ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

5 (449)

SEPTEMBER – OCTOBER 2021

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

http://www.geolog-technical.kz/index.php/en/

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

«Известия НАН РК. Серия геологии и технических наук».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ39VPY00025420,** выданное 29.07.2020 г.

Тематическая направленность: *геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соединений.*

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

http://www.geolog-technical.kz/index.php/en/

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420,** issued 29.07.2020.

Thematic scope: *geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.*

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19

http://www.geolog-technical.kz/index.php/en/

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN **SERIES OF GEOLOGY AND TECHNICAL SCIENCES**
ISSN 2224-5278
Volume 5, Number 449 (2021), 153-160 ***https://doi.org/10.32014/2021.2518-170X.109***

Tleulesov A.K.[1*], Suyundikov M.M. [1], Shomanova Zh.K.[2], Akramov M.B.[3], Suiindik N.M.[4]

[1]Toraighyrov University, Pavlodar, Kazakhstan;
[2]Pavlodar State Pedagogical University, Pavlodar, Kazakhstan;
[3]The Dushanbe branch of the National University of Science and Technology NUST MISIS, Dushanbe, Tajikistan;
[4]Nazarbayev University, Nur-Sultan, Kazakhstan.
E-mail: *askaralek66@mail.ru*

ASSESSMENT OF QUALITATIVE AND QUANTITATIVE ELEMENTAL COMPOSITION OF WASTE IN THE TERRITORY OF SLUDGE COLLECTOR OF PAVLODAR ALUMINIUM PLANT

Abstract. During the operation of metallurgical plants, a large amount of waste is generated. Pavlodar aluminium plant has three sludge collectors, two of which have already been taken out of service due to filling. A large amount of bauxite sludge containing many valuable elements such as aluminium, copper, iron, manganese, chromium, and titanium is stored in these sludge collectors. For their utilization and prediction of the distribution of the concentrations of elements, it is required to make a qualitative and quantitative assessment of the composition of the waste. For this purpose, on the territory of the third (exploited) sludge collector samples were taken, indicating the coordinates of the sampling site on the map. The samples were analyzed on a BRA-18 X-ray fluorescence analyser. The concentration of elements was estimated using the artificial neural network (ANN). A separate neural network was created for all analyzed elements. The Levenberg-Marquardt algorithm was used for training. Based on the results of the ANN tests, graphs of the concentration of aluminium and copper were plotted depending on the place of sampling. As a result of the experiments, it was noted that the true concentrations of the analyzed samples for aluminium and copper are in good agreement with the predicted concentrations for these elements.

Key words: industrial waste, utilization, artificial neural network.

Introduction. Pavlodar region, which is essentially a diversified industrial complex where electricity, alumina, aluminium are produced, oil refining, mechanical engineering, ferrous metallurgy, food industry, production of building materials, and pharmaceuticals are developed, is one of the most industrialized regions of Kazakhstan. The presence of a large number of industrial enterprises also implies a great burden on the local ecology. One of these enterprises is the Pavlodar Aluminium Plant (PAP) - the only Kazakhstani enterprise that is a producer of alumina. According to the sanitary classification, the production of alumina (aluminium oxide) belongs to the hazard class I [1]. In the production of alumina, one of the large-tonnage wastes is dump bauxite sludge, which is sent through pipelines to sludge collectors. The volume of accumulated sludge in the sludge collector No. 1 is 52 million tons, in the sludge collector No. 2 - 42 million tons. (Both were taken out of service, at present the sludge collector No. 3 is in operation) [2].

Many chemical elements from sludge collectors, due to their increased migration ability, penetrate into groundwater, polluting them. Heavy metals penetrate into plants in the surrounding areas, and through the food chain enter the body of animals and humans, leading to various diseases. For example, copper belongs to the group of highly toxic metals that can cause acute poisoning in humans and animals, and also have a wide range of toxic effects with a wide variety of clinical manifestations [3].

From 01.07.2021 a new Environmental Code is being introduced in Kazakhstan [4]. The Code is aimed at reducing emissions from industrial enterprises into the atmosphere and discharges to water and soil. One of the key principles of this Code is that “the polluter pays, or the polluter pays and fixes”. Also, the Code provides for a waste hierarchy, which is aimed at reducing the generation of waste, and the generated waste must be reused, recycled, disposed of and only then disposed of at landfills.

In this work, the elemental composition of samples from waste stocks on the territory of sludge accumulator No. 3 of PAZ has been studied with the aim of their further recycling.

Experiments. Figure 1 shows a map showing the points of sampling from the territory of the storage lake (the other part during sampling was under slime water with a depth of 0.5-1.5 m). The dots in Figure 1 mark the sampling sites (test sites). The coordinates of the points on the sampling site are taken relative to the point (0, 0), located at the intersection of two mutually perpendicular segments, denoting two orthogonal axes: x and y. The sludge pond is approximately 750 m long (x-axis) and about 740 m wide (y-axis).

Sampling points are usually staggered on rectangular or square areas, but if the area is very large, sampling along one or both diagonals is used [5-8].

Due to the heterogeneity of the relief of the territory, the test plots were located according to the relief elements, and since the shape of the sludge pond was almost oval, we decided to arrange the points for sampling point samples, as shown in Figure 1.

Spot samples were taken from one layer at a depth of 5-20 cm, weighing 200-250 g using the envelope method. In this case, the samples are similar to each other and make it possible to more objectively assess the content of chemicals in them.

A total of 125 samples of waste sludge were taken from the sludge pond. Every 5 spot samples from one sample area were mixed in a glass jar, resulting in 25 pooled samples.

Elemental analysis of the samples was carried out on a BRA-18 X-ray fluorescence analyzer (Russia, 2006). The energy dispersive X-ray analyzer with a semiconductor detector BRA-18 is designed for X-ray spectral analysis of chemical elements of solid, liquid and powder samples from sodium (Z = 11) to uranium (Z = 92).

Figure 1 - Plan of the sludge tank with indication of sampling points

The action of the BRA-18 analyser is based on the excitation of the atoms of the sample of the investigated substance by the radiation of an X-ray tube, which causes their fluorescence.

This radiation from the sample enters the semiconductor detector, where quanta of different energies are converted into electrical pulses, the amplitude of which is proportional to the energy of the absorbed quanta. The analyser uses a silicon detector. Using an analog-to-digital converter, a sequence of electrical pulses is converted into a spectrum reflecting the energy spectrum of fluorescent radiation from the sample [9-11].

The analyser is a stationary device. The instrument was controlled, the spectrum was processed, and the content of the elements was calculated using a PC. The results of the analysis of the elemental composition of the aluminium plant wastes were discussed by us in [12].

To determine the concentration of elements in the sludge collector, depending on the coordinates of the places of the selected samples of the combined samples and to predict the distribution of elements on the territory of the sludge collector, we built an artificial neural network (ANN). The block diagram of the architecture of the constructed artificial neural network is shown in Figure 2.

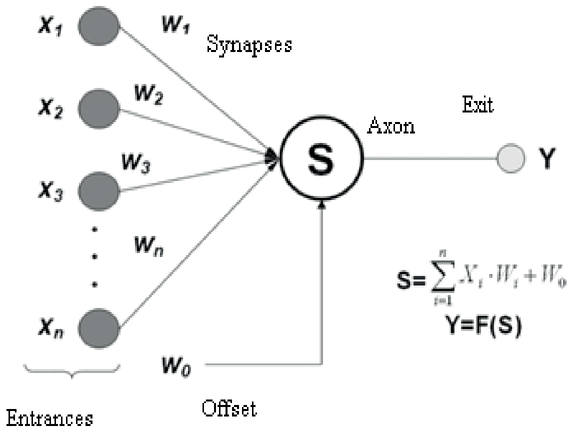


Figure 2 - Block diagram of the architecture of an artificial neural network

Input data for the neural network can be represented as vectors X_1, X_2, X_3, ... X_n, dimension X*1. The matrix of weighting coefficients W has the dimension SxX, where S is the number of neurons in the hidden layer of the neural network, and X, respectively, is the dimension of the input data vector. The constant bias, when added to the weight vector, is fed to the input of the activation function.

To build a neural network, you need to select its parameters. Most often, the choice of values for weights and thresholds requires training, i.e. stepwise changes in weight coefficients and threshold levels [13, 14].

For all analyzed elements, a separate neural network was created, in which the architecture of the network itself was the same for all elements, only the input data in the training set were different.

For the study, we used the Levenberg – Marquardt algorithm [15], it usually requires a little more memory, but the execution takes less time. If the result stops improving (the mean square error of the sample increases), then the training stops automatically.

Results and discussion. The test results for Al and Cu are shown in Tables 1 and 2.

Table 1 - Research results using ANN for aluminium

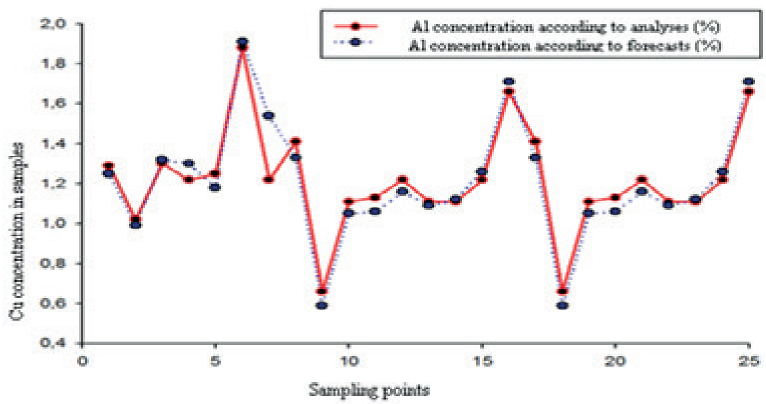
Input data		Actual value	Result			
X	У	Concentration	Predicted value	Absolute error	Relative error	Grade
182	126	1,29	1,24	0,05	2,94	Good
176	198	1,01	0,98	0,03	3,39	Good
176	274	1,31	1,33	0,02	1,78	Good
245	427	1,23	1,31	0,08	6,41	Good
297	489	1,26	1,19	0,07	5,73	Good
338	514	1,87	1,90	0,03	1,69	Good
389	534	1,21	1,53	0,32	20,61	Bad
444	525	1,40	1,32	0,08	6,14	Good
523	524	0,65	0,58	0,07	12,48	Bad
618	543	1,10	1,04	0,06	5,27	Good
472	476	1,14	1,07	0,07	6,58	Good
365	475	1,21	1,15	0,06	4,95	Good
334	369	1,10	1,08	0,02	1,82	Good
431	411	1,11	1,12	0,01	0,94	Good
561	427	1,23	1,27	0,04	2,83	Good
527	374	1,67	1,72	0,05	2,90	Good
590	355	1,40	1,31	0,09	6,94	Good
486	305	0,67	0,61	0,06	10,60	Bad
402	315	1,10	1,02	0,08	7,30	Good
300	285	1,14	1,06	0,08	7,60	Good
318	207	1,23	1,15	0,08	6,79	Good

391	218	1,10	1,07	0,03	2,76	Good
418	141	1,10	1,12	0,02	1,82	Good
339	136	1,21	1,24	0,03	2,05	Good
291	116	1,65	1,71	0,06	3,47	Good

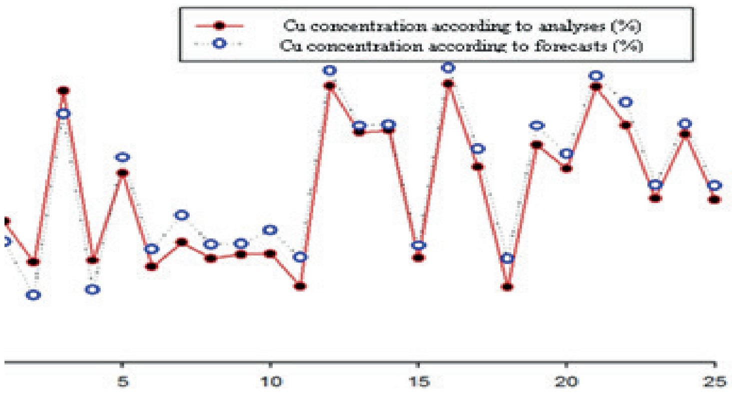
Table 2 - Results of the study using ANN for copper

Input data		Actual value	Result			
X	У	Concentration	Predicted value	Absolute error	Relative error	Grade
182	126	16,36	16,02	0,34	2,10	Good
176	198	15,68	15,13	0,55	3,52	Good
176	274	18,53	18,15	0,38	2,04	Good
245	427	15,71	15,22	0,49	3,13	Good
297	489	17,17	17,41	0,26	1,52	Good
338	514	15,58	15,88	0,30	1,95	Good
389	534	16,00	16,45	0,45	2,81	Good
444	525	15,72	15,96	0,24	1,50	Good
523	524	15,81	15,99	0,18	1,12	Good
618	543	15,81	16,20	0,39	2,47	Good
472	476	15,28	15,76	0,48	3,13	Good
365	475	18,60	18,86	0,26	1,38	Good
334	369	17,83	17,94	0,11	0,62	Good
431	411	17,88	17,98	0,10	0,54	Good
561	427	15,75	15,96	0,21	1,36	Good
527	374	18,66	18,93	0,27	1,44	Good
590	355	17,25	17,55	0,30	1,72	Good
486	305	15,25	15,73	0,48	3,14	Good
402	315	17,64	17,96	0,32	1,83	Good
300	285	17,24	17,49	0,25	1,44	Good
318	207	18,61	18,79	0,18	0,97	Good
391	218	17,95	18,33	0,38	2,14	Good
418	141	16,75	16,97	0,22	1,33	Good
339	136	17,80	17,97	0,17	0,98	Good
291	116	16,70	16,94	0,24	1,47	Good

Using the obtained results of ANN analyses, we plotted the graphs of the dependence of the concentration of aluminium and copper on the points of coordinates of the selected samples (Figure 1). The dependences of the concentration of aluminum and copper on the coordinates of the selected samples are shown in Figure 3.



a)



б)
Figure 3 - Dependence of the concentration of a) aluminium and b) copper on the coordinate (number) of the selected samples

Analysing the graphs, you can see that the true concentrations of the analysed samples for aluminium and copper are in good agreement with the predicted concentrations for these elements.

Figure 4 shows the results of the distribution of the chemical element aluminium, obtained using an artificial neural network.

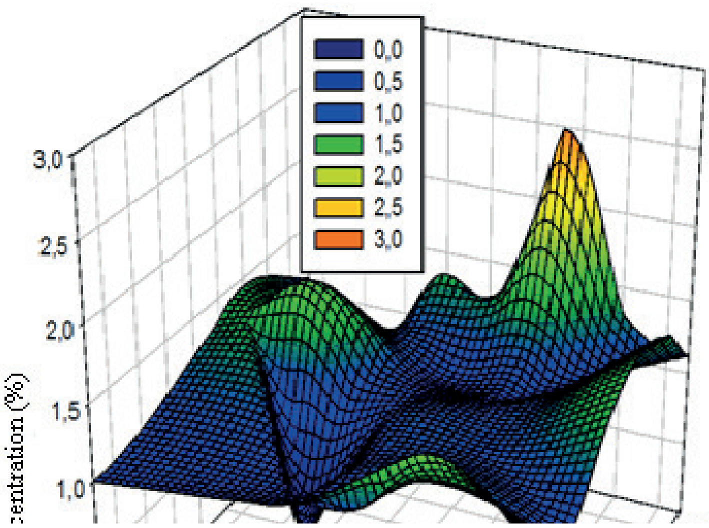


Figure 4 - Electronic map of aluminium distribution according to ANN

The results of the distribution of the chemical element copper using the developed ANN are shown in Figure 5.

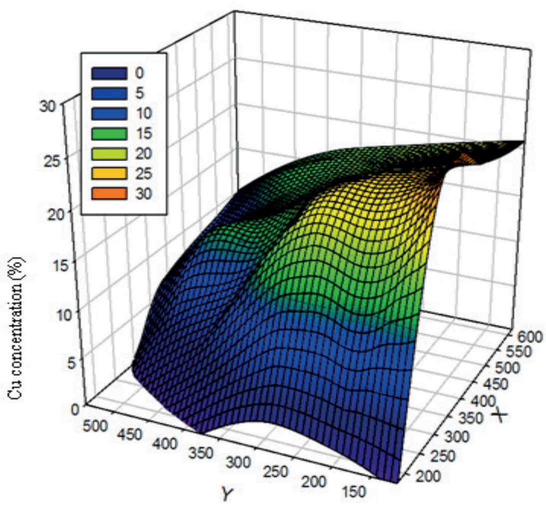


Figure 5 - Electronic map of copper distribution according to ANN.

The distribution is represented using element concentration and corresponding coordinates. In the above electronic maps, the distribution of chemical elements obtained using the developed neural network shows that the greater the concentration of an element at a specified point, the more red it has on the map; the lower the concentration of an element, the more blue it has on the map. As can be seen from Figures 4 and 5, the neural network shows high accuracy on all three data samples obtained by splitting samples taken at different points of the sludge pond.

The results obtained are successfully applied in the recycling of production wastes at the Pavlodar aluminium plant.

Conclusion. Thus, as a result of the studies carried out, it was found that the use of the developed ANN for predicting the distribution of the concentrations of chemical elements in the body of the PAZ sludge collector gives reliable results and it is recommended to use it for a qualitative and quantitative assessment of the composition of bauxite sludge. Work on utilization and prediction of the distribution of element concentrations should be continued, as it is important for Pavlodar and Pavlodar region as a whole.

Тлеулесов А.К.[1*], Суюндиков М.М.[1], Шоманова Ж.К.[2], Акрамов М.Б.[3], Сүйіндік Н.М.[4]

[1]Торайғыров Университеті, Павлодар, Қазақстан;
[2]Павлодар мемлекеттік педагогикалық университеті, Павлодар, Қазақстан;
[3]«МИСиС» Ұлттық зерттеу технологиялық университетінің Душанбе филиалы, Душанбе, Тәжікстан;
[4]Назарбаев Университеті, Нұр-Сұлтан, Қазақстан.
E-mail: *askaralek66@mail.ru*

ПАВЛОДАР АЛЮМИНИЙ ЗАУЫТЫ ШЛАМ ЖИНАҚТАУЫШЫНЫҢ АУМАҒЫНДАҒЫ ҚАЛДЫҚТАРДЫҢ САПАЛЫҚ ЖӘНЕ САНДЫҚ ЭЛЕМЕНТТІК ҚҰРАМЫН БАҒАЛАУ

Аннотация. Металлургия өндірісі жұмыс істеген кезде қалдықтардың көп мөлшері пайда болады. Павлодар алюминий зауытында үш шлам жинақтауыш бар, олардың екеуі толтыруға байланысты пайдаланудан шығарылды. Бұл шлам жинақтауыштарда алюминий, мыс, темір, марганец, хром, титан сияқты көптеген құнды элементтер бар боксит шламының үлкен көлемі сақталған. Оларды жою және элементтер концентрациясының таралуын болжау үшін қалдықтардың құрамын сапалы және сандық бағалау қажет. Осы мақсатта үшінші (пайдаланылатын) шлам жинақтауыштың аумағында картада үлгілерді іріктеу орнының координаттары көрсетіле отырып, сынамаларды іріктеу жүргізілді. Үлгілерді талдау БРА-18 рентген-флуоресцентті анализаторында жүргізілді. Элементтердің шоғырлануын бағалау жасанды нейрондық желі (ЖНЖ) көмегімен жүзеге асырылады. Барлық талданған элементтер үшін жеке нейрондық желі құрылды. Оқыту үшін Левенберг-Марквардт алгоритмі қолданылды. ЖНЖ талдауларының нәтижелері негізінде сынамаларды іріктеу орнына байланысты алюминий мен мыс шоғырлануының графигі салынды. Жүргізілген эксперименттердің нәтижесінде талданған үлгілердің алюминий мен мыстың нақты шоғырлануы осы элементтер үшін болжамды шоғырлануымен жақсы сәйкес келетіні атап өтілді.

Түйінді сөздер: өнеркәсіптік қалдықтар, қайта өңдеу, жасанды нейрондық желі.

Тлеулесов А.К.[1*], Суюндиков М.М.[1], Шоманова Ж.К.[2], Акрамов М.Б.[3], Суюндик Н.М.[4]

[1]Торайгыров Университет, Павлодар, Казахстан;
[2]Павлодарский государственны педагогический институт, Павлодар, Казахстан;
[3]Душанбинский филиал Национального исследовательского технологического университета «МИСиС», Душанбе, Таджикистан;
[4]Назарбаев Университет, Нур-Султан, Казахстан.
E-mail: *askaralek66@mail.ru*

ОЦЕНКА КАЧЕСТВЕННОГО И КОЛИЧЕСТВЕННОГО ЭЛЕМЕНТНОГО СОСТАВА ОТХОДОВ НА ТЕРРИТОРИИ ШЛАМОНАКОПИТЕЛЯ ПАВЛОДАРСКОГО АЛЮМИНИЕВОГО ЗАВОДА

Аннотация. При работе металлургических производств образуется большое количество отходов. Павлодарский алюминиевый завод располагает тремя шламонакопителями, два из которых уже выведены из эксплуатации в связи с заполнением. В этих шламонакопителях складирован большой объем бокситового шлама, содержащий немало ценных элементов, таких как алюминий, медь, железо, марганец, хром, титан. Для их утилизации и прогнозирования распределения концентраций элементов требуется произвести качественную и количественную оценку состава отходов. С этой целью на территории третьего (эксплуатируемого) шламонакопителя произведен отбор проб с указанием на карте координат места отбора образцов. Анализ образцов выполнялся на рентгенофлуоресцентном анализаторе БРА-18. Оценка концентрации элементов произведена с помощью разработанной искусственной нейронной сети (ИНС). Для всех анализируемых элементов была создана своя отдельная нейронная сеть. Для обучения был применен алгоритм Левенберга-Марквардта. На основе результатов анализов ИНС были построены графики концентрации алюминия и меди в зависимости от места отбора образцов. В результате проведенных экспериментов было отмечено, что истинные концентрации проанализированных образцов по алюминию и меди хорошо совпадают с спрогнозированными концентрациями для этих элементов.

Ключевые слова: промышленные отходы, утилизация, искусственная нейронная сеть.

Information about authors:

Tleulessov Askar Karimzhanovich – master of engineering and technology, senior lecturer, Toraigyrov University, *askaralek66@mail.ru*; https://orcid.org/0000-0001-9368-4947;

Suyundikov Merkhat Madenievich – candidate of Technical Sciences, Head of the Department of Metallurgy of Toraigyrov University, Pavlodar, Kazakhstan, *suyundikovm@mail.ru*; https://orcid.org/0000-0002-1352-5821;

Shomanova Zhanat Kairollinovna – doctor of technical sciences, professor of the Geography and chemistry department, Pavlodar state pedagogical university, *zshoman@yandex.ru*; https://orcid.org/0000-0001-8346-9688;

Akramov Muhammad Bozorovich – candidate of Physical and Mathematical Sciences, Head of the Department Energy-efficient and Resource-saving technologies of Dushanbe Branch of the National University of Science and Technology «MISiS», Dushanbe, Tajikistan, *akramov60@mail.ru*; https://orcid.org/0000-0001-7155-7410;

Suiindik Nurtas – undergraduate student of the School of Engineering and Digital Sciences, Nazarbayev University, Nur-Sultan, Kazakhstan; *nurtas.suiindik@nu.edu.kz*; https://orcid.org/0000-0001-8549-2523.

REFERENCES

1. Order of the Minister of National Economy of the Republic of Kazakhstan Sanitary rules “Sanitary and epidemiological requirements for the establishment of a sanitary protection zone of production facilities” dated 20.03 2015 [Prikaz Ministra natsional’noi ehkonomiki Respubliki Kazakhstan Sanitarnye pravila “Sanitarno-ehpidemiologicheskie trebovaniya po ustanovleniyu sanitarno-zashchitnoi zony proizvodstvennykh ob”ektov” ot 20.03 2015 g. № 237]. **2015.** (in Russ.) http://adilet.zan.kz/rus/docs/V1500011124#z86.
2. Conclusion of the state environmental expertise on the draft standards for the disposal of production and

consumption waste for the Pavlodar Aluminum Plant and the heat and power plant of the Joint-Stock Company “Aluminum of Kazakhstan” for 2018-2022 [Zaklyuchenie gosudarstvennoi ehkologicheskoi ehkspertizy na proekt normativov razmeshcheniya otkhodov proizvodstva i potrebleniya dlya Pavlodarskogo alyuminievogo zavoda i teploehlektrotsentrali Aktsionernogo obshchestva «Alyuminii KazakhstanA» na 2018-2022 gody]. **2018.** (in Russ.) tabigatpv.gov.kz/upload/fm/aprel.

3. Ilyin V.B. Heavy metals in the soil-plant system. [Il’in V.B. Tyazhelye metally sisteme pochva-rastenie]- Novosibirsk: Nauka. **1991**, 151. (in Russ.).
4. Environmental Code of the Republic of Kazakhstan. Code of the Republic of Kazakhstan No. 400-VI of January 2, 2021 CRK [Ehkologicheskii Kodeks Respubliki Kazakhstan. Kodeks Respubliki Kazakhstan ot 2 yanvarya 2021 goda № 400-VI ZRK]. **2021.** (in Russ) http://adilet.zan.kz/rus/docs/K2100000400.
5. GOST 17.4.3.01-83. Soil. General requirements for sampling. (in Russ.).
6. GOST 5180-84. Soils. Methods of laboratory determination of physical characteristics. (in Russ.).
7. GOST 17.4.4.02-84. Soils. Methods of selection and preparation of samples for chemical, biological and helminthological analysis. (in Russ.).
8. Mineev V.G. Practical work on agrochemistry. Publishing house of Moscow University: Moscow, Russia. **2001,** 689 p. (in Russ.).
9. Mohamad H.H. Fundamentals of Artificial Neural Networks. - Massachusetts: MIT Press. **1995**, 538. (in Eng.).
10. Yasnikov I.S., Nagornov Yu.S., Gorbachev I.V., Mikeev P.P., Sadovnikov P.S., Shubchinskaya N.Yu., Aminarov A.V. Scanning electron microscopy as a method for studying microscopic objects of electrolytic origin. Basic research. [Yasnikov I.S., Nagornov YU.S., Gorbachev I.V., Mikeev P.P., Sadovnikov P.S., Shubchinskaya N.YU., Aminarov A.V. Skaniruyushchaya ehlektronnaya mikroskopiya kak metod izucheniya mikroskopicheskikh ob”ektov ehlektroliticheskogo proiskhozhdeniya // Fundamental’nye issledovaniya]. **2013,** 1, 758-764. (in Russ.).
11. Usov B.A., Okolnikova G.E., Akimov S.Yu. Ecology and production of building materials. System technologies [Usov B.A., Okol’nikova G.EH., Akimov S.YU. Ehkologiya i proizvodstvo stroitel’nykh materialov // Sistemnye tekhnologii]. **2015**, 17, 84-105. (in Russ.).
12. Tleulessov A., Akramov M.B. Research of bauxite sludge of the Pavlodar aluminum plant as raw materials in the production of building materials. Materials of the MNPC Electric Power industry of Tajikistan: Current problems and ways to solve them. [Tleulessov A., Akramov M.B. Issledovanie boksitovogo shlama Pavlodarskogo alyuminievogo zavoda v kachestve syr’ya pri proizvodstve stroitel’nykh materialov. Materialy MNPK «Ehlektroehnergetika Tadzhikistana: Aktual’nye problemy i puti ikh resheniya], Dushanbe. **2019**, 232-236. (in Russ.).
13. Galushkin A.I. Application of neurocomputers in financial activity: [Galushkin A.I. Primenenie neirokomp’yuterov v finansovoi deyatel’nosti], [Electronic resource] Access mode: *http://www.hardline.ru/3/37/1484/.* **2020**. (in Russ.).
14. Haikin Simon. Neural networks. Full course. - M.: Publishing House Williams. **2006**, 1104. (in Russ.).
15. Parkhomenko S.S., Ledeneva T.M. Training of neural networks by the Levenberg-Marquardt method in conditions of a large amount of data. [Parkhomenko S.S., Ledeneva T.M. Obuchenie neironnykh setei metodom Levenberga-Markvardta v usloviyakh bol’shogo kolichestva dannykh] VSU Bulletin, Series: System Analysis and Information Technologies. **2014**, 2, 98-106. (in Russ.).

МАЗМҰНЫ-СОДЕРЖАНИЕ-CONTENTS

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайтах:

www:nauka-nanrk.kz

http://www.geolog-technical.kz/index.php/en/

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Редакторы: *М.С. Ахметова, А. Ботанқызы, Д.С. Аленов, Р.Ж. Мрзабаева*
Верстка на компьютере *Г.Д.Жадыранова*

Подписано в печать 15.08.2021.
Формат 60х881/8. Бумага офсетная. Печать – ризограф.
4,6 п.л. Тираж 300. Заказ 4.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19