom of each tree trunk to the first branches. The value of lichen occurrence frequency is calculated by the formula:

$$R=A/B \times 100\% \quad (11)$$

Where A - is the number of trees with lichens;
B - the total number of trees studied;

In areas where production is located, epiphytic lichens are also used to assess air quality using the standard lichenological method, which are divided into 3 groups: fruticose, deciduous, scaly. When carrying out work on lichenological bio indication in this way, the number of lichen species in each category and the percentage of tree trunk coverage by lichens is given in the following table and the degree of air pollution is classified.

Table 2 table for determining the class of air pollution by henna indication

Color and growth features					Air pollution class
Gray color			Yellow color		
Fruticosa	Deciduous	Scaly	Scaly	Deciduous	
+	+	+	+	+	I
+	+	+			II
+	+		+		II
+	+		+		III
+	+				IV
+					V–VI

In the course of the research, data obtained after collecting lichens on tree trunks and counting them using colorless frames were collected in the form of a table, the air quality in the area where the pollution source is located was determined.

The assessment by the lichen-indication method of air pollution by slag dust rising from the surface of the slag-saving warehouse of the lead plant on windy days into the atmospheric air in the Shymkent city is estimated by comparing special classification data and lichen coatings on trees of uncontaminated areas.

The floristic method of bio indication of environmental pollution is based on the analysis of changes in the floral composition of plant communities. The application of the floristic bio indication technique is especially effective in assessing the level of air pollution in the zone of operation of large enterprises (Tatyana et al., 2021). In urban centers with old housing stocks, the process of creating large-scale machine production in any industry leads to an increase in the concentration of lead and other heavy metals in the environment. Air pollution in the vicinity of production leads to the depletion of vegetation growing in this area, which reduces the diversity of plants, floral composition and their height (Sahar et al., 2023).

Engineering, road traffic, agriculture and waste pollute the environment, as a result of which toxic substances, such as heavy metals, which can pose a danger to human health, enter the air, soil, food and water. In tree communities, lichens are the first indicators of atmospheric pollution. At the same time, epiphytic fruticose lichens (Usnea, Alectoria, Bryopogon) are known to be the most sensitive to air pollution. With the limit of their resistance to pollution from 302 to 3 micrograms/m3, the content of HF-1 micrograms/m3 and dust 0.01 mg/m3, the growth of lichens begins to thin and disappear. Then epiphytic leaf lichens with higher resistance to pollution of the henna families Hypogymnia, Parmelia, Parmeliopsis and Sphagnum begin to disappear when the indicator of air pollution is sulfur dioxide SO2 – 3–7 micrograms/m3 and dust 0.01–0.2 mg/m3. The high sensitivity of lichens to the effects of pollutants depends on the characteristics of their ecological physiology (anatomical structure, presence in a sterile substrate, the ability to absorb and concentrate highly diluted substances in the stratum, etc.). Indicators of coverage of trunks of Karatal trees with lichen coatings near the slag storage of the lead plant are shown in table 3 below.

Table 3 table of the results of the study of lichen flora near the Slag repository.

Symptoms	Trees									
	1	2	3	4	5	6				0
The total number of henna species, including:										
Fruticosa	–	–	–	–	–	–	–	–	–	–
Deciduous	+	+	–	–	–	–	–	–	–	–
Scaly	+	–	+	+	–	–	+	–	–	–
The degree of covering of tree trunks with leaf lichens, %	20									
The degree of covering of tree trunks with scaly lichens, %	40									

The heavy metals pose a toxic hazard when they enter the body in high concentrations or accumulate in the food chain over time. In addition, the excessive accumulation of many heavy metals can cause carcinogenic diseases, damage vital organs such as the cardiovascular system, nervous system, respiratory system and brain, and eventually lead to the disruption of normal biological functions (Yuke et al., 2022). According to regulations, the environmental hazard of granulated slag dust is at level 3, and lead in slag dust is at level 1 hazard and its MPC = 0.0003 mg/m3 (Isaev et al., 2022).

Research results and discussion

The conducted research revealed the level of atmospheric pollution by assessing the impact on plants of slag dust rising into the air on windy days from the slag dump near the Shymkent city lead plant. In order to determine the level of atmospheric pollution by slag dust, the most effective method of floristic lichen indication was to analyze the conditions of lichen growth on tree trunks of the Kazygurt microdistrict stretching south of the slag dump, at a distance of 881 meters to Zhidelibaisyn street. For floristic lichen-indication, 10 full-grown Karatal trees were selected in each of the selected land areas, and the degree of lichen coverage of their trunks was assessed. Bio indication studies were conducted on the degree of thick coverage of tree trunks by projective lichen coverages, using transparent frames divided into 10 x 10 cm cells with a height of 150 cm for each Karatal tree. Indicators of coverage of Karatal tree trunks of the Shymkent city arboretum by lichen coverages are shown in tables 4 and 5.

Table 4 table of the results of studies of lichen flora near the Arboretum

Symptoms	Ағаштар									
	1	2	3	4	5	6				0
The total number of henna species, including:										
Fruticosa	–	–	–	–	–	–	–	–	–	–
Deciduous	+	+	+	+	+	+	+	+	+	+
Scaly	+	+	+	+	+	+	+	+	+	+
Degree of coverage of tree trunks with fruticose lichens, %	0									
The degree of covering of tree trunks with leaf lichens, %	100									
The degree of covering of tree trunks with lichens in the form of scales, %	100									

Table 5 assessment of air pollution by lichens in Arboretum

№	Color and growth features					Air pollution class
	Grey color			Yellow color		
	Scaly	Deciduous	Fruticosa	Scaly	Deciduous	
Karatal	+	+	–	–	–	III
Oak	+	+		+	+	
Birch	+	+	–	+	–	

In addition to determining the species composition of tree lichens, their quantitative size and percentage coverage of tree trunks were determined. The assessment of the occurrence and content of lichens in tree trunks was indicated on a 5-point scale. Thus, for each of the studied zones and each species of lichens on tree trunks — fruticose, deciduous, and scale-like — the extent of coverage of the emergence and growth zone was established as a score (Table 6).

Table 6 assessment of the frequency of occurrence of lichens and the degree of coverage of tree trunks on a 5-point scale.

Frequency of occurrence (occurrence), (%)		Degree of coverage, (%)		Rating score (score)
Very rare	Less than 5	Very low	Less than 5	1
Rare	5-20	Low	5-20	2
Rare	20-40	Average	20-40	3
Often	40-60	High	40-60	4
Very often	60-100	Very high	60-100	5

The peculiarities of lichen flora distribution on the studied trees, which are the results of lichen indication studies of floristic bio indication, are determined according to Table 7 below after bringing the air quality scale to the type shown.

Table 7 air quality scale for projection coverage of tree trunks by lichen

Projection cover, %	Number of species	Number of dominant species	Degree of contamination
> 5	>5	> 5	Very fresh air
	3– 5	> 5	Fresh air
	2 – 5	< 5	Relatively clean air
20 – 50	> 5	> 5	
	> 2	< 5	The air is only slightly polluted
< 20	3 – 5	< 5	Air contaminated
	0 – 2	< 5	The air is highly polluted

The average values of the appearance (occurrence) of each lichen species and tree trunk coverage on tenfold trees sampled during the assessment of air pollution by the lichen-indication method are calculated as scaly (N), deciduous (L) and fruticose (F). Knowing the average formation and point values of the indicators N, L, F of lichens, it is not difficult to calculate the index of relative air purity. The closer the value of relative atmospheric purity is, the cleaner the air is in the habitat of lichens growing on tree trunks. There is the following direct connection between the relative purity of the atmosphere and the average concentration of residual dust in the atmosphere.

$$ACT = (N + 2L + 3F) / 30, \text{ that is} \qquad (12)$$

The air pollution in the vicinity of the slag storage of the lead plant is calculated according to the results of studies in Table 5:

$$ACT = \frac{(3 + 2x3 + 3x0)}{30} = 0{,}3 \qquad (13)$$

Statistical evaluation of indicators of lichen diversity in the completed scientific research shows that the air pollution near the storage site of slag waste lead plant located in the city of Shymkent, slag dust has a 3-point index and that lichens in Karatal trees only two species, their diversity is at a low level. In this regard, in the southern direction of the warehouse slag waste Shymkent lead plant 881 m, noting that the remote tree lichen index of projection cover is 20 %, the number of lichen species-no more than 2, and their dominant species-less than 5, he was convinced that the average relative purity of the atmosphere is 0.3. In addition, according to the pollution classification of floristic lichen indication in tables 4–6 and the values of the relative temperature of the atmosphere air pollution index near the lead plant showed that the average annual wind speed air is significantly polluted with dust, and, conversely, the air quality of the arboretum in the relative cleanliness index. We evaluated the possibility of effective use of waste to produce agloporite we conducted on samples of granulated slags of CJSC «Yuzhpolymetal».

Table 8 Chemical composition of slag

Fe	SiO_2	Al_2O_3	MgO	Zn	Ba	Cu	Pb	S	Ag	As	Sb
40,25	20,31	4, 22	4,8	15,4	4,01	2,44	3,62	4,48	11,81	0,36	0,05

Annual volume of formation, use and storage of waste: 48,000 tons.

Table 9 physical properties of non-ferrous metallurgy slags

Slag type	Appearance	Bulk weight, t / m3	Humidity, %	Density, %	Melting point, °C
Lead, lead-zinc and zinc slags	Red-black, the details are smooth, with sharp corners	1,8-2,2	2-4	3,4-3,7	1100-1180

According to the mineralogical analysis, the main rock-forming minerals in the granulated slag are amorphous glass phase (56.86–63.37 %), franklinite (14.9–15.4 %), gahnite (8.3–11.2 %), sphalerite (2.5 %–4.0 %), quartz (1.0–4.0%), calcite (1.4–3.3 %) and galena (1.4–3.3 %). The content of organic compounds in the slag from 237.0 mg/kg to 317.0 mg/kg, including the proportion of petroleum products from 250 mg/kg to 317 mg/kg.

According to spectral analysis data, the base of the granulated slag consists of iron (24.07–28.95 %), silicon (22.03–32.93 %), calcium (7.24–10.71 %), zinc (8.58–11.85 %), aluminum (5.17–6.25 %), sodium (1.99–4.33 %), magnesium and potassium (1.4–3.04 %), oxides of lead (1.57–3.46 %), copper (0.57–1.84 %).

Sudden cooling during slag extraction prevents crystallization, slag particles have an amorphous structure. In the presence of an activator (Ca(on)2), glassy slag reacts with water to form stable calcium hydrosilicate compounds. The reactivity depends on the chemical and mineralogical composition of the slag and the degree of its amorphous structure.

Model: lead slag, primary. The exothermic effect between 340 and 900^{0}C (DTA), at which the weight transfer of the sample is recorded, is related to the supply of oxygen into the system. The process is related to the oxidation of the components in the dough. Within this thermal representation, the DTA-650–720^{0}C curve shows a very intense elevation associated with the release of excess system heat into the atmosphere. The effect is accompanied by an increase in additional sample weight. This is characteristic of pyrrhotite (Fe1+x S), which increases the mass and temperature of the sample due to oxidation.

Thus, it is determined that the chemical and mineralogical composition and physical and mechanical properties of granulated slag can be considered as a valuable raw material for the production of building materials.

Conclusion

In the conducted research work statistical evaluation of indicators of lichen diversity has established that the air pollution near the storage site of slag waste lead plant, located in the city of Shymkent, slag dust has a 3-point indicator, and that lichens in Karatal trees only two species, their diversity is at a low level. In this regard, in the southern direction of the warehouse slag waste Shymkent city lead plant 881 m, noting that the index of lichen projection cover trees in the distance is 20 %, the number of lichen species-no more than 2, and their dominant species-less than 5, we found that the average relative purity of the atmosphere is 0.3. Further we found that according to the indicators of the pollution classification of floristic lichen indication in tables 4–6 and the values of the relative temperature of the atmosphere air pollution indicator near the lead plant indicates significant air pollution by dust at the average annual wind speed, in contrast, the quality of the arboretum air is in the relative cleanliness indicator.

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