17th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE SGEM 2017

CONFERENCE PROCEEDINGS
VOLUME 17

Ecology, Economics, Education and Legislation

Issue 52

ECOLOGY AND ENVIRONMENTAL PROTECTION

17th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE S G E M 2 0 1 7

CONFERENCE PROCEEDINGS
VOLUME 17

ECOLOGY, ECONOMICS, EDUCATION AND LEGISLATION
ISSUE 52

- - - - - - - - - - - - - - - - - - -

ECOLOGY AND ENVIRONMENTAL PROTECTION

- - - - - - - - - - - - - - - - - - -

29 June - 5 July, 2017
Albena, Bulgaria

DISCLAIMER

This book contains abstracts and complete papers approved by the Conference Review Committee. Authors are responsible for the content and accuracy.

Opinions expressed may not necessarily reflect the position of the International Scientific Council of SGEM.

Published by STEF92 Technology Ltd., 51 "Alexander Malinov" Blvd., 1712 Sofia, Bulgaria
Total print: 5000

ISBN 978-619-7408-09-6
ISSN 1314-2704
DOI: 10.5593/sgem2017/52

INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE SGEM
Secretariat Bureau

E-mail: **sgem@sgem.org** | URL: **www.sgem.org**

ORGANIZERS AND SCIENTIFIC PAR

- THE CZECH ACADEMY OF SCIE
- LATVIAN ACADEMY OF SCIEN
- POLISH ACADEMY OF SCIENCE
- RUSSIAN ACADEMY OF SCIEN
- SERBIAN ACADEMY OF SCIEN
- SLOVAK ACADEMY OF SCIENC
- NATIONAL ACADEMY OF SCIE
- INSTITUTE OF WATER PROBLE
- NATIONAL ACADEMY OF SCIE
- SCIENCE COUNCIL OF JAPAN
- THE WORLD ACADEMY OF SCI
- EUROPEAN ACADEMY OF SCIE
- ACADEMY OF SCIENCES OF M
- MONTENEGRIN ACADEMY OF
- CROATIAN ACADEMY OF SCIE
- GEORGIAN NATIONAL ACADE
- ACADEMY OF FINE ARTS AND
- TURKISH ACADEMY OF SCIEN
- NIZHNY NOVGOROD STATE UN CIVIL ENGINEERING, RUSSIAN
- BULGARIAN ACADEMY OF SCI
- BULGARIAN INDUSTRIAL ASS
- BULGARIAN MINISTRY OF ENV

INTERNATIONAL SCIENTIFIC COM

Ecology, Economics, Education and Legi

- PROF. DR. L. LAVRYSEN, BELG
- PROF. DR. JÜRGEN H. BREUSTE
- PROF. TIEN-HUI CHIANG, TAIW
- DR. KRASSI RUMCHEV, AUSTR

THE DEGREE OF BORON CONTAMINATION OF THE UNDERGROUND AND SURFACE WATER OF THE ILEK RIVER VALLEY

Prof. Dr. Lyudmila Pavlichenko[1]

PhD Student Aina Rysmagambetova

Assoc. Prof. Ainur Tanybayeva

Assoc. Prof. Guldana Minzhanova

[1] Al-Farabi Kazakh National University, Almaty, **the Republic of Kazakhstan**

ABSTRACT

The article is a review of numerous studies devoted to the problem of identifying the main sources of pollution of the Ilek River and the underground water of its valley. The main sources of pollution are: the old sludge collector; new sludge collector; industrial site, soils polluted by the Alga Chemical Factory and dust from the dried surface of the sludge accumulators and the slag pipelines emergency leakage. It is established that in the sludge accumulators area the river drains heavily underground water contaminated with boron. A consequence of this is the pollution of the river and the Aktobe reservoir. The main ways of entering boron into groundwater are filtration through the bottom of the old sludge accumulator, infiltration into the aquifer of contaminants washed off by snowmelt waters and storm runoff from the side of the listed sources. The analysis of these sources allowed forming ideas about the nature of the distribution of contaminated groundwater, the dynamics of pollution levels of groundwater and surface water, and environmental risks for the population of the region. Pollution of underground and surface waters by boron of the valley of the river Ilek – sources of water supply in the Aktobe region - influences the social and economic development of the region and the formation of an ecological situation in the territory of the Russian Federation. The river Ilek is transboundary, it flows into the Ural River and eventually the polluted waters enter the Caspian Sea, to the spawning grounds of sturgeon.

Keywords: ecology, underground water, surface water, boron pollution, sludge collector

INTRODUCTION

The Ilek River flows from the south to the north through the entire Alga district of the Aktobe region, has a constant surface runoff and numerous old people. Geochemical features of landscapes of the study area are mainly caused by oxidizing, alkaline and neutral media in soils and waters, reducing media are limited by local distribution.

Since 1937, the Alga Chemical Factory named after S.M. Kirov, which located in the valley of the Ilek River in the Alga town, dumped all the effluents of the enterprise into the floodplain of the river without cleaning. In 1956, 200-400 m from the river, the first storage pond was built without an anti-filtration screen, which caused pollution of the underground and later surface waters of the Ilek River basin by boron. This accumulator has been preserved since 1963, by this time about 20 thousand tons of

https://doi.org/10.5593/sgem2017/52

boron accumulated in it. However, this first reservoir has never been the subject of environmental studies, in the 2005 year hydro-geological map with a source of groundwater contamination by boron it is fixed by a contour with a range of boron concentrations of 50-100 mg/dm^3 against a background of concentrations of 10-50 mg/dm^3.

From 1963 to 1980 years, a sludge tank without an anti-filtration screen, now called «old», was built to take effluent from boric acid production in the floodplain of the river on alluvial quaternary sandy-gravel sediments with high permeability. This accumulator became the subject of ecological studies, since in 1972 year the fact of groundwater contamination with boron was discovered, and in 1975 year an experimental production ground for studying groundwater contamination with boron-containing industrial wastes was organized. Long-term observations have shown that the change in the natural regime of groundwater is due to the filtration of industrial effluents discharged into the pond. In 1980 year, a «new» sludge accumulator was constructed, which was built in accordance with environmental requirements.

However, sludge accumulators are not the only cause of pollution of the underground and surface waters of the Ilek valley. The Industrial State Association «ZapKazGelogiya» researched very high concentrations of a number of chemical elements, many of which are toxicants, were noted in soil and soil samples at the industrial site of the Alga Chemical Factory and the territory of the Alga town in 1989-1990 years. Exposure to the factory's emissions caused the presence of copper, lead, zinc, molybdenum, silver, arsenic, mercury throughout the town. Boron, phosphorus, strontium, yttrium, lanthanum, cerium in elevated contents was noted within the territory of the factory.

In industrial wastes, in alluvial waters and in the river, the industrial state association «ZapKazGeologiya» 1989-1990 years and other organizations discovered boron. Its solutions at smaller and larger maximum permissible concentrations (MPC = 0.5 mg/dm^3) are encountered in surface and groundwater all over the valley from the Alga town to the borders of the Orenburg region, that is, over 100 km.

In 1993, when drilling holes from the surface of ice on the reservoir, information was received on the pollution of the Aktobe reservoir with boron and fluorine, which threatens the water supply in the Aktobe city: with admissions turbulent mixing with sludge occurs and the transfer of boron to surface water with subsequent entry into water intake holes [1-2].

In 1994, a «wall in the ground» was built along the northeastern side of the «old» sludge collector to protect underground and surface water. However, the environmental effect of this «wall» was inadequate and short-lived, as in some areas the integrity of the «wall» is broken, and in addition, it flows over the groundwater. The urgency of the situation led to the inclusion of the problem of pollution of underground and surface waters by boron in the list of priority environmental problems in the Aktobe region and the development of a feasibility study of its solution. In this feasibility study, as a basis for the development of technical solutions, a hydro-geological map with a contour of pollution, identified by monitoring the pollution of groundwater by boron, conducted by LLP «Akpan», but the issue of boron entering the right coast of the river remained without solution.

Due to the termination of the monitoring program funding in 2005, LLP «The Centre for Health Protection and Eco-Projecting», which developed the feasibility study, conducted a random sampling of surface and groundwater, soil, mud, vegetation,

captured fish, livestock meat in the areas of the Ilek river boron pollution. In addition, for the first time in the history of the pollution problem study, holes were drilled in the sludge accumulators. Determination of boron content in aqueous extracts from samples of sludge taken from different depths of old and new sludge accumulators showed high boron content in slurry samples, starting from a depth of 1 meter. The maximum boron concentration in the old sludge collector was 1800 mg/dm^3. Holes also demonstrated intense infiltration through the bottom of the sludge collector - in the aqueous extract from a depth of 23 m the concentration of boron was recorded at 840 mg/dm^3. Thus, «old» sludge ponds remain a powerful and sustainable supplier of boron to the environment.

Based on research in 2008, held LLP «The Centre for Health Protection and Eco-Projecting» boron concentration of the alignment in the area of influence of the old sludge tank there have been significant changes in the content of boron in groundwater. The data is displayed in Figure 1.

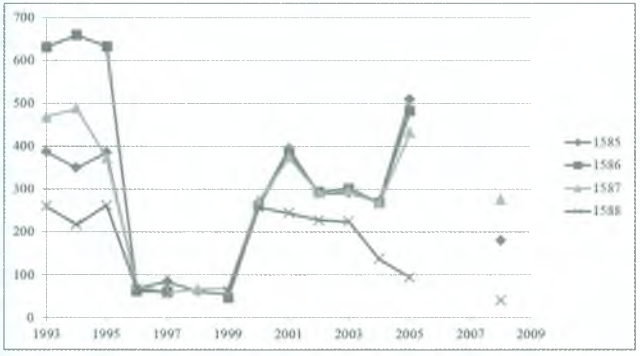

Figure 1 - Dynamics of changes in boron concentrations along the IV-IV section (1585, 1586, 1587, 1588 waters holes)

Waters holes 1585, 1586 and 1587 are closest to the map of the old sludge collector with borate sludge, which is reflected in the concentrations of boron in them. Until 1995 year, the influence of the «wall in the ground» has so far had a weak effect - the watertight wall that blocked the ground flow cut off the flow from the sludge collector. A sharp decrease in boron content in 1996 year simultaneously in all holes of the alignment indicates that in addition to increased water availability this year there was an additional reason for improving the quality of groundwater in the forest. This can be caused by a rise in the groundwater level near the «wall» as a result of overlapping of their flow in the northern and eastern part of the sludge collector. By 1996, this rise was sufficient to reduce the gradient of the eastern groundwater flow several times (from the old sludge collector to the Ilek River) and to almost completely stop the flow of infiltration waters with a high concentration of boron from the sludge accumulator [3].

The zone of influence of backwater by 1996 spread to the hole 1585, where the «wall» is absent. The termination of the flow from the sludge collector caused a sharp decrease in boron concentrations in this hole. On the other hand, the east flow gap caused a decrease in the gradient in the tail remaining from the stream (1586 and 1587

https://doi.org/10.5593/sgem2017/52

boreholes are located here), where a significant decrease in the filtration rate formed ideal conditions for the flushing regime in the year of increased water content.

The rise in groundwater near the «wall»increased until 1999 year to its maximum value, before the release of groundwater to the surface in local relief depressions, which manifested it as swamping in the zone between the «wall» and the sludge accumulator. At this point, the level of water backed by the «wall» equalled their level in the sludge accumulator, and further containment of filtration from the sludge accumulator became impossible.

Thus, already in 1999, the ecological capacity of soil in the zone between the «wall» and the sludge accumulator was finally exhausted. In fact, this zone turned into an additional capacity of the sludge accumulator, but without the effect of dusting. The maximum backlog level was sufficient to form in the eastern part of the «transverse» flow bypassing the «wall» and renewing the filtration from the sludge accumulator, which is recorded in the Figure 1 in a jump in boron concentration in 2001. Under the influence of the impenetrable «wall» of new hydrodynamic conditions below the old sludge accumulator, the concentration of boron in groundwater again began to experience the prevailing influence of filtration from it, which either is smoothed out in the high water year or is exacerbated in the shallow water.

The time dynamics of boron concentration in the holes of the IV-IV closest to the sludge accumulator clearly fixes the influence of the wall construction on the wave of a significant decrease in boron concentrations before the ecological capacity of the zone between the «wall» and the sludge accumulator is depleted. The positive influence of the «wall» affects for 4-5 years, when the concentration of boron decreased 12-15 times. After that, the concentration was determined by the flow of the configuration changed near the sludge accumulator bypassing the «wall» or through ruptures in it, washing soil, often contaminated by the Alga Chemical Factory and dust from the surface of the sludge accumulator.

The same direction of boron concentration changes in the holes on the left and right coast is observed only until the end of 2000 year, and then the boron concentrations in the right-coast holes begin to decrease continuously, indicating the interruption of hydraulic communication with groundwater on the left coast. Since 2001, the effect of the subterranean «punching» of groundwater disappears.

This is quite understandable from the point of view of the velocity of the front of the wave of concentrations. The analysis of the dynamics of boron concentrations in groundwater carried out in a feasibility study for separate sections gave an approximate estimate of the rate of propagation of a wave of concentration changes in the range 200-300 m/year. Since the distance to the Ilek River is about 400-500 m in the area of the range IV-IV, the hydraulic communication becomes understandable after the beginning of the filtration of the wall supported by the wall, bypassing the wall and reducing the amount of backwater.

In left-coast holes, where the water content of the year affects the amount of boron infiltrated with atmospheric precipitation and snowmelt waters from the territory of the plant, sludge accumulator and surrounding areas, concentration jumps are observed. On the right coast, the role of atmospheric precipitation of boron is much less than on the left, so fresh sediments do not work to infiltrate the boron, but to wash the soil, constantly reducing its concentrations to background concentrations typical of the underground waters of the borough province.

Selective sampling of monitoring holes showed that the main reason for the appearance of boron on the right coast is the «punching» of a boron-contaminated groundwater stream from the old sludge accumulator to the east in 2008 year. Since after the breakthrough of the wall supported in the northern and north-eastern parts of the wall in the ground of the groundwater flow, the pressure decreased, the drainage role of the Ilek River was restored and normal filtration from the right coast was restored.

According to the description of the observation network in the Information Bulletins on the state of the environment in the Republic of Kazakhstan, the Centre for Environmental Monitoring of the Environment of the Republic of Kazakhstan RSE "KazGidroMet" on the site of the Alga-Aktobe reservoir three posts fall.

According to the information bulletins [4], on the basis of the average cases of high pollution averaged over the year, Table 2 was compiled. It should be noted that for the year 2017 the data for the first quarter

Table 2 - Results of observations of surface water pollution by boron at the site of the town of Alga-Aktobe, in mg/dm^3 for the period 1997-2017.

№	Years	Hydro Posts		
		Alga 1	Alga 2	Aktobe 1
1	1997	0,47	1,13	0,47
2	1998	0,34	1,02	0,43
3	2000	0,21	0,73	0,39
4	2001	0,2	0,49	0,34
5	2002	0,42	1,09	0,49
6	2003	0,23	0,96	0,81
7	2004	0,2	0,73	0,33
8	2005	0,2	0,64	0,3
9	2006	0,36	1,04	0,4
10	2007	0,35	0,72	0,37
11	2008	0,36	0,63	0,35
12	2009	0,37	0,64	0,46
13	2010	0,356	0,703	0,356
14	2011	0,214	0,526	0,365
15	2012	0,285	0,640	0,372
16	2013	0,262	0,477	0,280
17	2014	0,270	0,413	0,258
18	2015	0,251	0,371	0,234
19	2016	0,211	0,483	0,265
20	2017		0,432	

The large amplitudes of fluctuations in boron content in surface waters at the Alga 2 and Aktobe 1 posts are evidence that groundwater drained by the surface runoff of the Ilek River flows into the Aktobe reservoir, wedged out in different parts of the river. Since the eastern flow of groundwater from the old sludge accumulator (the first section of the wedge) passes the shortest path to the river (about 400 m), its influence at a groundwater velocity of 300 m/year affects the boron concentrations in the river (Alga 1 post) already in 2002 Year, and the peak of the 2006 concentrations is formed under the influence of wedging in section 2, where the wave from the formed groundwater flow bypassed the «wall».

From the other zones of wedging, the impact of the breakthrough of groundwater backed by a «wall» affects a few years later, depending on the distance of this zone from the old sludge collector. The breakthrough wave arrives at these zones of decay

with much smaller amplitude as a result of the imposition of the influence of groundwater discharge from other sources (a new sludge accumulator, traces of breakthroughs in the slurry pipelines, soil contaminated with emissions from the Alga Chemical Factory).

Mismatches in time of the Aktobe 1 and Alga 2 peaks are a consequence of the influence of sorption of boron by the silt of the Aktobe reservoir and the partial return of boron during admissions due to turbulent mixing. The small peaks of the background alignment are explained first by the influence of the backwater (prior to the breakthrough, its influence extended to post 1).

The boron element belongs to the class of biologically active substances. Boron is an essential for plants and toxic to humans. The excessive intake of boron into the body, according to the literature, leads to the development of a number of pathological conditions, in particular, diseases of the gastrointestinal tract - boron enteritis. Boron compounds have recently been recommended as a means of weight loss, but due to harmful effects on the body, their use was prohibited. Absorption of boron compounds occurs rapidly, but their release proceeds slowly, to wit there is a cumulating. Manifestations of cumulative-chronic boron intoxication - watery stools, vomiting, loss of appetite, skin rash with persistent peeling – «boron psoriasis», a state of mental confusion, anemia, cachexia. Acute poisoning with boric acid is accompanied by convulsions, meningism, and later collapse, followed by death. Frequent symptoms of poisoning are gastrointestinal disturbances. The toxic effect of borax is similar to that of acid. It is also known that boron acts depressingly on reproductive functions and causes infertility [5-6].

Compilation of statistical reporting data for the period 1996-2006, conducted by LLP «The Centre for Health Protection and Eco-Projecting», showed that throughout the period under review, the overall mortality rate in the town of Aktobe exceeded the average national rate. In the Alga region, there were small fluctuations in the mortality rate, which before 2002 exceeded the republican level. After 2002, there has been a trend of its constant decline, and as a result after 2004 this indicator has become below the average republican level.

Despite the fact that a whole range of factors influence the formation of the incidence rate, including the availability of medical care and the need of the population for getting sick lists, the development of a network of private medical centres, the incidence of morbidity by treatment remains the most important characteristic of the health of the population.

Comparison of primary morbidity rates by the appeal of the adult population of the Aktobe city, the Alga town, and the Alga district and the Republic of Kazakhstan as a whole showed that in 2001 the primary morbidity of the adult population of the Aktobe city was consistently higher than that in other considered territories.

Particular attention should be paid to the classes of diseases, according to which a reliable tendency to growth is revealed in all age groups, which indicates the stability of the process, as well as the long-term presence of a complex of factors provoking the onset of these diseases. To such classes of diseases in Aktobe city researches of LLP «The Centre for Health Protection and Eco-Projection» endow the diseases of the endocrine system, disruption of nutrition and metabolism, diseases of the blood and blood-forming organs, diseases of the circulatory system. In addition to the above classes of diseases, diseases of the genitourinary system, congenital anomalies and malformations, diseases of the eye and its appendages were noted on the territory of the

Aktobe region. These classes of diseases are proposed to be recognized as regionally specific.

To check the role of contamination of the components of the natural environment with boron in the morbidity of the population of the Alga district, a primary risk assessment of the incidence of contaminated meat and fish products (table 3) and boron content in the groundwater of individual wells of farms was carried out. The calculations were based on the results of field research conducted by LLP «The Centre for Health Protection and Eco-Projection» regarding boron concentrations in selected samples of animals, fish and water from individual wells, as well as from literature sources on the basis of safe reference doses [7].

Table 3 - Results of determination of boron content in products and calculations of its intake into the organisms

Type of sample	Place of sampling	Content, mg/kg	Average daily intake for adults, mg/day
Beef	Alga	4,638	1,168776
Mutton	Village of Kugailly	4,389	1,106028
Yaz ordinary	The Ilek River (Alga town)	4,457	0,463528
Carp, silver	The Ilek River (Bestamak settlement)	1,991	0,207064
Perch River	The Ilek River (Bestamak settlement)	2,489	0,258856
Perch River	The Ilek River (Alga town)	2,67	0,27768

The daily intake of boron in the body with drinking water in the presence of a drinking water supply is taken equal to 1 mg / dm3, the amount of water consumed is 2 dm^3, the background concentration of groundwater in individual wells is 25 mg/dm^3, the quantity of consumed meat and fish products in accordance with local customs double in comparison with the recommendations of the World Health Protection. Admissible daily dose of boron is taken equal to 6.16 mg/day.

Then for stays all year round in a centralized water supply and the use of meat and fish a risk factor for adult will be 0.883 – low risk, if staying warm season in the country, and in the cold - in the risk ratio will be set to 4.668 – average risk, and if living on a farm alone the risk ratio will be equal to 8.351 – high risk.

Since the main part of the total risk factor is the risk of drinking water, the problem of boron contamination will have a long-term impact on the quality of life of the population of the Aktobe region.

CONCLUSION

The problem of boron contamination of the Ilek River is very acute, as the boron is transported along the Ilek River and is stored in the mud of the Aktobe reservoir, which is a recreational resource and a source of water supply for the Aktobe city. The greater dynamism of boron leads to the fact that when the water is stirred up during the releases from the reservoir, the boron enters the lower reaches of the Ilek River, causing damage to the river organisms (the teratogenic effect) and the population, adversely affecting

heredity. The assessment of the ecological situation in the area of the object under research is indicative of the degree of pollution to which alluvial groundwater are subject to long-term wastewater filtration. The results of research have shown the most likely cause of high concentrations of boron in groundwater on the right coast of the Ilek River is the change in hydrodynamic conditions caused by the construction of a «wall in the ground» near the northern and part of the eastern sides of the sludge accumulator. In the flat part of the Ilek River valley with small gradients of groundwater, the formation of a backwater during the construction of the «wall» ensured the «squeezing» of the polluted left-coast flow towards the right coast. As a result, a steady aureole of boron contamination was formed. One of the environmentally hazardous properties of boron and its compounds is its high solubility and active ability to migrate in the aquatic environment. Toxic boron compounds have a negative effect on flora and fauna, as well as on human health. In this regard, it is necessary to investigate and justify new ways of cleaning the boron-contaminated underground and surface water.

REFERENCES

[1] Zeiberlich N.E., Vlasko G.N. On the contamination by boron of underground water of the Ilek valley in the Aktobe/ Bulletin Moscow, the testers of nature. Geology chapter, Vol. 66., 1991, pp 96-102;

[2] Burakov M.M., Pavlichenko L.M. Scope of the project on the purification of groundwater in the valley of the Ilek River from the forest /All-Russian scientific conference dedicated to the 80th anniversary of the Department of the National Institute for the Study of Tomsk Polytechnic University «Problems of Hydrogeology, Engineering Geology and Hydro ecology», Tomsk, Russia, 2011, pp 614-622;

[3] Pavlichenko L.M., Sklyarova G.L., Aktymbayeva A.S. Assessment of the role of the main sources of boron contamination of groundwater and surface water in the valley of the Ilek River/The Bulletin of KazNU, geography series, №1 (34), 2012, pp 96-104;

[4] Information bulletin on the state of the environment of the Republic of Kazakhstan, №1 (65), 2017, pp 87-92;

[5] WHO (World Health Organization) Guidelines for Drinking-water Quality. World Health Organization Library Cataloguing-in-Publication Data, NLM classification: WA675, 2011, p.17;

[6] Malakootian M., Hasibi A., Zeinadini A. The Evaluation of Underground Water Recourses' Boron Concentration and Variation Pattern Iranian J Publ Health, Vol. 36, №4, 2007, pp 74-80;

[7] Nemenko B.A., Arynova G.A., Ospanova G.K., Elgondina G.B., Dosmukhametov A.T., Sharbakov A.Zh. Methodological guidelines for assessing the health risks of the population of environmental chemical factors, Almaty, 2004, p.42.

THE DEGREE OF POLLUTION WITH HEAVY METALS OF FALLOW SOILS IN RURAL ADMINISTRATIVE UNITS OF PSARY AND PŁOKI IN POLAND

Volodymyr Pohrebennyk[1], Prof, PhD

Agnieszka Petryk[2], PhD, Eng

[1] Lviv Polytechnic National University, **Ukraine**
[2]University of Economics in Cracow, **Poland**

ABSTRACT

The article aims at analysing the content of heavy metals in the soils of two rural administrative units of the municipality of Trzebinia namely Psary and Płoki which are located in the Silesian-Kraków Upland, in the western part of the Malopolska province, in Poland. The analysis of soil material was based on the determination of granulometric composition of the soil with the use of the Casagrande method modified by Prószyński (according to the industry standard BN-78/9180-11)[1], soil reaction in 1M KCl and in water with the use of potentiometric method, electrolytic conductivity of the soil with the use of conductometric method, content of organic matter in soil by its annealing using the modified Tiurin method, the total heavy metals content in the soil using FAA method.These areas have been heavily transformed by the mining and processing industries. It was found that the mean content of lead, cadmium and zinc in the soils of Psary and Płoki exceeded the permissible concentrations of these elements according to the regulations adopted by the Polish legislator [2] for agricultural land. The mean copper content in the soils of the aforementioned rural administrative units did not exceed the concentration of the element stated in the ministerial standards. The research conducted on fallows of the rural administrative units showed the positive direction of the relationship between the content of heavy metals and organic matter content as well as pH value in the soil layer of 0-20cm.

Keywords: heavy metals, zinc, soil, plant, fallow land, pollution

INTRODUCTION

In Poland, up to 3% of arable land is contaminated with heavy metals. The toxic presence of heavy metal ions in the soil solution considerably reduces the activity of soil enzymes such as dehydrogenase, alkaline phosphatase, acid phosphatase and urease. In this regard lead is the most harmful element whereas zinc and copper are the least toxic ones. Solubility, transport and bioavailability of heavy metals in the soil are determined by chemical, biological and geochemical processes. Heavy metals occur in soils in active, exchangeable, specifically absorbed, chemically absorbed, related to the organic matter and residual forms. These forms are dependent on the type of metal, its original form and chemical properties, granulometric composition and oxidation-reduction potential of soil as well as the content of organic matter in soil [3]. Heavy metals undergo various transformations in soil. Trace elements, in certain amount, can be accumulated in soil environment and by mineralization can and become their new source [4]. Soils characterised by a high content of clay and organic matter can accumulate substantial amounts of heavy metals, storing them in the surface layers. For that reason they are considered to be resistant to chemical contamination. Soil reaction

https://doi.org/10.5593/sgem2017/52