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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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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.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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ENVIRONMENTAL IMPACT OF LEAD TOXICITY

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Abstract. We will talk in this article about the fact that due to anthropogenic activity, toxic metals and metalloids are constantly released into the environment, and therefore pose a threat to human, plant and animal health. This global threat is of concern to health organizations. This is because the bioaccumulation of these toxic pollutants above their limits has a detrimental effect on living systems. Lead toxicity should only be considered as an etiological factor in areas with high environmental risk factors, which include lead paints, lead batteries, homes near major roads/traffic areas, and exposure to pesticides. The toxicity of lead to the skeletal system has received a lot of attention in recent years, but little research has been done on the toxicity of lead to the skeleton in the early stages of zebra fish life. In the study of the circulation of lead in food, it was shown that the transfer of lead concentrated in the air to the biota can occur directly or indirectly through the soil; that is, plants take lead from the air and soil. Lead is characterized by a wide range of toxic effects caused by it on various representatives of the biota. The degree of toxicity of lead for microflora depends on the type of soil: on black soil, neutralization of toxicity occurs faster than on clay soil.

Keywords: Lead, water, chromium, cadmium, industry, man

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ҚОРҒАСЫН УЫТТЫЛЫҒЫНЫҢ ҚОРШАҒАН ОРТАҒА ӘСЕРІ

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Аннотация. Біз бұл мақалада антропогендік белсенділіктің арқасында улы металдар мен металлоидтар қоршаған ортаға үнемі шығарылып отырады, сондықтан адам, өсімдіктер мен жануарлардың денсаулығына қауіп төндіреді. Бұл жаһандық қауіп денсаулық сақтау ұйымдарын алаңдатып отыр. Себебі бұл улы ластаушы заттардың шектерінен жоғары биоаккумуляциясы тірі жүйелерге зиянды әсер етеді. Қорғасынның уыттылығы қоршаған ортаға қауіп төндіретін факторлары жоғары аудандарда ғана этиологиялық фактор ретінде қарастырылуы керек, оған қорғасынды бояулар, қорғасынды батареялар, негізгі жолдар/қозғалыс аймақтары маңындағы үй және пестицидтердің әсері жатады. Келесі зерттеу жұмысында қорғасынның әсері электронды қалдықтарды кәдеге жарату аймақтарында тұратын балаларда Pb синтезін электронды қалдықтарды кәдеге жаратуға қатысы жоқ аудандарда тұратындарға қарағанда көбірек тежейтінін көрсетеді. Электрондық қалдықтардан бөлінетін басқа токсиндер де Pb синтезінің тежелуіне ықпал етуі мүмкін және жергілікті балаларды анемияға әкелуі мүмкін делінеді. Қаңқа жүйесіне қорғасынның уыттылығы соңғы жылдары үлкен назар аударуда, бірақ зебра балықтарының өмірінің алғашқы кезеңдерінде қорғасынның қаңқаға уыттылығы туралы аз ғана зерттеулер жүргізілген. Азықтүлік құрамындағы қорғасынның айналымын зерттеу кезінде ауада шоғырланған қорғасынның биотаға ауысуы тікелей (жауын-шашынның әсерінен, өсімдіктердің антенналық бөліктері арқылы) немесе топырақ арқылы жанама жолмен жүруі мүмкін екендігі көрсетілді; яғни өсімдіктер ауадан және топырақтан қорғасын алады. Қорғасын биотаның әртүрлі өкілдеріне оның әсерінен болатын улы әсерлердің кең ауқымымен сипатталады. Микрофлора үшін қорғасынның уыттылық дәрежесі топырақтың түріне байланысты: қара топырақта уыттылықтың бейтараптануы сазды топыраққа қарағанда тезірек жүреді.

Түйін сөздер: Қорғасын, су, хром, кадмий, өнеркәсіп, адам

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ВОЗДЕЙСТВИЕ ТОКСИЧНОСТИ СВИНЦА НА ОКРУЖАЮЩУЮ СРЕДУ

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Аннотация. В статье рассматривается проблема антропогенной активности в результате которой токсичные металлы и металлоиды постоянно выбрасываются в окружающую среду и, представляют опасность для здоровья человека, растений и животных. Эта глобальная угроза беспокоит организации здравоохранения, так как биоаккумуляция токсичных загрязнителей выше пределов нормы оказывает вредное воздействие на все живые системы. Токсичность свинца следует рассматривать как этиологический фактор только в районах с высокими факторами риска для окружающей среды, включая свинцовые краски, свинцовые батареи, дома возле основных дорог/зон движения и воздействие пестицидов. В данной исследовательской работе показано, что воздействие свинца подавляет синтез Pb у детей, живущих в зонах утилизации электронных отходов, больше, чем у тех, кто живет в незагрязненных районах. Другие токсины, выделяемые электронными отходами, могут способствовать ингибированию синтеза Pb и, согласно исследованиям, вызывать анемию у детей. При изучении циркуляции свинца в пищевых продуктах было показано, что перенос свинца, сконцентрированного в воздухе, в биоту может происходить либо прямым либо косвенным путем, то есть из воздуха и почвы. Свинец характеризуется широким спектром токсических воздействий, которые он оказывает на различных представителей биоты. Степень токсичности свинца для микрофлоры зависит от типа почвы: в черноземе нейтрализация токсичности происходит быстрее, чем в глинистой почве.

Ключевые слова: свинец, вода, хром, кадмий, промышленность, человек

Introduction

The presence of lead, chromium and cadmium metals in drinking water poses a serious threat to the health of living beings around the world (Daribayev et al., 2023).

Pollution of fresh waters with heavy metals has become an acute problem in many countries, including Kazakhstan, and industrial progress is the main source of toxic heavy metals. As gut microbial communities play an important role in fish homeostasis, immune regulation, metabolism, and disease resistance, it is crucial to understand how

heavy metals affect the diversity of the fish gastrointestinal microbiome. Heavy metal pollution has a serious negative impact on the quality of the entire river ecosystem and poses a potential threat to human health. A comprehensive approach involving deterministic and probabilistic models (Monte Carlo simulation) with sensitivity analysis in the river ecosystem has been used to determine chronic daily heavy metal consumption (CDI) and associated health risks. The risk of carcinogenic and non-carcinogenic water and sediment was assessed using several methods of exposure. The results of the analysis showed that the structure of the heavy metal concentration in the sludge is slightly different and higher than in water. Lead (Pb) has been involved in many genotoxic, neuroepigenotoxic, and chromosomal toxic mechanisms and has interacted with different pathways of synaptic plasticity, which may be the basis for previous reports on the relationship between Pb and cognitive impairment. The use of leaded gasoline was discontinued in the United States from 1976 to 1996 and discontinued in the European Union by 2000, but there is growing concern that gasoline will remain an important source of influence in many countries, especially Africa and Asia (Richard L. Canfield et al., 2020).

In addition, domestic scientists have conducted research on the main factor that negatively affects the plant in Salt conditions. The results of a study on the effect of heavy metals on seedling elongation according to the results obtained on the effect of heavy metals on the synthesis of photosynthetic pigments during the cultivation of corn varieties showed that the effect of heavy metals on corn varieties significantly inhibited the processes of accumulation and growth of biomass, in particular, the growth of plant roots (Ivahnyuk et al., 2023). Heavy metals in water can be dangerous to public health. Their high concentration in drinking water can damage nerves, liver, bones, block functional groups of vital enzymes and are possible carcinogens for humans.

The mechanism of its action is due to the inhibition of the detoxification enzymes of xenobiotics, therefore, the influence of lead leads to biochemical shifts, in particular the activity of a number of mitochondrial or cytosolic enzymes. Increased lead content in the soil leads to a decrease in the number of the main representatives of the soil microbiocenosis. Some soil fungi that are resistant to the toxic effects of lead compounds are, on the contrary, more sensitive-actinomycetes and nitrogen-fixing bacteria, which can be used as bioindicators of the level of soil contamination with lead compounds.

Lead ingress into drinking water is caused by lead pipes or lead parts of the water pipe. The scattering radius around the metallurgical enterprise reaches 30-40 km, and within a radius of 1–2 km there is a zone of particularly severe landscape damage, where the damage reaches 10 and 100 times (Mineev V.G., 1990).

In the area of the lead smelter, its content in atmospheric air is 0.62–0.95 μg/m3, sometimes reaching 12 μg/m3. With exhaust gases, lead compounds (oxides, chlorides, fluorides, nitrates, sulfates, etc.) are released in the form of solid particles, about 20 % of which are located near the roadway. The lead level, which reduces the yield or height of the plant by 5–10 %, is considered toxic and amounts to 50 million for Clover. When the lead content in the soil of experimental sites is 500 and 2500 mg/kg, the yield of radishes is reduced from control to 50–23 %, onions to 74–23 %. The term

"heavy metal" mainly refers to a group of elements, including metals or metalloids, which are highly toxic to organisms due to their cumulative potential, since they are not broken down by organisms, so they accumulate in tissues and in the environment (Tiago Morales-Silva et al., 2023).

In most fish, the manifestation of intoxication is observed at a concentration of 0.1–0.4 mg/l. Over the years, the level of lead in the tissues of large sea fish and dolphins increases significantly, the accumulation of metal in the muscles is an indicator of the duration of pollution. A large number of waterfowl are poisoned by the use of lead and fish waste, and about 2 million ducks die each year in North America as a result of this. Therefore, lead is considered a practically hazardous substance for a number of water bodies and waterfowl.

Lead sulfate and lead (II) oxide are more toxic than other compounds, dogs and horses are most susceptible to lead poisoning and its compounds; cats and rabbits are moderately sensitive, guinea pigs are insensitive, sheep, goats, rats, mice, birds are the most resistant. According to literary data, a single intake of lead at a dose of 155-454 mg/kg is fatal, a single inhalation of a concentration of about 271–795 mg/m3 is fatal; 9.9–11.4 mg/m3 causes poisoning after 1–16 days and severe intoxication after 4–9 months; 0.7–1.7 mg/m3 leads to poisoning after a few weeks and months; 0.07–0.14 mg/m3 is described as a dangerous concentration, 0.011-–0.04 mg/m3 causes a functional shift in higher nervous activity after 6 months. With regular inhalation, symptoms of poisoning are observed after 6 months. The consequences of exposure to lead in childhood are serious and long-term (Alexa Eisenberg et al., 2020).

Relevance of research.

Excess lead in plants, associated with its high concentration in the soil, inhibits respiration and suppresses the process of photosynthesis, sometimes leading to an increase in the amount of cadmium and a decrease in the content of zinc, calcium, phosphorus, sulfur. As a result, the yield of plants decreases and the quality of the product deteriorates sharply. External signs of the negative impact of lead are the appearance of black and green leaves, twisting of old leaves, the appearance of thick leaves. The resistance of plants to excess lead is not the same: cereals are less hardy, legumes are more resistant. Therefore, signs of toxicity of various agricultural crops can be from 100 to 500 mg/kg with a different total amount of lead in the soil.

Together with copper and lead, zinc ranks first among the scattered elements in terms of the intensity of absorption by ocean biosomes. The accumulative indicator of atmospheric pollution of zinc can be mosses, the metal content in which is 0.860 mg/g near non-ferrous metallurgy enterprises.

In the norm, the content of zinc in atmospheric air is 0.05 mg/m3; in water – 1.0 mg/m3; in soil – 23.0 mg/kg. The content of zinc in the air in the area of the plant for processing non-ferrous metals within a radius of 300 m - 0.350 mg/m3; 500 m – 0.285 mg/m3; 1000m – 0.148 mg/m3; 2000m – 0.52 mg/m3; on average, 72 kg of zinc, 3 times more than lead and 12 times more than copper per 1 km2 of the Earth's surface are received annually by atmospheric precipitation. Lead is found mainly in zinc ores, but is also abundant in fossil fuels (Ilyas Ikramov et al., 2023).

Polluted wastewater is especially dangerous for the oceans. The maximum concentration of zinc, which reduces the efficiency of wastewater treatment by 5 %, is 5-10 mg/L.the total amount of zinc entering the environment is 314 thousand tons per year. The amount of dissolved zinc species in the World Ocean is 6850 million tons. is a ton. Zinc belongs to the most common toxic components of large-scale pollution of the World Ocean, which can currently be estimated in the surface layer of sea water (60–100 microns), where it reaches 1020 microns/l. For the oceans and inland seas, the upper limit of environmental tolerance is considered to be 50 mcg/L too at an average concentration of 20 mcg/L.

The main anthropogenic sources of primary entry of heavy metals into the environment are non-ferrous metallurgy enterprises. Soil contamination with this metal has led in some places to very high accumulations of up to 66,400 mg/kg in the upper soil layer. In garden soils, up to 250 mg/kg of zinc accumulates, and zinc in the upper layer of the soil is stored up to 8–13 %. The total number of microorganisms is significantly reduced: in a temperate climate, cereals decrease by 20–30 %, beets – by 35 %, peas – by 40 %, potatoes-by 47 %, and mushrooms become more resistant. Zinc levels, which reduce the yield and height of the plant by 5–10 %, are considered toxic and amount to 435–725 million for oats, 210–280 for Clover, and 240–275 for beets. As a method for determining the types of heavy metal pollution, it is most effective to use the frequency range corresponding to the phase peaks (Xuesong Xie et al., 2023).

Excess zinc in plants occurs in areas of industrial soil pollution, as well as with improper application of zinc-containing fertilizers. Many plant species have high resistance to its excess in the soil. However, if the content of this metal in the soil is very high, the most common sign of zinc toxicosis is observed in chlorosis of young leaves. If it enters plants excessively and antagonism with other elements occurs, the absorption of copper and iron decreases and symptoms of their insufficiency appear.

Excess zinc is an energy nucleotide in ATP. This is the main source of energy in a living cell. In all processes of the body, ATP is important in the metabolism of substances. ATP inhibits cell synthesis in 1929 as a result of research work by scientists from the Harvard School of Medicine (Carl Loman and Yellapragada Subbarao). In terms of the importance of such inhibition, zinc occupies the second place after copper. Heavy metals are mainly used in mining, smelting, agricultural activities, atmospheric precipitation, etc (Daribayev et al., 2023).

In animal and human bodies, zinc affects cell division and respiration, skeletal development, the formation of brain and behavioral reflexes, wound healing, reproductive function, immune response, and interacts with insulin. With a lack of the element, a number of skin diseases appear. For animals and humans, zinc is less toxic, since with excessive intake it does not accumulate, but is excreted. However, in the literature there is individual information about the toxic effect of this metal: in live animals, weight gain decreases, depression occurs in behavior, and miscarriage is possible. Zinc compounds are dangerous for all fish with a concentration of 15mg/L for 8 hours, severely damaging the fish's glands. The toxicity of zinc increases copper and nickel ions. Zinc chloride is 0.2 mg/l toxic to snails and crustaceans. oysters have the ability to accumulate zinc; feeding such oysters to rats will cause them to lose consciousness.

Research materials and methods.

Excessive intake of zinc into the body of animals is accompanied by a decrease in the amount of calcium not only in the blood, but also in the bones, and the absorption of phosphorus is also disrupted; as a result, osteoporosis develops. The toxicity of zinc depends on catalytic activity. Zinc can pose a mutagenic and oncogenic risk. The gonadotoxic effect of zinc is manifested by a decrease in sperm motility and their ability to penetrate the egg.

Cats that inhale zinc dust will experience swelling, bleeding in the lungs. Exposure to zinc sulfate aerosol (1.1 mg/m3 for 1 hour) irritates the upper respiratory tract in guinea pigs.

Prolonged administration of zinc and its compounds in various ways (from 1 to 5 months) in white mice, rats and rabbits caused the following types of toxic action:

- growth retardation;
- protein metabolism disorders;
- dystrophy of internal organs;
- violation of enzymatic activity, carbohydrate and Mineral Metabolism;
- gonadotoxic abnormalities;
- mutagenic and carcinogenic effects.

In low concentrations, zinc (Zn) is necessary for plants and animals, but it becomes toxic when it exceeds critical levels. Very high temperatures and heat waves in the area under study are due to secondary exposure (Vardui Margaryan et al., 2022).

Copper is one of the essential elements for living organisms, irreplaceable with other metals. In plants, it is actively involved in the processes of photosynthesis, respiration, nitrogen recovery and fixation. Copper is part of a number of enzymes, oxidases – cytochrome oxidase, ceruloplasmin, superoxidadismutase, urate oxidase, etc. and participates in biochemical processes as a component of enzymes that carry out the oxidation reaction of substrates with molecular oxygen (Dobrovolsky, 1983).

Copper has a higher phytotoxicity than zinc. It is especially pronounced on light soils. In terrestrial phytomassas and roots, there are signs of antagonism in the accumulation of copper and manganese and independence in the accumulation of copper and zinc.

Oxidative stress caused by copper and cadmium ions is characterized by increased lipid peroxidation and inhibition of oxidative enzyme activity in plant tissues, which indicates that the antioxidant system of plant body protection itself can be a sensitive object to the effects of heavy metals.

Near sources of industrial pollution, in some cases, soil contamination with copper up to 3500 mg/kg may be observed. Copper mining and smelting are accompanied by emissions during ores processing, the special composition of which affects the content of pollutants in the air (Ikramov et al., 2023).

Excess copper interferes with changes in the permeability of cell membranes, increased lipid oxidation, and electron transport in chloroplasts.

The presence of excess copper causes a lack of iron and manganese in plants.

The results of the experiments of the scientific research institute "study of the physiological foundations of the resistance of cereal plants to the effects of heavy metal

ions", according to which copper inhibits the growth and accumulation of biomass of terrestrial organs and especially the roots of the studied plants. With an increase in the amount of copper in the medium, its content in plant organs increases accordingly. Cadmium ions have a toxic effect on the growth and accumulation of biomass compared to the copper ions of the studied plants. Zinc and lead, common environmental pollutants, significantly inhibit seed germination, the growth and accumulation of biomass of individual organs of cereal grasses of the natural flora of the Republic, that is, inhibit the growth of terrestrial organisms and roots at high concentrations of heavy metals. Environmental pollution with heavy metals is becoming more and more a problem, and it is causing great concern around the world due to its negative consequences. These inorganic pollutants enter our waters, soils and atmosphere due to the rapidly growing agricultural and metallurgical industries, the misuse of waste, fertilizers and pesticides (Jessica Briffa et al., 2020).

Soil cover pollution of cadmium is considered one of the most dangerous environmental phenomena, since it accumulates excessively high in plants even with poor soil pollution. The highest concentration of cadmium in the upper soil layer is observed in mining areas up to 469 mg/kg, around zinc alloys they reach 1700 mg/kg. Every year, about 9,000 tons of cadmium enter the air, as a result of human activity, 7,700 tons are released into the air.

The toxicity of cadmium for plants is observed due to impaired enzyme activity, inhibition of photosynthesis, transpiration disorders, as well as inhibition of recovery from NO2 to no. In addition, in plant metabolism, it is an antagonist of a number of nutrients (Zn, Cu, Mn, Ni, Se, Ca, Mg, P). Due to the toxic effect of the metal, plants experience growth retardation, damage to the root system and leaf chlorosis. Cadmium easily penetrates plants from the soil and atmosphere, among phytotoxic and heavy metals, it ranks first in terms of its ability to accumulate in plants (Cd, Cu, Zn, Pb). Pollution of toxic metals is of concern to the world community due to their high toxicity, long-term resistance, non-biodegradable and bioaccumulation in the ecosystem (Moses Akintayo Aborisade et al., 2022).

Cadmium is easily collected by many organisms, especially bacteria and snails, where the level of bioconcentration reaches several thousand. It was found that aquatic organisms at the stage of embryonic development are most susceptible to the toxic effects of cadmium. Research in fish shows the teratogenic effect of cadmium compounds. Epidemiological data indicate a slow excretion of cadmium from the body (0.1 % per day). There are also reliable data on the carcinogenic hazard of cadmium. Today, it is estimated that the concentration of cadmium in the body in 5% of the population of the United States and Japan has already reached relatively high levels. According to the Austrian Institute of nutrition, cadmium is recognized as the most dangerous heavy metal.

Heavy metal compounds it is toxic due to their ability to bind tightly to proteins and disrupt the normal functioning of biocatalysts, enzymes and other biologically active protein substances. Heavy metals have a toxic effect in any state of aggregation and in any natural environment. Each metal is characterized by their accumulation in

certain organs. Cadmium ions enter the body and combine with carboxylic, amino and sulfhydryl (-soon, NH2, SH) groups of protein molecules. According to the sensitivity of animals and humans, heavy metals can be placed in the following rows: Hg, Cu, Zn, Ni, Pb, Cd, Cr, SN, Fe, Mn, Al. The place of accumulation of cadmium is the kidneys, liver, pancreas and thyroid gland. Acting on the skin, cadmium causes dermatitis and eczema. The accumulation of cadmium in various organs is accompanied by the formation of kidney stones. Its toxic effect is especially pronounced in the children's body – speech development is inhibited, mental development is observed. Cadmium reduces the activity of digestive enzymes, catalase activity of blood and tissues, affects carbohydrate metabolism, and has a pronounced effect on the developing fetus. Prolonged exposure to cadmium leads to kidney failure, protein formation in the urine, calcification, and pyelonephritis. In agriculture, the main sources of cadmium are the use of phosphorus fertilizers, compost and wastewater (Ikramov et al., 2023).

The balance of the atmosphere is ensured by the joint vital activity of plants and animals, each of which, during breathing, not only absorbs substances necessary for life in the air, but also releases elements that are vital for others. The growth and development of plants is impossible without the animal world, and the existence of the animal world is impossible without plants. Human life is impossible without either animals or plants, therefore, heavy metals and other toxicant substances migrate, accumulate and enter the human body through the trophic chains of the biological cycle. Environmental pollution with heavy metals is an environmental problem around the world that poses a threat to humans, animals and plants due to their non-decomposition (Yuquan Wei et al., 2019).

The US Environmental Protection Agency estimates that exposure to heavy metals and other toxic substances causes more than 2,700 types of cancer each year.

Biosubstrates (hair, blood, urine, saliva, teeth, nails) are usually examined to assess the dose of toxic substances that have entered the body. Changes in the microelement composition of hair and urine clearly characterize the degree of pollution of the atmosphere. So, in the hair of children living near the copper smelter, CU, as, Pb, Cd, near the battery plant – PB and Cd, etc.are collected. It has also been found that the accumulation of Pb and Cr in the hair of children living in areas of cities with high traffic, these elements are usually released into the air in significant amounts when burning leaded gasoline. When the lead in the hair is higher than 9 mcg/g, the development of diseases in the child's body is clearly reflected. A disease of the nervous system was detected when the lead concentration in the hair of children ranged from 14.2 to-24.0 mcg/g, and when it was higher than 30 mcg/g, changes were observed in the bones. Heavy metals found in agricultural land soils enter the human body through inhalation, ingestion and skin contact (Liping Li et al., 2019).

Conclusion

One of the most important results of the study revealed a significant increase in mortality rates from cancer among employees who had industrial contact with non-ferrous metal compounds compared to other residents of the city.

Harmful production factors affecting the state of health of those working in the production of processing non-ferrous metals are a complex in the form of an aerosol that

decomposes alloys and, to a lesser extent, metal oxides in the form of a condensation aerosol. Data from sanitary statistics show that at metallurgical enterprises there is an increase in occupational diseases due to prolonged exposure to dust, harmful gases, noise, vibration on the body. Deposits of exploited copper-zinc ores are gradually being depleted.

According to A.G. Dernova, as a result of pollution of the habitat in East Kazakhstan with heavy metals, primarily lead, zinc, cadmium and other substances contained in discharges into reservoirs with emissions of industrial enterprises into the atmosphere, it was established that the level of danger to public health in this region has reached.

According to E.N. Sraubaev, A.E. Shpakov, it was found that pollution of the atmospheric air of the city of Leninogorsk with heavy metals increases the incidence of the population by 40–60 %. It was found that an increase in dust in snow samples by 100 kg/km2 per day leads to an increase in the incidence of bronchial asthma by 11 and the incidence of acute bronchitis by 33 cases per 1000 population. Arsenic, cadmium, lead, and Mercury are among the known endocrine disorders that can affect fetal brain development, as well as infant growth.

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