Pesticide monitoring in Armenia

final report

visit of the surroundings of Yerevan, July 22 – 28, 2010

Ing. Zuzana Honzajkova

Ing. Marek Sir

Institute of Chemical Technology in Prague, November 2010

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In cooperation with the Czech non-profit organisation Arnika, we visited Armenia in July 2010. The purpose of our visit was monitoring of pesticide contamination in selected localities. In Armenia, the mission was prepared and organised by a local non-governmental organisation Armenian Woman for Health & Healthy Environment (AWHHE).
Our team visited in total four localities where pesticides were present. These localities were, in particular, storages serving for pesticide distribution and storing in the past. The localities included one dumping site of pesticide residues and wastes contaminated by pesticides, which is partially secured at present. Further, we visited a disposal site of wastes from a metallurgical plant processing copper ore.
The present report comprises detailed description of the visited localities and taken samples. Preliminary conclusions concerning the nature of contamination and possible risks ensuing from it are presented for each of the localities. An annex to the report states results of analyses of all the taken samples, and comparison with pollution criteria.

Methodology of sampling and sample analysis

Several samples were taken in each of the localities. Mostly, mixed samples were taken, formed by several partial samples taken in various places of the given locality. We always endeavoured to take a sample representing the given whole to the maximum possible level. Systematic sampling, including depth profiles, was carried out in one of the localities. The samples were taken by means of a shovel into plastic sample containers with screw lids. Soil samples were stored at room temperature, water samples were stored in a refrigerator in the dark. The number and description of the taken samples is stated below in the parts of the text concerning the individual localities.

Sample analysis was carried out in laboratories of the Institute of Chemical Technology in Prague. For the analysis, there was used an efficient method, verified in the long term, of extraction by hexane in ultrasound, and subsequent analysis of the extract by gas chromatography.
In the laboratory, sample homogenization was carried out at first. Subsequently, a representative part of the sample was taken for analysis, specifically, 2.5 g of the sample. The sample was placed, together with 10 ml of hexane, into an extraction bottle, and extracted in ultrasound water bath for the period of 20 minutes. Subsequently, the extract was analysed by means of a gas chromatograph with ECD detector. Results of analyses of all the samples are presented in tables in an annex in the end of this document.

Visited localities

Our aim was to monitor occurrence of pesticides in four localities in the vicinity of Yerevan. The localities were places contaminated by pesticides because of the former activities (dumping site, storages, sale places). Further, heavy metals contamination was monitored in the neighbourhood of the disposal site of waste from a metallurgical plant in the vicinity of the city Alaverdi.

Nubarashen

Sampling date: July 23, 2010, July 26, 2010

The dumping site is located ca 20 km from Yerevan, the capital of Armenia, ca 1 kilometre from the closest residential houses. It served for disposal of pesticide residues and wastes contaminated by pesticides. Unfortunately, the dumping site is located on a hill, and, thus, rainwater and leachate from the dumping site flow down in the direction of the close, lower situated, residential houses. At present, the dumping site is sealed and fenced, the territory under the dumping site is accessible, covered by grass and shrubs, marks of livestock grazing are visible there.

Samples taken

In this locality, the territory under the dumping site was sampled systematically. The places of sampling are depicted in Figure 2. There were taken 9 samples from the surface, and three samples from each of the three profiles parallel with the lower base of the dumping site. During taking of surface samples (samples N1 - N9), soil overburden was removed at first. Subsequently, ca 250 g of soil was taken by means of a shovel, from the depth of at most 5 cm. In the places designated N1, N4 and N7 in Figure 2, in total 8 depth samples were taken from drill holes in the profile vertical to the lower base of the dumping site. The samples were taken from the depth 0.5 m, 1 m and 1.5 m. Manual drilling equipment with Edelman drill was used for the sampling. Sample of 250 g was taken from each of the depth profiles.

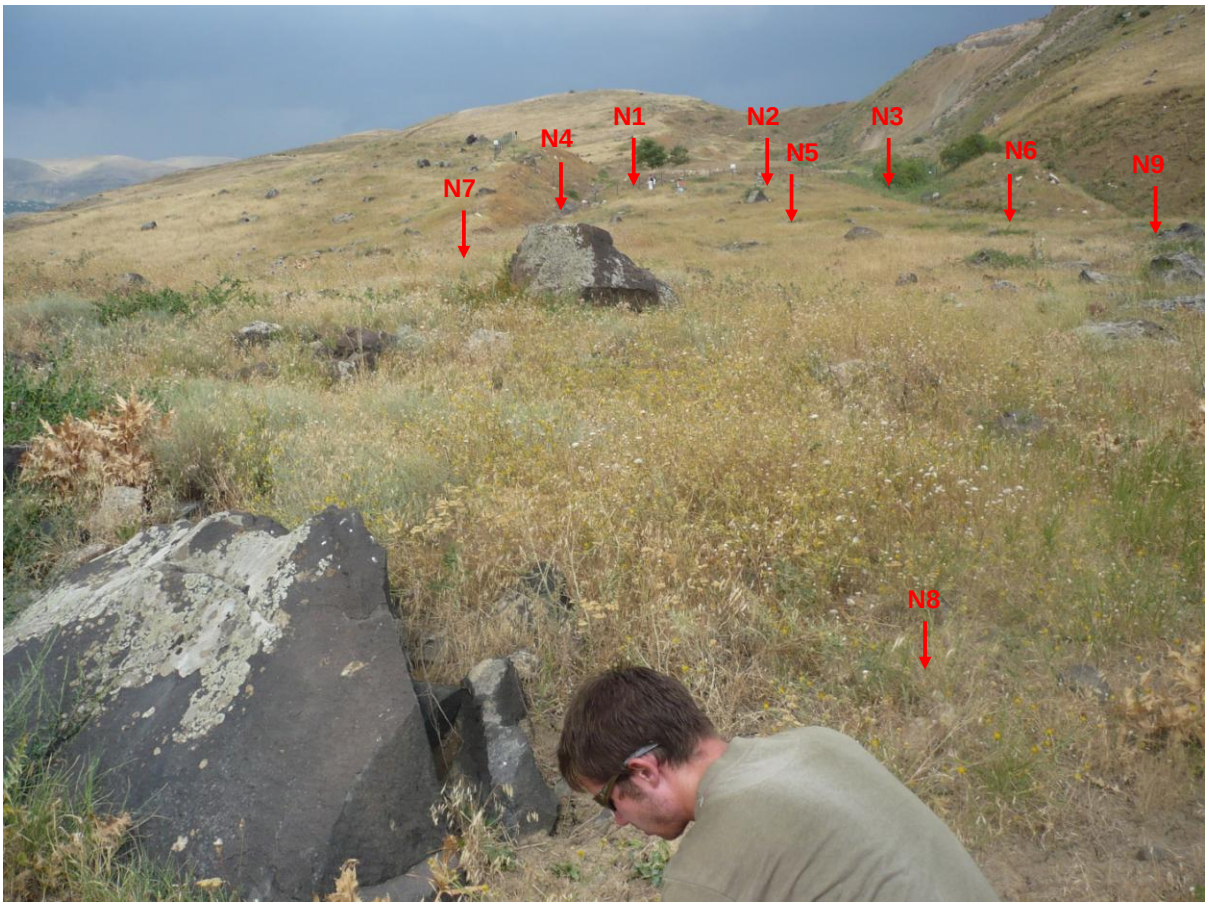

Figure 1: Places where surface samples were taken under the Nubarashen dumping site.

Results and risk assessment

In the surface samples, pesticide concentrations were found reaching hundreds of milligrams to units of grams per a kilogram of soil. Especially 4,4´-DDT, 2,4´-DDT, 4,4´-DDE, alpha-HCH, and beta-HCH were found. In the vicinity of the dumping site, high pesticide contamination was found also in the whole depth profile, in the order of hundreds mg of DDT per kg of soil, even in the depth of 1.5 m under the surface.

From these results, it is obvious that massive pesticide releases from the body of the dumping site were taking place in the past. Under the dumping site, a channel is visible through which water flows off the dumping site during rain periods. In this channel, the highest levels of pesticide concentrations were found (samples N1, N4, and N7).

The spreading contamination in the surroundings of the dumping site represents considerable risk for the environment and people living in the vicinity. It is also very likely that pesticides enter the food chain, because marks of livestock grazing were found in close vicinity of the dumping site where also the highest DDT concentrations were detected.

Covering and fencing the dumping site partially prevented direct exposition of people and livestock, but spreading into the environment could still continue. Thus, sealing the dumping site does not represent a solution of the problem. It will be necessary to decontaminate the whole territory of the dumping site, in order to prevent possible risks.

Echmiadzin

Sampling date: July 24, 2010

In this locality, 2 storages are located where fertilizers and pesticides were handled. In close vicinity of the storages, vegetable patches are found, and small ponds for trout breeding are located ca 30 metres from the storages. The storages form part of a local farm where people live permanently, and which is located also in close vicinity of the storages.
The storages had been partially cleared already, however, pesticide residues were noticeable on floors and shelves. The presence of pesticide residues was proved also by strong smell. In close vicinity of one of the storages, there was a patch where local people grew vegetables.

Figure 2: First storage, closest to the vegetable patches.

Samples taken

In total, 5 samples were taken. In each of the both storages, one mixed sample of the material swept from the floor was taken, and, further, there was taken one mixed sample of the soil from the patches in the vicinity of the storage, a sample of sediment from an empty pond for trout breeding, and a sample of water from another breeding pond.

Results and risk assessment

In the material swept from the floors of the storages, high HCH and DDT concentrations were found, in the order of up to hundreds mg/kg. In the surrounding soil and water, increased concentrations of HCH and DDT and its derivatives were also detected, in comparison with the background levels. Pesticide contamination was not proved in water from the pond. Lack

of information of the local inhabitants on the hazardous properties of these substances represents the highest risk. They handle the material deposited in the storages without any protective equipment. The first storage had been swept recently. The pesticides may enter the surrounding environment also through this handling. There exists a risk of contamination of agricultural soil and crops, and contamination of breeding ponds, with the possibility of accumulation of these hazardous substances in fish meat. A further risk is pesticide accumulation in eggs of hens bred there.

Masis, Berriutyun LTD Masis

Sampling date: July 26, 2010

The locality is used for handling of fertilizers. A big storage with corresponding facilities and railway siding is present here. At present, the storage is still used for storing fertilizers. Two small storages, where pesticides and fertilizers were handled, are located next to the big storage used up to now. The first of the small storages is a ruined building without roof, freely accessible. In this room, bags and barrels with pesticides and fertilizers are present. The barrels are rusted through, and the bags are torn. Thus, their content is spilled loosely on the floor. The room does not have a roof, and, thus, these wastes are exposed to rain and weather influences.
The second of the small storages is formed by two rooms, and it is generally secured. In the past, this place served for sale of pesticides and fertilizers, the rooms are partially cleared, pesticide and fertilizer residues are spilled on the floor. In the both rooms, strong pesticide smell was noticeable.

Figure 3: Storage serving for storing fertilizers in the locality Masis.

Figure 4: View of the interior of the first storage.

Samples taken

In total, 5 samples were taken in this locality. A mixed sample from the bags, and another one from the floor, were taken in the first storage. A mixed sample of the material swept from the floor was taken in the second storage. Further, there were taken a mixed sample of plasters from the both storages, and a mixed sample of soils in close vicinity of the storages, ca 10 metres from the storages.

Results and risk assessment

In the samples from the storages, alpha-HCH, beta-HCH and gamma-HCH is found predominantly, in concentrations up to the order of units g/kg. Plasters from the storages are contaminated predominantly by beta-HCH and 4,4´-DDT. In the vicinity of the storages, increased concentrations of DDT and DDE were found. Thus, the analyses confirmed that pesticides were present in the both small storages in high concentrations.
The situation presents risks mainly for the employees working in the locality. In the first, freely accessible, room with the pesticides, cigarette ends were found on the floor, originating, with the highest likeliness, from the employees. They move here without any protective equipment, and this presents a huge health risk for them. Contamination of the stored fertilizers, and of landscape in the vicinity, represents another risk.

Jrarat

Sampling date: July 24 and July 26, 2010

Figure 5: Interior of the building of the big storage.

A big storage of fertilizers, serving also as a pesticide storage in the past, is found in the locality. The storage is locked, and accessible only with consent of the owner. Pesticide residues in barrels, and fertilizers in bags, are found in the storage. Further, ruins of a small storage, without a roof, are found in the locality. The small storage is filled with barrels and bags with fertilizers and pesticides. A railway siding, which served for handling of fertilizers and pesticides, is located close to the storages. Further, a pond for trout breeding is found ca 50 m from the small storage.

Figure 6: Ruins of the small storage where torn bags with crude DDT were found.

Figure 7: View of a part of the small storage, with barrels containing waste contaminated with DDT.

Samples taken

In total, 8 samples of solid substances were taken in this locality. There were taken 3 mixed samples of the material swept from the floor, and plaster, in the big storage, and, further, 2 samples in the small storage, samples of soils in the vicinity of the big storage and of the small one, and, finally, water from the breeding pond located nearby.

Figure 8: Analysis confirmed that the powder in the bags is DDT

Figure 9: View of the pesticide storage from the breeding pond

Results and risk assessment

Results of analyses proved that the powder in the torn bags in the ruined storage is essentially a raw pesticide DDT. The sample contained in total 647 g of pesticides per kg, majority of them was formed by 4,4-DDT (515 g/kg), and 2,4-DDT (100 g/kg). Further, the sample contained by-products and decomposition products of DDT, including predominantly DDD and DDE, the toxicity of which is similarly high as in the case of DDT. The estimated stored amount is in the order of hundreds of kilograms.

The rusted-through barrels contain wastes contaminated by DDT. The fertilizers stored in the big storage come in contact with spilled pesticide residues, and with raw pesticides in inadequate packaging. In the material swept under the barrels with pesticides, high concentrations of DDT, DDD and DDE were found, in the order of tens g/kg. Also the plasters in the storage are contaminated, predominantly by DDT.

The risk is obvious at first sight, because the building where pesticides are deposited is ruined, and without a roof. Only parts of walls remained of the building. The pesticides are deposited, practically, in open landscape. Rain and wind actions cause transport of pesticides into the surrounding landscape. This was confirmed also by the results of analysis of a soil sample from the vicinity of the storage. In total 280 mg of DDT, DDE and HCH per kg was found in this sample. This corresponds to values for a highly contaminated territory.

One of the further big risks is the possibility of contamination of breeding ponds in close vicinity of the storage. In view of the possibility of accumulation of these persistent pollutants in animal adipose tissues, it would be recommendable to carry out an analysis of fish meat.

Alaverdi

Sampling date: July 27, 2010

Several concrete structures are located in the locality, serving in particular for disposal of slag and fly ash from a nearby metallurgical plant processing copper ore. Some of the structures are already full, and covered by grass and shrubs. The disposal site is located in hilly area above the city Alaverdi.

Samples taken

3 samples of solid material were taken. A sample of metallurgical waste, and a sample of fly ash with slag, were taken in the structures. Further, a soil sample was taken in the vicinity under the disposal site.

Results and risk assessment

As expected, high percentage of metals, namely of copper, lead, zinc, cadmium, chromium and arsenic, was found in waste and slag from the metallurgical plant. However, high concentrations of heavy metals were found also in the soil sample taken in the distance ca 20 m from the disposal site, out of the actual disposal site area. The surrounding environment is contaminated in particular by lead, cadmium and arsenic. These hazardous substances are being washed out of the disposal site by rain precipitations, and are spreading downhill towards the city Alaverdi, the suburbs of which are located in the order of hundreds of metres from the disposal site. The neighbourhood of the disposal site is freely accessible.

Annexes

In the tables, the found out concentrations can be compared with pollution criteria for soils and underground water according to the Methodical Instruction of the Ministry of Environment of the Czech Republic. The amounts of pesticides in many localities exceed the criterion C several times.

Criterion A
For OCPs = 0.05 mg/kg of dry matter
Criteria A correspond approximately to natural content of the monitored substances in nature (in connection with the usual sensitivity limit of analytical determination). When criteria A are exceeded, it is regarded as pollution of the corresponding environmental component, with the exception of areas with naturally higher content of the monitored substances. However, if criteria B are not exceeded, the pollution is not regarded as significant to the extent that it would be necessary to obtain more detailed data for its assessment, i.e., to start investigation or to monitor the pollution.

Criterion B
For OCPs = 2 mg/kg of dry matter
Exceeding of criteria B is regarded as pollution that may have adverse impacts on human health and the individual environmental components. It is necessary to collect further data for assessment whether the case presents a significant environmental burden, and what are the risks connected with it. Thus, criteria B are set as intervention limits, exceeding of which means that it is necessary to deal with the pollution further. If criteria B are exceeded, it is necessary to preliminarily assess risks ensuing from the found out pollution, to determine its source and causes, and, depending on the results, to decide on further investigation or start of monitoring.

Criteria C
For OCPs:
residential areas: 2.5 mg/kg of dry matter
recreational areas: 5 mg/kg of dry matter
industrial areas: 10 mg/kg of dry matter
for sum of DDT and its metabolites - all land use areas: 2,5 mg/kg of dry matter
Exceeding of criteria C is regarded as pollution that may represent a significant risk of endangering human health and environmental components. Seriousness of the risk may be confirmed only by its analysis. Recommended values of target parameters for decontamination may be also higher than the stated criteria C, depending on the results of risk analysis. Documents necessary for deciding on the method of corrective measure are formed, in addition to the risk analysis, by studies evaluating technical and economic aspects of the proposed solution.

Criterion values are valid in case of OCPs for each pesticide separately.

However, not so strict criteria are valid in Armenia yet. When assessing the pollution level, the so-called Provisional Low POPS Content Level may be taken into consideration, this level being 50 mg/kg. The value 50 mg means weight of each pesticide contained in a sample separately.

Locality	Nubarashen							Criterion C
Sample	NV1	NV2	NV3	NV4	NV5	NV6	NV7	residential; recreational; industrial
Description	soil samples - first profile			soil samples - second profile		soil samples - third profile		
Depth (m)	0.5	1.0	1.5	0.5	1.0	0.5	1.0	
Substance	Content in dry matter (mg/kg d.m.)							
alpha-HCH	2.40	5.35	6.8	-	0.06	-	-	2.5; 5; 10
beta-HCH	1.37	1.61	0.87	0.03	0.04	-	0.01	2.5; 5; 10
gamma-HCH	0.49	0.06	0.01	-	-	-	-	2.5; 5; 10
HCB	1.23	0.50	0.30	-	-	-	-	2.5; 5; 10
heptachlor	0.06	0.01	-	-	-	-	-	2.5; 5; 10
heptachlor exo-epoxide	-	-	-	-	-	-	-	2.5; 5; 10
alpha-endosulfan	0.07	0.03	-	-	-	-	-	2.5; 5; 10
beta-endosulfan	-	-	-	-	-	-	-	2.5; 5; 10
dieldrin	-	-	-	-	-	-	-	2.5; 5; 10
endrin	-	0.02	0.07	-	-	-	-	2.5; 5; 10
2,4´-DDE	0.24	0.19	0.61	-	0.01	-	0.01	2.5; 5; 10
4,4´-DDE	1.37	1.30	2.40	0.03	0.09	0.02	0.08	2.5; 5; 10
2,4´-DDD	1.32	0.41	1.88	-	-	-	0.01	2.5; 5; 10
4,4´-DDD	4.15	1.52	13.36	0.04	0.02	0.01	0.02	2.5; 5; 10
2,4´-DDT	17.8	7.33	24.54	0.11	0.05	0.01	0.06	2.5; 5; 10
4,4´-DDT	148.31	64.18	214.12	0.79	0.35	0.08	0.59	2.5; 5; 10
Σ DDT	173.19	74.93	256.91	0.97	0.52	0.12	0.77	2.5
Total	178.10	82.51	264.23	1.1	0.62	0.13	0.79	

Table 1: Summarized results of analyses at Nubarashen dumping site – underground samples taken in three profiles down the hill from the dumping site. Samples were taken from the drill hole.

Locality	Nubarashen										Criterion C
Sample	N1	N2	N3	N4	N5	N6	N7	N8	N9	NS	residential; recreational; industrial
Description	soil samples - surface										
Substance	Content in dry matter (mg/kg d.m.)										
alpha-HCH	248.36	0.12	0.72	10.90	0.07	0.77	0.21	0.12	0.11	-	2.5; 5; 10
beta-HCH	45.50	-	2.11	14.75	0.03	2.3	0.12	0.42	0.05	0.01	2.5; 5; 10
gamma- HCH	67.94	0.01	-	2.19	0.00	-	0.02	0.02	0.02	-	2.5; 5; 10
HCB	9.80	-	0.30	3.92	-	0.34	0.17	-	-	-	2.5; 5; 10
heptachlor	-	-	-	-	-	-	-	-	-	-	2.5; 5; 10
heptachlor exo-epoxide	-	-	-	-	-	-	-	-	-	-	2.5; 5; 10
alpha-endosulfan	-	-	-	-	-	-	-	-	-	-	2.5; 5; 10
beta-endosulfan	-	-	-	-	-	-	-	-	-	-	2.5; 5; 10
dieldrin	-	-	-	-	-	-	-	-	-	-	2.5; 5; 10
endrin	2.17	-	-	-	-	-	-	-	-	-	2.5; 5; 10
2,4´-DDE	30.81	5.95	1.4	7.58	-	0.48	0.68	-	0.38	-	2.5; 5; 10
4,4´-DDE	30.49	30.69	5.57	27.51	0.03	2.33	4.97	0.14	5.80	-	2.5; 5; 10
2,4´-DDD	36.57	0.39	1.13	11.85	-	1.8	0.28	0.07	0.07	-	2.5; 5; 10
4,4´-DDD	152.93	0.18	4.24	51.47	-	4.3	0.78	0.28	0.06	0.01	2.5; 5; 10
2,4´-DDT	664.89	3.63	15.69	177.19	0.01	16.57	4.60	0.89	1.00	-	2.5; 5; 10
4,4´-DDT	4045.22	6.45	115.31	1250.78	0.04	100.25	18.5	5.13	1.87	-	2.5; 5; 10
Σ DDT	4960.91	47.29	143.34	1526.38	0.08	125.73	29.81	6.51	9.18	0.01	2.5
Total	5334.68	47.30	146.11	1558.15	0.19	127.89	29.87	7,05	9.35	0.02	

Table 2: Summarized results of analyses at Nubarashen dumping site – surface layer samples taken in several profiles down the hill from the dumping site.

Locality	Echmiadzin				Criterion C	Echmiadzin
Sample	E1	E2	E3	E4	residential; recreational; industrial	EV
Description	storage 1 - sweepings	storage 2 - sweepings	patch near the storage - soil	trout pond - sediment		trout pond - water
Substance	Content in dry matter (mg/kg d.m.)					µg/kg
alpha-HCH	2.27	7.36	0.06	0.06	2.5; 5; 10	0.29
beta-HCH	34.95	7.17	0.05	0.05	2.5; 5; 10	-
gamma-HCH	31.73	-	-	-	2.5; 5; 10	-
HCB	1.1	41.92	-	-	2.5; 5; 10	0.02
heptachlor	-	4.13	-	-	2.5; 5; 10	-
heptachlor exo-epoxide					2.5; 5; 10	
alpha-endosulfan	15.31	329.25	-	-	2.5; 5; 10	-
beta-endosulfan	-	106.81	-	-	2.5; 5; 10	-
dieldrin	-	3.28	-	-	2.5; 5; 10	-
endrin	-	83.93	-	-	2.5; 5; 10	-
2,4´-DDE	0.52	361.72	-	0.01	2.5; 5; 10	-
4,4´-DDE	0.73	499.81	0.03	0.01	2.5; 5; 10	-
2,4´-DDD	-	30.90	0.04	-	2.5; 5; 10	-
4,4´-DDD	0.35	279.45	-	-	2.5; 5; 10	-
2,4´-DDT	2.30	610.22	0.01	-	2.5; 5; 10	-
4,4´-DDT	8.55	-	0.02	-	2.5; 5; 10	0.01
Σ DDT	12,45	1782,10	0,10	0,02	2.5	0.01
Total	97.72	2358.57	0.20	0.13		0.31

Table 3: Results of analyses for samples taken in obsolete pesticides storage near Echmiadzin and its vicinity.

Locality	Masis					Criterion C
Sample	M1	M2	M3	M4	M5	residential; recreational; industrial
Description	storage 1 - sweepings	storage 1 - pink material	sotrage 2 - sweepings	storage 1 and 2 - plaster	vicinity of the storages - soil	
Substance	Content in dry matter (mg/kg d.m.)					
alpha-HCH	6.65	4145.98	1.44	4.19	0.06	2.5; 5; 10
beta-HCH	10.35	4795.80	4.1	30.12	0.20	2.5; 5; 10
gamma-HCH	1.51	3587.43	7.84	0.26	0.01	2.5; 5; 10
HCB	0.03	25.98	0.15	-	-	2.5; 5; 10
heptachlor	-	26.29	-	-	-	2.5; 5; 10
heptachlor exo-epoxide	-	3.83	-	-	0.01	2.5; 5; 10
alpha-endosulfan	-	24.22	-	-	0.02	2.5; 5; 10
beta-endosulfan	8.2	5.1	1.13	0.20	0.19	2.5; 5; 10
dieldrin	1.1	1.85	-	-	0.07	2.5; 5; 10
endrin	-	-	-	-	-	2.5; 5; 10
2,4´-DDE	45.11	10.42	4.65	0.40	0.07	2.5; 5; 10
4,4´-DDE	55.70	8.88	6.34	0.73	0.58	2.5; 5; 10
2,4´-DDD	5.60	9.92	5.18	0.59	0.19	2.5; 5; 10
4,4´-DDD	1.67	12.31	0.99	0.94	0.02	2.5; 5; 10
2,4´-DDT	70.59	31.57	4.76	3.97	0.14	2.5; 5; 10
4,4´-DDT	18.72	14.74	11.17	16.52	0.38	2.5; 5; 10
Σ DDT	197,39	87,84	33,09	23,15	1,38	2.5
Total	224.96	12704.23	47.67	57.91	1.94	

Table 4: Results of analyses for samples taken in obsolete pesticides storage in Masis and its vicinity.

Locality	Jrarat								Criterion C
Sample	J1	J2	J3	J4	J5	J6	J7	J8	residential; recreational; industrial
Description	big storage – sweepings from the floor	big storage - sweepings under barels	big storage - powder from the cover of the barrels	big storage - plaster	vicinity of the big storage - soil	small storage without a roof - mixed sample from the bags	small storage without a roof - mixed sample from the barrels	vicinity of the small storage without a roof - soil	
Substance	Content in dry matter (mg/kg d.m.)								
alpha-HCH	0.67	14.41	0.26	-	0.06	210.99	0.75	7.55	2.5; 5; 10
beta-HCH	0.25	19.25	0.74	-	0.08	19.25	3.14	13.42	2.5; 5; 10
gamma-HCH	-	377.46	0.27	-	-	1609.47	0.47	1.30	2.5; 5; 10
HCB	-	-	0.05	-	-	-	0.36	-	2.5; 5; 10
heptachlor	-	-	-	-	-	-	28.40	-	2.5; 5; 10
heptachlor exo-epoxide	0.03	-	-	-	-	-	-	-	2.5; 5; 10
alpha-endosulfan	-	-	-	-	-	-	-	-	2.5; 5; 10
beta-endosulfan	0.02	16.68	-	-	0.02	16.68	12.00	-	2.5; 5; 10
dieldrin	-	0.24	-	-	-	0.24	-	-	2.5; 5; 10
endrin	-	-	-	-	-	-	-	-	2.5; 5; 10
2,4´-DDE	0.07	78.03	-	-	0.10	204.56	153.10	9.6	2.5; 5; 10
4,4´-DDE	0.19	430.01	0.94	0.18	0.26	1925.96	474.67	40.94	2.5; 5; 10
2,4´-DDD	0.05	1704.72	-	0.23	0.04	5286.43	31.54	4.21	2.5; 5; 10
4,4´-DDD	0.32	6256.25	-	-	0.01	23087.13	18.4	10.10	2.5; 5; 10
2,4´-DDT	0.30	5855.78	15.16	1.68	0.06	99479.88	332.87	30.3	2.5; 5; 10
4,4´-DDT	0.49	12485.27	70.32	9.14	0.12	515918.01	297.49	163.46	2.5; 5; 10
Σ DDT	1,42	26810,06	86,42	11,23	0,59	645901,97	1308,07	258,61	2.5
Total	2.40	27238.09	87.76	11.22	0.75	647758.6	1352.83	280.06	

Sample	A1	A2	A3	Criterion	A	B	C	C	C

Locality	Alaverdi								
Description	solid waste from metallurgical plant	fly ash, slag	soil, vicinity of the disposal site	Land use specification	-	-	residential	recreational	industrial
Substance	Content in dry matter (mg/kg)			Limit values	Content in dry matter (mg/kg)				
Pb	12060	19820	1374	Pb	80	250	300	500	800
Zn	155	2644	133	Zn	150	1500	2500	3000	5000
Cu	48120	61170	1022	Cu	70	500	600	1000	1500
As	1765	7514	453	As	30	65	70	100	140
Cr	112	92	59	Cr	130	450	500	800	1000
Fe	21000	174800	99700	Fe	-	-	-	-	-
Cd	12	94	1.3	Cd	0,5	10	20	25	30

EUROPEAN UNION

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