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ASSESSMENT OF SOIL POLLUTION WITH WASTE IN CHISINAU URBAN ECOSYSTEM

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ABSTRACT. The degree of land pollution within Chisinau Urban Ecosystem refers to the second level, and namely low polluted. One of the most polluted areas in the Chisinau urban ecosystem (CUE) is the Biological Wastewater Treatment Plant (BTP) and the adjacent lands: the village Bic and the agricultural land in the vicinity of BTP. The high content of heavy metals (HM) in the soil of BTP territory and the adjacent sectors is explained by the accumulation of large amounts of mud at the BTP, containing essential quantities of HM and the utilization of this mud as fertilizer for growing crops. Assessment of BTP sector pollution demonstrated that the summary index of pollution (Zc) is of 27.43, which confirms that the land is moderately polluted. The value of this index characterizes the sector as one with a high level of population morbidity.

Key words: *mud, level of pollution, industrial sites, summary index of pollution, urbus soil.*

INTRODUCTION

Soil is a specific natural body formed on the surface of the Earth's crust as a result of long interaction of pedogenetic factors and of the influence of living organisms and organic wastes on parental rocks in certain climacteric conditions and on various relief types (Ursu, 2011). Soil is a biotic and abiotic ecosystem. The soil ecosystem function is to transform the organic matter and its mineralization into nutrition for plants; to create and maintain a good soil structure; to purify the ground waters. The soil is characterized by a wide, and usually slow, local variation, fluctuation of abiotic conditions. These conditions promote and develop various creatures in the soil. The local population of the soil is also of a wide local variety (Eijsaccers, 1983).

The fundamental feature of the soil is to serve as living environment for plants so as to obtain crop yields (Chiriţă et al., 1974). But, the provision of this superior soil function is determined by several factors of soil degradation: degradation under the action of natural (the process of erosion, landslides) and human factors (natural structure destruction, compaction, reduction of humus reserves, pollution with various substances, especially with wastes) (Ursu, 2011).

Earlier research was conducted on the impact of waste on the air (Bulimaga et al., 2011), on surface water (Bulimaga, 2010) and biocenosis (Bulimaga, 2009). The study of the impact of waste on ecosystems showed a significant reduction of

plant diversity within the Chisinau Urban Ecosystem (CUE). Waste pollution causes modification of ontogenetic character of these species: some of them vegetate almost all the year round, reproduce intensively by the vegetative way, and as consequence the number of plants reproduced from seeds is being reduced. Finally, genetic degradation of populations occurs (Bulimaga, 2009). The impact of wastes on CUE soil has not been evaluated so far. It should be noted that unlike on other environmental components (air, water and biocenosis) the economic activities (building blocks, industrial enterprises, highways, aqueducts and other infrastructure engineering) that occur in urban ecosystems cause not only soil pollution but also complete transformation of natural soil into the so-called **urbus soils** (Cristea and Baciu, 2003). As a result of scaling, compaction and mixing natural soil with various construction materials, gravel and wastes, the loss of structure, of the properties and of the natural functions of soil occurs. The present paper studies the impact of wastes and economic activities which cause soil pollution with various heavy metals.

The purpose of this paper is to evaluate the degree of land pollution of Chisinau urban ecosystem (CUE) with heavy metals caused by waste, human activities and to establish the summary pollution index (Zc) of the most polluted sector of the city.

MATERIALS AND METHODS

Research on the impact of wastes on soil and its pollution with heavy metals was virtually conducted on the entire CUE territory: on industrial sites, residential sectors and adjacent agricultural lands. In order to establish the dynamics of soil pollution with heavy metals from wastes, the investigations were carried out both at the BTP and on its adjacent territories. The studies were carried out based on representative soil samples collected from each sampling point using the methods recommended for urban ecosystems in the shape of envelope (Методические.., 1988). The analysis of soil samples for heavy metals content was conducted in the accredited laboratory of the Hydro-Meteorological State Service.

RESULTS AND DISCUSSIONS

The impact of wastes (result of human activities) is reflected on all environmental components. But the biggest impact is on the soil, which serves as an accumulator of pollutants from the atmosphere, atmospheric precipitations, wastewater discharges and waste generation.

In order to determine the degree of soil pollution with heavy metals (HM) in CUE, soil samples were collected from 0-20 cm layer across the city. The data from Table 1 demonstrate that the concentration of heavy metals in the surface soil layer varies from one profile to another. Thus, on profile I (Buiucani and Ciocana sectors), MAC exceedings were not detected for any of the analyzed metal. On the segment of Profile II (Valea Morilor lake, Industriala street), MAC exceedings were observed just in Mateevici Street for Pb by 1.47 times, the concentrations of Cu, Zn, Cr being within the MAC limits.

Table 1. *Overall content of heavy metals in soil samples mg / kg (samples were collected 0-20cm)*

Samp. Nr.	Sam-pling point	Location	Cu	Zn	Pb	Cr
1	**2**	**3**	**4**	**5**	**6**	**7**
Profile I						
5	3	Buiucani resid. sector, Balcani str, watershed	29.3	41.9	15.6	32.1
7	4	Buiucani resid. sector, str. N. Costin, slope	13.4	22.5	10.8	24.8
11	7	Recreational area Sculeni, Meadow river Bâc	**35.3**	28.4	12.7	26.5
27	15	Calea Orheiului str., Chişinău mine	**37.0**	51.1	18.4	29.6
31	17	M. Costin Str., watershed	18.2	43.5	14.4	28.0
35	19	forest Rascani, valley floor	11.9	37.1	12.1	17.5
39	21	Str., M. Sadoveanu, watershed	23.3	57.0	16.1	31.3
43	23	Ciocana resid. sector, Milescu-Spătaru str., valley	**38.5**	42.4	13.2	31.5
Profile II						
15	8	Valea Morilor	28.8	**70.7**	23.9	22.3
19	10	Str.. Matievici. slope	19.0	**86.0**	**47.3**	17.7
23	12	Str., Varniţa, below the bridge Izmail	26.7	**77.5**	**34.7**	26.3
27	14	19,Otovasca Str., slope	19.6	54.4	15.3	26.8
31	16	Industrială Str., valley	11.7	27.7	7.3	16.1
Profile III						
1	I	Hânceşti str., watershed	**73.1**	**133.0**	18.8	39.8
17	9	Valea Trandafirilor	15.0	53.5	13.1	22.7
25	13	Varniţa Str., r Bac valley	**49.2**	47.6	61.9	60.6
29	15	16,Voluntarilor Str., watershed	14.8	42.7	12.9	25.7
Profile IV						
I	1	Grenobl Str., Children's Hospital, watershed	43.0	36.0	12.5	32.4
5	3	Sarmizegetusa/Burebista, Str.	19.2	50.9	17.0	46.1
7	4	R Bac valley near bridge, residence BTP	33.3	**72.6**	30.3	34.0
9	5	Site BTP, bottom of slope	696.3	201.7	**136.3**	**4608.9**
10A	5	Ter. BTP, bottom of slope	21.4	56.1	17.4	42.4

The analysis of HM content in the 4 profiles points to the fact that MAC exdeedings for HM are observed only in some places. The results show a low level of soil pollution. There are only some insignificant exceedings: Profile 1 (for Cu, samples 11, 27, 43, MAC exceedings are of 1.01; 1.12; 1.16 respectively. On Profile II exceedings are in Zn (samples 15 and 19), in Pb - in samples 19 and 23. On profile III: exceedings in Cu, samples 1 and 25, MAC exceedings are of: 2.15 and 1.49, respectively); on profile II (for Zn, samples 15, 19 and 23; MAC exceedings are of 1.29, 1.56, 1.41,

respectively. For Pb: samples 19 and 23, MAC exceedings are of 1.43 and 1.05, respectively). On profile III (for Cu, samples 1 and 25 MAC exceedings are of 2.12 and 1.45 respectively, and for Zn sample 1, the exceeding is by 2.42 times. Profile IV (exceedings for Zn, samples 7 and 10, for Pb, sample 9, are by 4.25 times. The MAC exceeding for Cr-9, is more than 46.01 times. The exceeding for profiles I – III can be explained by accidental pollution and for Profile IV by the fact that pollutions occur primarily within and around BTP, where significant quantities of sludge and correspondingly of heavy metals contained in it are accumulated.

Geochemical compositions of the soil cover within industrial sites of Chisinau urban ecosystem

In order to establish the dynamics and the sources of soil pollution with heavy metals (Cu, Zn, Pb, Cr) on the entire BTP territory on time, the research has been conducted on the soils of BTP industrial sites. The current situation is compared with that of the 1990s (Константиновой et al., 1993). The obtained results are presented in Table 2. The data indicate that within Buiucani industrial platform, concentrations exceeding MAC by 1.2 to 1.5 times were detected only on the territories of "Tracom" and JSC "Pielar" enterprises. On the territory of JSC "Viorica-Cosmetic", the concentration of total form Cu, which basically constitutes 1 MAC (C = 28.9 to 32.4 mg / kg, MAC Cu = 33 mg / kg), was detected.

The study on the degree of soil pollution on the territory of industrial sites indicates the fact that virtually on all the territories MAC exceedings were found (between 1 and 2 MAC). The greatest excesses of MAC have been established for: Cu – 6.33 MAC (JSC "Tractor"), Zn - 2.51 MAC (JSC Topaz) and Zn – 2.48, JSC "Pielart" (Buiucani industrial site). The MAC excess for HM within Buiucani industrial site is explained by the dispersal of these metals during the operation of the industrial enterprises (the Tractor Factory, Topaz, etc.) found here. A high content of lead – 2.57 MAC is found in Maria Dragan street, school No. 35 (site CET-1), which is explained by accidental pollution (dumping of waste containing lead).

It should be mentioned that BTP site is characterized by increased amounts of heavy metals. The highest content of heavy metals is established within BTP site and the adjacent lands: for Cu - 4.36 MAC (Valea Crucii near the circle); Cu – 2.35, Zn – 2.88, Pb - 1.36 (left bank of BTP); Cu – 2.96, Zn - 3.26, Cr – 1.33 MAC (BTP territory, the drying bed).

In order to determine the degree of soil pollution with heavy metals within the BTP, soil samples were collected in the 0-20 cm layer from residential and agricultural areas throughout the city (Table 3). Based on the results, the indicators of the degree of soil pollution with chemicals were determined. The results on the content of heavy metals in residential and agricultural areas are shown in Table 3.

Table 2. *Content of heavy metals in soil on the territory of industrial sites Chişinău city*

Sampling point	Location	Element, mg/kg			
		Cu	Zn	Pb	Cr^{90}
1	2	3	4	5	6
Territory of industrial sites Buiucani (sites nr.1)					
p.5	Meadow river Bâc, JSC "Tractor factory"	**36.27**	**87.58**	25.23	7.02
p.7	Meadow river Bâc, JSC "Tractor factory"	8.4	21.86	8.2	5.28
p.9	Meadow river Bâc, JSC "Tractor factory"	**38.0**	**96.75**	**32.96**	12.58
p.37	Site JSC "Tractor factory"	**208.83**	**68.97**	25.13	10.41
p.13	Meadow river Bâc, JSC "Topaz"	**50.51**	**138.07**	**42.79**	14.43
p.15	Meadow river Bâc, JSC "Topaz"	32.25	**86.42**	25.71	6.57
p.21	Meadow river Bâc, JSC "Topaz"	30.15	**56.16**	17.24	4.76
p.17	Meadow river Bâc, JSC "Viorica Cosmetic"	33.56	**96.75**	27.33	7.52
p.19	Meadow river Bâc, JSC "Viorica Cosmetic"	26.6	51.83	14.77	6.70
p.24	Meadow river Bâc, JSC "Viorica Cosmetic"	16.33	39.57	10.24	7.60
p.25	Site JSC "Viorica Cosmetic"	28.89	**57.66**	15.17	7.21
p.41	Site JSC "Viotrica Cosmetic"	32.41	**90.88**	26.77	8.43
p.27	Meadow river Bâc, JSC "Viorica Cosmetic"	19.64	41.38	13.54	7.45
p.29	Meadow river Bâc, left Bank, JSC "Viorica Cosmetic"	25.98	56.80	16.08	7.47
p.31	The shore of r. Bâc, upstream JSC "Viorica Cosmetic"	13.66	37.88	11.28	5.67
p.33	Meadow river Bâc, upstream JSC "Viorica Cosmetic"	25.89	44.95	13.93	10.33
p.35	The shore of lake JSC "Viorica Cosmetic"	15.07	43.40	13.18	8.44
p.43	Site JSC "Pielart"	**61.03**	**136.14**	**45.87**	9.69
Territory of industrial sites CET 1 (sites nr.2)					
p.2	Calea Moşilor Str. / Ismail str., the shore of r. Bâc	27.00	**61.38**	20.94	3.85
p.4	Behind the hotel "Naţional"	15.14	**66.66**	16.61	1.59
p.9	Streets Intersection Gh. Caşu and Nistor	**50.35**	**68.90**	25.57	4.61
Territory of industrial sites CET 2 (sites nr.3)					
p.1	17/1, Ginta Latină Str., playground for children	17.82	46.52	12.67	6.3
p.3	Mircea cel Bătrân Str., transport circle	27.62	52.11	16.38	11.94
p.5	Maria Drăgan Str., school no. 35	**36.62**	**198.99**	**82.34**	15.56
p.7	Mălăeşti Str. (the end)	18.27	**60.62**	17.97	13.63

BTP industrial site *(site nr.4)*					
pr.1	Valea Crucii Str., The beginning, top of the street	**143.84**	44.74	14.47	12.23
pr.2	Valea Crucii Str., 100m below the	19.90	51.48	15.64	12.02
pr.3	Valea Crucii Str., inters. with bd. Dacia (left)	14.15	38.05	12.71	8.03
pr.4	Valea Crucii Str. / Dacia Boulevard (right)	15.45	40.20	14.95	5.11
pr.5	Botanical Garden, 30 meters from the main gate	28.64	39.45	12.16	10.20
pr.6	Pădurilor Str., vis-à-vis JSC "Floare"	26.17	52.65	19.56	6.57
pr.7	Salcâmilor Str., trolley station	26.68	54.39	20.69	4.62
pr.8	Grădina Botanică Str., near bridge	24.33	**59.29**	19.41	7.48
pr.12	Left bank of the river Bâc, BTP	**77.52**	**158.4**	**43.43**	37.03
pr.14	BTP, sludge drying bed, row No.1, No. 3	**97.79**	**198.99**	28.25	**132.29**
pr.15	250m NE of BTP, cabbage garden	**76.59**	**73.41**	15.49	87.87
pr.16	left watershed of r. Bac	21.93	39.86	13.98	9.04

Table 3. *The HM content in the residence and agricultural areas of Chisinau urban ecosystem*

Nr. of samp.	Sampling point	mg/kg			
		Cu	Zn	Pb	Cr
1	**2**	**3**	**4**	**5**	**6**
The Central residence sector					
3	94, Ialoveni Str. (house head south)	17.5	42.1	12.4	16.5
4	94, Ialoveni Str. (front of house)	26.6	**107.2**	16.7	14.9
5	Ialoveni Str., Infant-school	**33.9**	**90.9*)**	12.4	19.5
6	96, Ialoveni Str. (back of the house, under the maple)	18.4	**57.2**	10.9	16.0
7	96, Ialoveni Str. (back of the house, under the conifers)	17.6	**55.1**	11.5	16.8
1	Plowed field across from the Academy of Public Administration (APA)	**83.3**	41.3	6.9	16.2
2	Site AAP, 20m East	23.8	**64.1**	11.0	16.3
3	After the sports ground	17.7	46.8	9.4	17.9
Buiucani, residence sector					
1	Paris Str., 7-8m from the road	**91.6**	**61.1**	7.9	16.4
4	57,N. Costin Str, the street under the house	**37.9**	**70.9**	16.4	9.6
5	Ghibu Str., source	11.1	32.2	2.3	9.8
6	59,Ghibu Str. –playground	20.4	47.7	5.3	13.4
8	61/1, N. Costin Strbehind the building	9.4	**76.1**	9.5	7.7
10	194/1, Alba Iulia Str.	17.4	44.3	4.8	14.3

Tracom, sub-residence of factory sector					
1	sports field	19.3	**134.1**	**167.4**	19.8
2	174, Columna Str.	13.8	**64.0**	19.9	17.3
4	Columna Str. (5 m from the street)	**44.9**	**109.8**	**52.4**	21.8
5	50 m str Columna (square in the middle of the circle)	21.0	**67.6**	18.6	24.8
6	Tracom (eastern part)	22.9	**82.6**	24.8	30.2
7	Tracom (50 m from the block of assembly)	25.6	43.1	23.0	24.0
Colina Puschin, sub-residence sector, July 11, 2008					
1	14, Colina Puskin Str.	19.4	**120.0**	40.0	12.8
2	7A, Z. Arbore Str.	27.7	**207.0**	**133.6**	13.2
4	84/1, Albişoara Str., the schoolyard	16.5	52.6	16.1	21.6
5	80/5 and 84/5, Albişoara Str.	21.8	**85.9**	**129.2**	23.7
7	74/1, Albişoara Str. 5m Albisoara Street	26.8	**91.5**	**38.6**	30.1
8	74/1, Albişoara Str.	20.7	**84.4**	21.9	17.5
9	Pruncului Str., A.S. Puskin house	18.1	**69.1**	22.7	16.4
Râscani, residence sector, May 21, 2008					
1	16/3, Al. Russo Str.	14.4	**72.0**	9.9	18.2
3	17/4, Al. Russo Str., trash	21.2	**247.0**	**200.0**	17.3
4	9/2, Dimo Str.,	15.8	**160.5**	**81.7**	17.3
5	7/3, Dimo Str., in front of the building with 9 floors	13.2	**70.6**	10.4	15.7
6	10m from Kiev street, backyard 10/1	17.8	**70.3**	10.2	15.8
9	1, Dimo Str., in front of the building	19.3	**101.2**	9.5	13.4
BTP - the Biological Wastewater Treatment Plant, sub-residence of Bâc village sector					
1	soil with potatoes	**182.8**	**280.1**	**38.5**	**559.4**
1a	potatoes from soil with potatoes	10.3	32.1	0.0	2.7
2	v. Bâc, mud on the end platform BTP, meadow	**101.6**	**244.1**	17.3	**322.1**
3	From the village Bic (small slum) across the bridge over r. Bâc	**42.9**	**89.8**	7.5	88.6
5	S. Bâc, str. Grădinilor, 176, cornfield of corn	10.1	26.2	0.0	32.8
7	Right side of the road „Bubueci-Chisinău”	11.8	33.6	0.0	15.8
9	Site of BTP, scattered mud	**105.6**	**205.9**	15.4	**360.2**
11	Around aerotank BTP (site)	**74.1**	**164.5**	8.4	**182.4**
12	Around central aerotank BTP (site)	20.2	56.9	0.0	30.6
13	Around the secondary decanter	**246.4**	**264.3**	30.1	**598.4**
14	BTP, near the pumping station	22.1	44.8	0.0	54.7
Durlesti, agricultural site of residence sector					
1	Durlesti-village, land planted with vines	**79.4**	28.9	0.6	8.1
4	Bottom of valley, raw land, association of grasses	**47.8**	37.1	0.9	9.4
5	Apple orchard "Rihard" abandoned	**97.5**	55.6	2.9	11.9
7	The middle of the slope right side, vines, well tended	**76.1**	46.6	3.1	16.9
9	Head landslide, old crumbling slope	**39.7**	50.1	4.4	12.3
12	Water balance, land planted with vines	32.6	36.4	1.3	10.1

Ciocana, residence sector					
1	99/1, Aleco Russo Str., part of the street, back of the house	16.8	47.9	10.0	22.3
2	59/2, Aleco Russo, intersection A. Russo-Sadoveanu	17.5	47.9	10.5	20.1
3	2/1, P. Zadnipru Str. front of house	16.5	54.2	11.4	21.0
4	14,Sadoveanu Str.,front of house	**110.7**	**66.8**	14.8	19.1
5	14,Sadoveanu Str., back of the house	16.7	**71.9**	11.2	22.5
6	35, Aleco Russo Str., stadium	16.2	49.0	22.1	20.9
7	4/1, Aleco Russo Str., around the kindergarten „Foisor”	17.8	**111.9**	**47.9**	20.5
8	7, Mircea cel Bătrân Bul., front of house	17.0	55.6	15.3	17.5
9	7, Mircea cel Bătrân Bul. back of the house	22.6	53.1	13.4	24.0
10	3, Mircea cel Bătrân Bul. front of house	21.7	58.1	14.7	19.5
Valea Crucii, residence sector, July 3, 2008					
1	257, Grenoble Str.former Weather Station	**34.4**	**89.7**	30.3	16.3
2	259, Grenoble Str. 1-2m from the road	13.1	37.6	1.0	17.4
3	Valea Crucii Str., below the bus station	23.2	**81.2**	12.8	18.8
4	22, Valea Crucii Str.	18.1	43.8	1.5	21.9
6	22/1, Valea Crucii Str.	11.8	41.0	1.4	15.9
	Valea Crucii Str., CMF 2 (court)	20.1	40.0	1.6	16.7
10	37, Cuza Vodă Str., front of house	13.3	38.9	1.9	18.6

**) with bolt is indicated the content of heavy metals exceeding MAC*

The obtained results show that the HM content in residential and agricultural areas differs greatly from one sector of the city to another. In the *Centre Sector*, Ialoveni street copper was detected in sample 5 - 1.03 and 2.52 MAC (the land opposite the Academy of Public Administration) and Zn between 1.4 to 1.95 MAC (Ialoveni street). In *Buiucani Sector,* Cu content varies between 1.15 and 2.78 MAC (M. Costinşi Street and Paris Street, respectively. Zn content in this sector is 1.11 to 1.38 MAC (str. Paris and N. Costin 61/1). In the *“JSC Tracom*” *sector*, Cu content is of 1.36 MAC, while Zn ranges between 1.16 and 2.44 MAC. *Colina Pushkin sector* contains a higher degree of soil pollution. Zn content varies between 1.26 (Pruncului street, A. Puşkin’s house) and 3.76 MAC (7A Z. Arbore street). Riscani sector is also highly polluted. Zn content varies between 1.28 MAC (16/3 A. Russo street) and 4.5 MAC in 17/4 A. Russo Street (the place for the landfill site).

One of the sectors with the highest degree of pollution is the *sector of the Biological Wastewater Treatment Plant* (BTP), which includes the BTP territory and the adjacent lands: the village Bic, the lands of the BTP. On these lands the HM content constitutes (MAC): Cu and Zn 1.30 and 1.62, respectively (the outskirts of the village Bic) and 5.2 MAC for Cu and 5.01 for Zn (the potato field adjacent to the BTP territory). On the BTP territory, the HM content is the highest: Cu - 7.5, Zn - 4.8 and Cr. - 6.0 MAC. The high content of HM on the BTP territory and the adjacent lands is explained by the accumulation of essential quantities of sludge on the BTP and

the adjacent territories containing major amounts of HM and its usage as fertilizer for growing crops. These data confirm the need to control the use of sludge as fertilizer on agricultural lands.

In Ciocana and Valea Crucii residence sectors, the Zn content also exceeds the MAC and varies between 1.22 MAC (14 Sadoveanu street), 2.1 MAC (4/1 A. Russo street (Foisorul kindergarten, Ciocana sector) and 1.63 MAC Zn (257 Grenoble street (former Meteorological station). The presented results demonstrate that many places within the Chisinau ecosystem are quite polluted.

According to (Ghid evaluare prejudiciu…, 2006). The Table "Indices of the degree of soil pollution with chemicals", the degree of soil pollution in the CUE is of the second level - low polluted.

To establish the most polluted sector of the CUE according to the author (Кирилюк, 2006), the summary index of pollution was calculated. The results of the estimates of the summary pollution index (Zc) for the most polluted land in the CUE is shown in table 4.

Table 4. *The HM content and summary index (Zc) of pollution on the BTP sub-residence of Bâc village sector*

Nr. of sample	Sampling point	Cu	Zn	Pb	Cr	Zn
1	Sol with potatoes	**182.8**	**280.1**	**38.5**	**559.4**	28.21
2	V. Bâc, Mud on the end platform, BTP, floodplain	**101.6**	**244.1**	17.3	**322.1**	28.49
3	At the edge village Bac	11.8	33.6	0.0	15.8	4.42
9	BTP (site), scattered mud	**105.6**	**205.9**	**15.4**	**360.2**	31.25
11	Around central aerotank BTP (site)	**74.1**	**164.5**	8.4	**182.4**	14.58
13	Around the secondary decanter	**246.4**	**264.3**	**30.1**	**598.4**	57.62
The average value of the summary index of pollution on the entire BTP sector						**27.43**

The average summary pollution index (Zc) for the BTP is 27.43. According to the author (Кирилюк, 2006) this sector refers to a moderate degree of pollution and these territories are characterized by a high level of illnesses in people. This fact is confirmed by the authors (Бодруг et al., 2009). It should be mentioned that according to the authors (Константиновой et al., 1993), the summary pollution index (Zc) for the BTP sector and other sectors of CUE in 1989-1990 exceeded the value of 128. The results presented by the authors (Константиновой et al., 1993) demonstrate enormous pollution practically on the entire CUE, where the summary pollution index (Zc) of 16-32 was characteristic of the entire UCE. The research of the pollution degree with heavy metals on CUE territory in 1989-1990 and the results obtained in the present study (2006-2010) show an essential decrease of soil pollution. This difference can be explained by the fact that in the period before 1990 in CUE a large number of industrial enterprises operated in whose technological processes essential

quantities of HM were used (Mezon, Vibropribor, Signal, Topaz, Pielart, Tractor Factory, etc.). They caused huge pollution of all environmental components and especially of the soil (most pollutants from the air settle on the soil surface). Currently, these companies no longer exist and this source of pollution has disappeared.

The study of soil quality within CUE according to other indicators during the period 2003- 2007 compared to the 1990s showed the following: the degree of soil pollution by chemical and microbiological indicators also decreases; 82.4% of the samples analyzed in 2003 and 48.5% in 2006 did not meet the requirements according to chemical indicators; 25.4 % in 2003 and 25.8% in 2006 did not meet the requirements according to coli-fagi indicators; 37.3% in 2003 and 31.7 % in 2006 did not meet the requirements according to the microbiological indicators. The reduction of soil pollution with HM over the years is explained by the decrease of the economic activity of the polluting enterprises and by the influence of climatic factors (atmospheric precipitations, wind, etc.) that lead to the washing and migration of the heavy metals and of other pollutants from the soil and their assimilation by the ecosystems, and the process of self-sanitation of the components of the environment (data of Chisinau Public Health Center for the years 2003-2006).

In conclusion, it can be stated that the degree of soil pollution on the territory of the 4 profiles are episodic and unessential. The study of the territories of the industrial sites indicates the fact that there is exceeded MAC almost on all of them (between 1 and 2 MAC). This fact is explained by the elimination and dispersal of HM by former and present industrial enterprises in operation. The most polluted of all sectors of CUE is the BTP, where essential exceedings of HM are observed. The results obtained on HM content on the adjacent territories of the BTP where sludge is used as fertilizer confirms the need to control its use as fertilizer on agricultural land.

CONCLUSIONS

1. The lowest polluted with HM lands are the profiles where MAC exceedings are accidental and unessential. Among the most polluted industrial sites are: Buiucani industrial site, CET-1, CET-2 and BTP.

2. The study on HM content in soil samples at the sampling points in the residence sectors demonstrates that the degree of pollution of CUE sectors are caused by mismanagement of solid household waste (SHW), which requires selective collection through the removal of hazardous waste: accumulators, luminescent lamps and other waste containing HM.

3. It was established that the most polluted with HM land within CUE is the BTP (Cu - 7.5 MAC, Zn - 4.8 and Cr - 6.0 MAC). The high HM content in the BTP soil and the adjacent sectors is explained by the accumulation of large amounts of sludge at the BTP containing essential quantities of HM and its use as a fertilizer for crop growing.

4. It was estimated that the degree of land pollution in Chisinau Urban Ecosystem refers to the second level of pollution – weakly polluted.

5. It was assessed that the highest level of pollution is established for the BTP sector. The value of the summary pollution index (Zc) of this sector is 27.43, which indicates the fact that this sector refers to the moderate degree of pollution. This index value (Zc) characterizes the sector by a high level of illnesses in people.

6. It was demonstrated that the degree of pollution of Chisinau Urban Ecosystem territory established in 1990 has essentially decreased compared to the year 2010, which is explained by the disappearance of HM pollution sources (industrial enterprises) and the natural sanitation process under the influence of natural climatic factors (atmospheric precipitations, wind, etc.) that lead to the washing and migration of heavy metals and of other pollutants from soil and their assimilation by ecosystems.

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