MONITORING OF THE IMPACT Of DUMPS ON THE ENVIRONMENT

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Abstract
Dumps (grounds) of solid industrial and domestic waste are sources of formation of anomalous technogenic and geochemical zones of various intensity having negative impact on natural complexes. A large number of these objects intensifies their ecological threat. In Belarus the total area of land occupied by grounds of domestic and industrial waste makes up 2950 ha. More than half of the functioning dumps are not equipped with environment-protective technological facilities and barriers. There has been no practice of filter waters and biogas collection on dumps. The main objective of the work was investigation of the impact of dumps (grounds) of industrial and domestic waste. Depending on the periodicity of the performed research two types of monitoring are realized: casual control (every 5-10 years) and regular control (annual, seasonal). Reconnoitring observation of the objects is performed before monitoring network is created. During reconnoitring observation of dumps the main method of research is landscape-geochemical profiling. During regular observations, sampling of underground waters is performed at fixed points from bore holes of the network mode and soil bore pits. reconnoitring observation allows one to reveal potential substances-pollutants of the environment and evaluate the availability and range of the pollution scope of underground waters and soils. Regular observation allows one to follow the dynamics of their change.

Introduction

Annually in Belarus in the process of industrial production more then 25 mln tones of waste are formed. The nomenclature of industrial waste is humerous and included more then 800 items. However, in the structure of waste by volume there is a sharp predominance of salt waste and clay-salt sludges of potash fertilizer potash production (79%), waste of phosphogypsum and hydrolytic lignin (1.8 and 1.2 % respectively). The level a utilization is rather low and makes up as a whole about 16%, including toxic waste – about 48%. Non utilized hazardous waste can be removed to the dumps of industrial and domestic waste or accumulated in the territories of enterprises (1).
Municipal waste form approximately 10% of the total amount of waste.
Almost all municipal waste (96%) and non utilized industrial waste (84,4%) are disposed to landfills, which in most cases do not fully comply with environmental requirements.

Objects of research

A number of observation objects includes more then 20 landfills in Minsk, Gomel, Brest, Vitebsk and other Belarusian cities. SDW of the largest cities (Minsk, Gomel, Brest, Vitebsk) occupy the aria about 20-30 ha, dumps of industrial waste (SIW) in Bobruisk, Svetlogorsk, Rechitsa and dumps of municipal waste (SDW) other towns (Orsha, Polotsk, Volkovysk) - 5-15 ha. Municipal waste and industrial enterprises waste which are mainly inert and belong to 3 and 4 danger class have in the amount of one third of the whole waste volume input are removed to the SDW dumping grounds. Dumping grounds of industrial waste represent receiving tanks of separate waste (hydrolytic lignin and waste with chromium content are removed to the dump in Bobruisk, the state of which is under control; and mainly waste of chemical productions - to the dump in Svetlogorsk). Screening of ground beds is not performed. Nature-protective technological facilities are available on some grounds in the form of by-pass canals and banks (Minsk, Orsha).

Methods

Objects of research are marked on landscape-geochemical maps where are also represented areas of carrying-out, transit or accumulation of chemical elements. Landscape-geochemical profiles are made

in the direction of possible ways of pollutant migration with surface, intrasoil and subsoil waters. At a different distance from the dump side with account of landscape structure of the territory soil profiles with collection of soil samples on genetic horizons, subsoil waters and vegetation are made.

For revealing and estimation of possible pollutants of local landscapes substratum of dumps and filtrates are also sampled.

Chemical analysis of soils, technogenic substratums and bottom sediments was carried out using atomic absorption spectroscopy, emission spectral and X-ray fluorescence methods. General hydrochemical and atomic absorption methods are used to determine chemical composition of water samples.

The level of anomalous character of element content in the medium components was evaluated with respect to the local background or mean factors for the territory of Belarus (K_o). The degree of pollution hazard was estimated by comparison of the received concentrations with the maximum permissible ones (MPC).

Results

The study showed that in the substratum of the ground-accumulators there is a wide range of elements pollutants, although their concentration depend on the type of the ground and the composition of waste stored. On the average for investigated grounds of solid industrial waste of Belarus the following pollutants are typical: copper (Ko 139), zinc (39.90), chromium (22.6), lead (17.6), tin (10.9), nickel (6.4). The substratum of the grounds of solid domestic waste contents the largest concentration of chromium (Ko 265), manganese (82), zinc (32), lead (23, copper (8) (table 1).

All objects are characterized by a high salt content of substratum: the sum of ions of the main salt composition can be higher then 1% (background for soils – 0.009%).

Table 1: Content of heavy metals in substrates of dumps, mg/kg

Type of dump and quantity of samples	Index	Pb	Ni	Cr	Mn	Cu	Sn
SDW, 21	min	9.5	12.8	29.7	65.0	38.0	<10
	max	1290.0	512.8	3028.9	4000.0	20000.0	400.0
SIW, 17	min	2.0	7.7	43.2	70.0	12.0	<10
	max	3000.0	100.0	60000.0	117000.0	200.0	35.0
Background content of Belarus	mean	12.0	20.0	36.0	247.0	13.0	10.0

As it is known the main way of pollutants spread outside the waste depository are streams formed as result of chemical elements leaching from waste by atmospheric precipitation and subsoil waters. The results of analyses on content of heavy metals in the filtrate from the waste are given in table 2.

Table 2: Content of heavy metals in the filtrates from the waste, mkg/dm^3

Object	Index	Cd	Pb	Cu	Ni	Zn	Mn	Cr	Hg	Mo
SDW (11)	min	0.5	3.7	ND	30.0	ND	ND	ND	ND	ND
	max	19.4	287.1	821.2	1444.0	2458.0	2374.0	1190.0	55.0	387.9
	mean	4.6	62.3	267.2	574.2	707.6	2696.8	343.6	11.4	105.8
	K_o	4.6	12.5	133.6		35.3	53.9			
Subsoil water (background)		1	5	2	-	20	50	-	-	-

One of the observed objects (the SDW dump "Trostenets") is shown on figure 1. The investigations in the impact of this dump have been carried out for 10 years. It is located within 5 km distance of Minsk and the industrial and municipal waste of city have been disposed there for forty years. Now 500,000 м^3 of waste per year are collected on this dump.

The area of the dump is 32 ha, its height is about 14 m. Nature-protective technological facilities are only in the form of by-pass canals. There is a mound of the road passing not far from the dump. This mound with a height of 1-2 m at the dump is a barrier on the way of surface streams from the dump..

Figure 1: Landscape-geochemical map of the locality of the SDW dump "Trostenets" (Minsk). Genuses of landscapes (1- eluvie; 2- eluvie-accumulative; 3- above-aquatic); 4- arable land; 5- wood; 6- meadow; 7- settlement; 8- dump; 9- points of soils sampling;10- bore holes

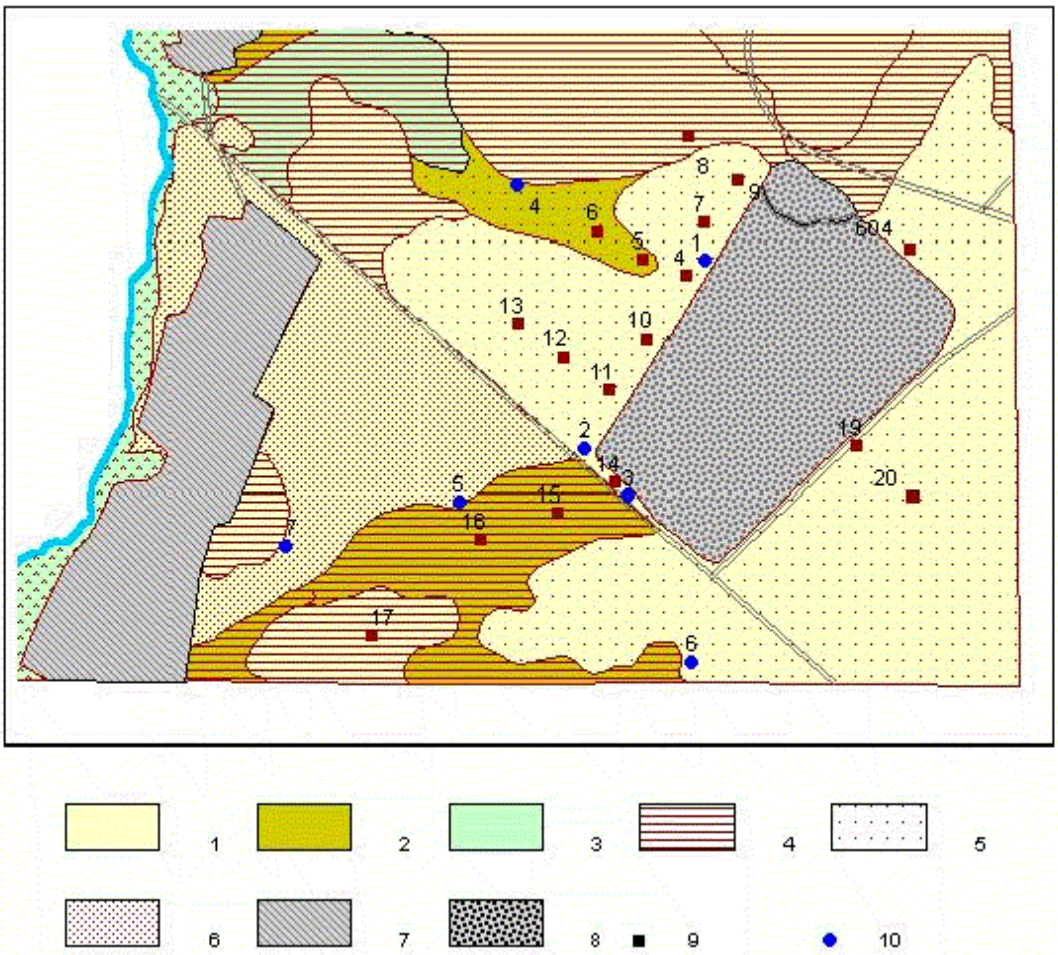
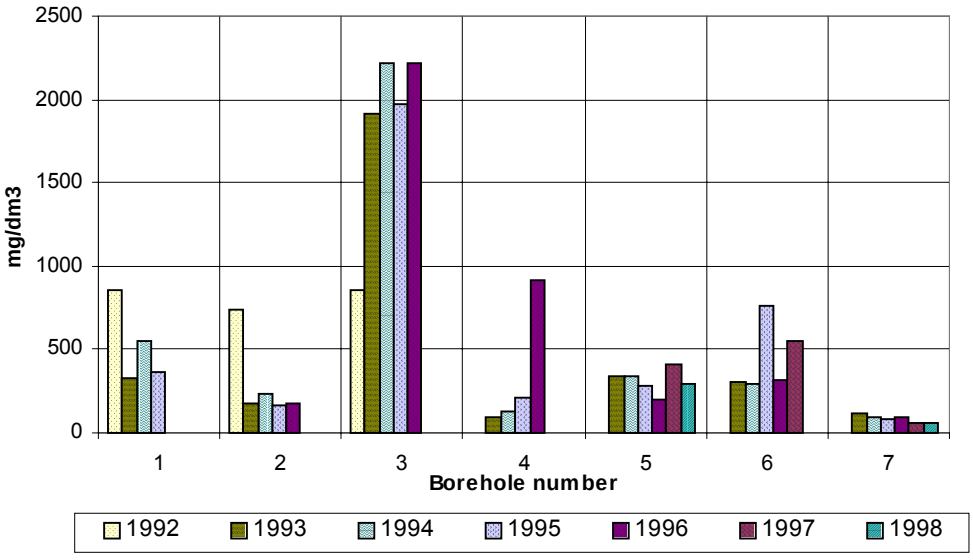


Figure 2: Dynamics of mineralization of ground waters in impact zone of SDW dump "Trostenets"



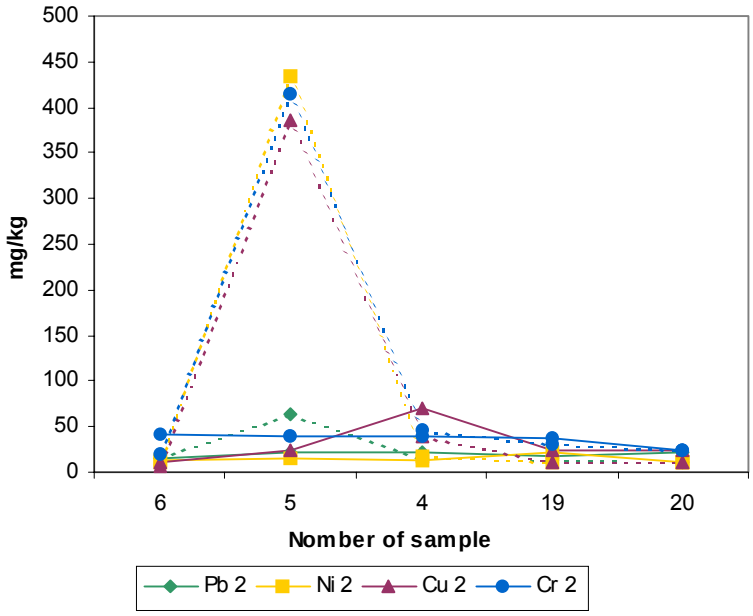
The results of long term monitoring showed rather stable character of the hydrochemical anomalie formed in ground waters. According to the composition of polluted ground waters HCO3-SO4-Ca type of water is formed in the impact zone of the dump (2). Dynamics of mineralization of ground waters we can see on figure 2. In water samples of some bore holes the concentration of ammonium, chlorides and nitrites periodically exceeds the MPC of this pollutants. So their concentrations are 2, 3. 4.times respectively. The pollution of underground waters with ammonium and nitrates is revealed in bore hole 7 being at a distance 700 m from the dump.
According to the data obtained the concentration of heavy metals in underground waters exceeds the background content : Mn is 3,8 times, Cr- 5-10, Pb- 4,7, Cu- 5-37, Zn is 67-208 times. The content of Ni is 2 times the MPC.

Table 3. Content of heavy metals in ground waters in impact zone of SDW dump "Trostenets", mkg/dm^3 (1999)

№ of samples	Depth of sampling, m	Cd	Pb	Cu	Ni	Zn	Mn	Cr	Mo
3a	32.2	0.413	10.91	33.13	10.06	59.79	35.03	5.73	37.22
22	12.0	0.003	4.99	17.05	4.26	58.75	4.01	24.46	9.07
7	43.4	0.231	12.09	44.23	40.39	315.60	215.20	36.55	4.78
3	32.2	0.002	6.78	31.06	199.10	35.09	38.09	4.50	5.35
Subsoil water (background)		1	5	2	-	20	50	-	-

Soil contamination is revealed not far from the dump ground at the distance of 20-30 m from the dump side. The content of lead, nickel, zinc and copper in the upper part of soil is several times the MPC (figure 3).

Figure 3: Content of heavy metals in soils in impact zone of SDW dump "Trostenets"(dotted line - 1990, another - 1999)



Conclusion

The research has shown that in the impact zones of all investigation landfills hydro- and pedogeochemical anomalies were revealed. It was started that the grounds as accumulators of solid waste represent stable pollutants of surface and underground waters. As a rule the following types of water are formed in the impact zones of landfills: SO_4-Na or mixed - near SIW, Cl-Na or mixed - near

SDW. The anomalies bear local character. Soil pollution depends on the availability and spread of water streams as well as on soil sorbent properties. Thus if landfills are located in autonomous landscape conditions with flat relief, pollution can be found at a distance of 200-300 meters; pollutants mainly transported with radial flows. If slope gradient is more extinct, pollutants migrate also with surface water flows and detected up to at a distance of 200-300 meters and more.

References

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