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Environmental pollution of Novi Sad and its surroundings and health risks

ABSTRACT

The work presents data on pollution of water, air, and soil of the city of Novi Sad area as a consequence of the NATO bombing. Because of the destruction of the Novi Sad Oil Refinery, large amounts of crude oil were spilt out, so that increased contents of crude oil and its derivatives (mineral oils), oil hydrocarbons and polycyclic aromatic hydrocarbons (PAH) were registered in the soil and water samples, whereas in the air, there were the products of incomplete combustion of crude oil and its derivatives determined. Also, tests of radioactive contaminants in the environment components were carried out. Besides that, the data on pollution of the Tisa river after the accident in the gold mine Baja Mare (Romania) were presented. All these findings suggest the existence of serious health risks and potentially increased incidence rate of cancer in future.

Key words: *Air pollution; Mineral oils; Oil hydrocarbons; PAH; Radioactivity*

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INTRODUCTION

In the course of NATO aggression, the "Novi Sad" Oil Refinery was bombed 12 times with about 270 missiles. By destroying the factory installations, 73569 t of crude oil were lost, of which 90% burnt down, 5600 t were discharged into the Danube, and the rest was spilt over the soil of the Refinery area. The soil layer contained in average 67 g/kg of crude oil and oil derivatives, whereas the layers beneath it, above the groundwater table, contained free oil derivatives in the amount of 56 ml/l of the drained water.

In the Danube sediment, polycyclic aromatic hydrocarbons (PAHS) were found in the amounts of 0.266-123.5 mg/kg, while the contents of other oil derivatives were 219-293 mg/kg. Based on a model, an estimation gave the following data for the air emission (in tons): SO_2: 820; NO_x: 150; PAB: 18; elemental carbon: 114, and total organic carbon: 183.

The daily dosimetric control and complete gamma-spectrometric analysis of more than 60 samples (shell fragments, soil, plant material, surface and drinkable water, and food) in the city of Novi Sad and its surroundings revealed no increased level of the natural radioactivity.

The recent environmental accident, the discharge of cyanides and heavy metals from the gold mine at Baja Mare (Romania) to the Tisa river caused the fish kill and deposition of heavy metals in the river sediment, which endangered the living world and will represent a danger to people as the terminal trophic level of the food chain. The analysis of the Tisa water at the Hungarian-Yugoslav border profile gave the following data (mg/l): CN 2.5, Mn 0.35, Zn 14, Cu 1.4, Pb 0.14, and Cd 0.02.

THE CONSEQUENCES OF THE NATO BOMBING TO THE NOVI SAD ENVIRONMENT

The city of Novi Sad was the place which experienced the gravest consequences upon the normal life of an urban area in the NATO bombing of the FR Yugoslavia. During the 78 days of intensive bombing, Novi Sad was under attack of NATO missiles on 36 days. Many residential and public buildings, as well as the economic complexes and the city infrastructure, were destroyed or damaged. All the Danube bridges, connecting Novi Sad to its parts on the Srem side, were destroyed.

Destruction of the Novi Sad Refinery

The destruction of the Oil Refinery was not in the function of incapacitating its production but it was a classical example of destroying an economic facility. This represents a unique example in the world of destroying the chemical industry with a great risk of causing an acute catastrophe and long-term environmental risk.

The NIS Oil Refinery "Novi Sad" is a company engaged in the processing of crude oil to obtain fuels, lubricants, and bitumen. The Refinery, since its foundation in 1969, when the first plant for atmospheric oil distillation was installed, to its destruction in 1999 has recorded a constant increase in both the production output and assortment. The construction of new plants and installations in the course of 30 years has resulted in the production capacity of processing of 2.5 mln tons of crude oil per year. The Refinery was designed to cover both the energy and oil program, including bitumen production. The construction of the production capacities has been paralleled with constructing the necessary enviromnent-protecting facilities.

Table 1. Chronology of NATO bombing of the NIS Oil Refinery "Novi Sad"

Attack No.	Date	Time	Number of missiles
I	5 April	22.00	2
II	7 April	2.44	2
III	12 April	22.00	2
IV	15 April	22.50	3
V	17/18 April	22.49 and 0.15	8
VI	24 April	3.18	8
VII	28 April	13.30	2
VIII	29 April	1.07	4
IX	29 April	23.38	3
X	2/3 May	23.50 and 0.10	108
XI	24 May	15.40	8
XII	7/8 June	23.50 and 0.10	120

The Oil Refinery "Novi Sad", is located in the Sever IV industrial zone of the city of Novi Sad, and it represents a complex of processing and appurtenant facilities, accompanying storing capacities, auxiliary premises, and other concomitant structures. The total Refinery area covers about 250 ha. Apart from the Refinery, in the Sever IV zone there are the constructions of the thermoelectric and heat generating plant,

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pier, and the "Novi Sad" harbor. To the downstream, on the Danube left bank, in a close vicinity of the Refinery, there is the water supply source "Ratno ostrvo" (War Island), feeding the city waterworks. The sewage system is located, in the area of water supply source, collecting the wastewaters from the Refinery and atmospheric waters from the Sangaj settlement, as well as the discharge site of the sewage collector Sever IV. Before the destruction of the Refinery, the possibility of polluting the local groundwater existed, which, in 30 years of work had been prevented by the appropriate measures undertaken by the Refinery (Boškov et al, 1999).

In the course of NATO aggression, the Refinery installations were hit in 12 attacks with about 270 missile of great destructive power. Table I gives the chronological survey of these attacks.

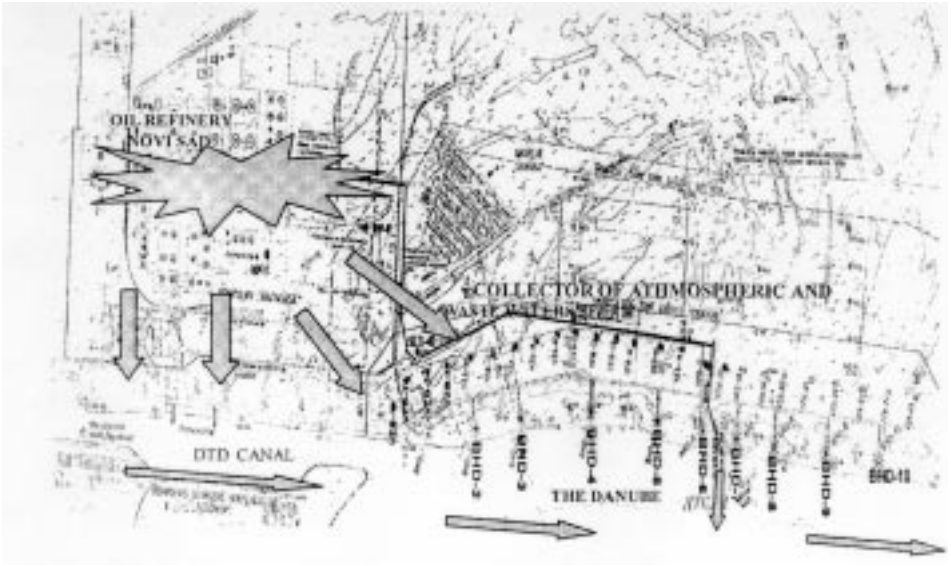

Figure 1. Possible influence of the crude oil and oil derivatives on the water supply source
→ Direction of spreading of the oil from the Refinery in the groundwater and from the collector "Sever IV" to the Danube. Ranney wells: BHD-2; BHD-3; BHD-4; BHD-5; BHD-6; BHD-7; BHD-8 and BHD-9 and the well under construction BHD-10 Black spots around the collector represent the piezometers

The bombing of the Refinery caused destruction or damage of the processing installations and of the large part of storing capacities. The attacks were accompanied by partial spill of crude oil and derivatives over the soil of the Refinery area. The spillage was especially intensive after the "carpet" bombing that took place on May 2 and June 7. As mentioned above, the total amount of crude oil destroyed was 73.569 t, 90% of which burned, more than 5600 t reached the Danube, and the rest was spilt over the soil of the Refinery area.

After the first strike on the Refinery on April 5, 1999, and especially after the subsequent strikes, the spilt oil derivatives have endangered seriously the environment. In addition to the heavy air pollution caused by partial oil combustion, the Refinery accident has significantly endangered the quality of soil, groundwater and surface water. It should be specially pointed out that the water supply source "Ratno ostrvo" is in the hinterland of the Refinery. Presently, it ensures about 50% of drinking water for the city of Novi Sad, which is to increase in future to 70%. The undertaking of the necessary measures of protection and revitalization of this area required organization of a complex and comprehensive monitoring system. The possible effect of the spilt crude oil and oil derivatives can be seen from Figure 1.

The objective of organizing the emergency monitoring system at the "Ratno strvo" water supply source was to survey the current state there and undertake the appropriate measures in regard of restricting the spread of pollution after the bombing of the Refinery. When the NATO aggression ceased, the monitoring activities were continued as a systematic research involving the analyses of water from the piezometric network, wells, and shallow borings in the area of the water supply source, as well as of the Danube water and sediment. The investigations have also encompassed the Refinery area. The hydro-geological and chemical analyses carried out in the frame of this monitoring system will serve to establish the possible spreading of the potentially present pollutants and undertaking the appropriate measures. This article presents only a part of the results obtained up to now.

Contamination of the Refinery soil

While the aggression lasted, it was not possible to carry out the soil analyses. When the war actions stopped, all the sites of crude oil and derivatives were identified (Figure 2), noting down data on the nature of the pollutant, its amount, and the area of the contaminated soil.

Figure 2. Survey of the locations of contaminated soil

The total area of contaminated soil was 85524 m^2, amount of the spilt oil derivatives 5602 t, and volume of the contaminated soil was about 40000 m^3.

Contents of oil and oil derivatives in the soil samples taken from the Refinery area were in the range from 3 to 42325 mg/kg. The most endangered appeared to be the four locations, namely the sites of the spillage of crude, vacuum distillate, gasoline, and of diesel fuel (Dalmacija et al, 1999).

Influence of the spilt oil on the quality of Danube water and sediment

To analyze oil contents in the Danube water we chose the profiles close to the Ranney well BHD-2, location at the sewage water discharge site, by the Ranney wells BHD-7, BHD-8, BHD-9, and by the Ranney well under construction BHD-10. As control profiles we took those at the Futog settlement, Novi Sad beech Strand, and at the site where the DTD Canal empties into the Danube. Samples were taken on May 5, June 13, August 23, and October 4, 1999. The results are illustrated in Figure 3.

It was found that the concentrations of oil and oil derivatives in the Danube water were significantly lowered in comparison to the time of accident (May 5). If we regard the profile at the Ranney well BHD-7, i.e. the site downstream of the sewage discharge point, it is evident that the quality of the Danube water has improved since the time of the Refinery destruction.

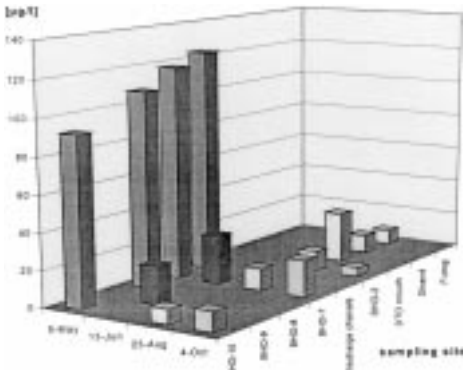

Figure 3. Contents of oil and oil derivatives in the Danube by the water supply source "Ratno ostrvo"

Sediment samples were taken on May 5, 1999 from the Danube bottom, at the river left bank, in front of the Ranney wells BHD-6, BHD-7, BHD-8, BHD-9, and at the well under construction BHD-10 and at the sewage discharge collector Sever IV, at about 10-m distance from the bank at a depth 2.5 m, and at the Danube water level of 437 cm. Sediment was sampled in two ways: by the Eckman sampler (sediment surface) and with the aid of the pipe penetrating to the deeper layers of the Danube bottom. At the location of the BHD-10 well, samples of the

surface and depth sediment were mixed to form a unique sample. Afterwards, sediment samples were taken on June 13, 1999 at the locations of Ranney wells BHD-7 and BHD-9, on August 23, 1999 at the same locations as on May 5, 1999 excluding the sewage discharge site, and on October 4, 1999 at the locations of the Ranney wells BHD-7 and BHD- 10.

Contents of mineral oil in the samples were determined by IR spectrometry after sediment extraction in the Soxhlet apparatus with carbon tetrachloride (Eaton et al, 1995; Škunca-Milovanović et al, 1990). The results are presented in Table 2.

It is evident from the results that the highest content of mineral oil was determined in the samples taken on May 5, 1999 at the location of sewage discharge site Sever IV and in front of the Ranney well BHD-7. In the deeper sediment samples, contents of mineral oils were much lower. By inspecting the results it can be seen that the concentrations of mineral oils decreased in the time after the bombing of the Refinery.

Table 2. Contents of mineral oils in the Danube (sampling date: *June 13, 1999; **August 23,1999; ***October 4, 1999)

Sampling site (Ranney well)	Mineral oil content (mg/kg) Surface sediment	Depth sediment
BHD-6	175	24
BHD-6**	14	11
BIID-7	219	28
BHD-7*	17	
BHD-7**	39	17
BHD-7***	48	
BHD-8	130	33
BHD-8**	18	
BHD-9	110	58
BHD-9*	51	
BHD-9**	15	17
BHD-10	30	
BHD-10**	11	
BHD-10***	25	
DISCHARGE SITE	293	34

Sampling date: *June 13, 1999; **August 23, 1999; *** October 4, 1999

With the aim of monitoring contents of the extremely toxic components of oil and oil derivatives, quantitative GCIMS analyses of samples on 16 polycyclic aromatic hydrocarbons from the EPA (Environmental Protection Agency) priority pollutant list (Eglinton, 1975; Boranic et al. 1968; Neilson 1998) were carried out in the time period from May 5 to October 4. We determined the contents of naphthalene, acenaphthylene, acenaphthene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, benzo[k]fluoranthene, benzo[a]pyrene, dibenzo[a,h]pyrene, benzo[g,h,i]perylene, and indeno[1,2,3-cd]pyrene. Among them, benzo[a]pyrene, fluoranthene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene and indeno[1,2,3-cd]pyrene are especially harmful to the environment because of their proved carcinogenicity.

The analyses were carried out by internal standard method (Desideri et al., 1984), which allowed the determination of concentrations of the extremely toxic components present in the sediment samples.

The results for particular PAHs are given in Table 3, while the PAH sums are presented in Figure 4. The PAH concentrations are expressed per mass of dry sediment.

Table 3. PAH contents in the Danube sediment samples

Polycyclic aromatic hydrocarbon	Sampling site (Ranney well) PAH content (μg/kg)													
	BHD-6		BHD-7				BHD-8		BHD-9			BHD-10		
Sampling date	5.5.	23.8.	5.5.	13.6.	23.8.	4.10.	5.5.	23.8.	5.5.	13.6.	23.8.	5.5.	23.8.	4.10.
Naphthalene														
Acenaphthylene														
Acenaphthene														
Fluorene														
Phenanthrene	14		4773	43	92	44		39	38	14	24			
Anthracene			2.0				15							
Fluoranthene	32	14	963	138	117	19	52	33	72	44	45	traces		45
Pyrene	118	11	2939	533	71	21	223	24	356	228	25	3.1		20
Benzo[a]anthracene	32		901	223	94	23	131	18	579		23	3.8		
Chrysene	33		1115	223	193	52	59	26	9.1		38		11	38
Benz[b]fluoranthene	16		36,679	161	34	7.4	22	6.6	30	17	12	3.8	2.9	8.5
Benz[k]fluoranthene	16		36,679	161	34	7.4	22	6.6	30	17	12	3.8	2.9	8.5
Benz[a]pyrene	2.8		60,567	124	9.1	9.1	7.3		67	34	18	traces		7.3
Dibenzo[a,h]anthracene	15		12,438	359			51		157	126		traces		
Benzo[g,h,i]perylene			2091	112	134	15		19	39	44				
Indeno[1,2,3,-cd]pyrene	2.7		992	30	9.7	2.0	5.6		13	16	4.5	traces		
Sum	266	25	123,460	1946	754	193	566	166	1360	637	190	11	14	119

Presence of PAH was established for each sample and the highest contents were determined in the samples taken on May 5, 1999 at the locations in front of the Ranney wells BHD-7, BHD-9, BHD-8, at the sewage discharge site, and the well BHD-6. The lowest PAH content was found at the location of the Ranney well under construction BHD-10, which is understandable having in mind the distance from the sewage discharge site. Extremely high PAH contents were determined in the sediment samples taken from the location in front of the Ranney well BHD-7: the total PAH content in this sample was 123460 μg/kg, the carcinogenic components making 101292 μg/kg.

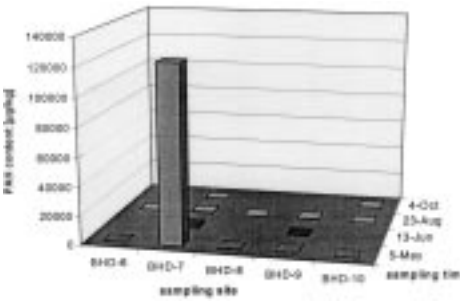

Figure 4. Total PAH contents in the Danube sediment

By comparing the results obtained from the samples taken during and after the bombing of the Refinery destruction it can be concluded that PA-H contents decreased significantly. The exception is the sample BHD- 10 taken on October 4, 1999, in which an increased concentration was observed. This can be explained by the fact that the sampling location is relatively far away in the downstream direction from the sewage discharge site and by the possibility of the sediment movement along the river bed.

Groundwater quality at the location of water supply source "Ratno ostrvo"

In the space between the border of the Refinery complex and the water source "Ratno ostrvo" the quality of water of the aquifer A has worsened as a consequence of the Refinery destruction and spillage of crude oil and oil derivatives. In Figure 2 the sites of uncontrolled spillage of crude and oil derivatives (dark areas) are presented, as well as the directions of their spreading towards the water source for supplying the city of Novi Sad with drinkable water.

The background value of the mineral oils content registered in the water of aquifer A in the period from August 1 to November 1, 1999 was about 20 μg/1 (Figure 5).

Quantitative GCIMS analysis was carried out of the groundwater samples taken at the location along the Refinery fence in the direction of water supply source during March 6-8, 2000, to check the presence of phenols, hydrocarbons, aromatic and polycyclic aromatic hydrocarbons. The results are presented in Table 4.

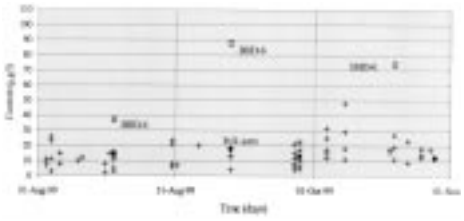

Figure 5. Ranges of measured contents of mineral oils at the location of water supply source "Ratno ostrvo" in Novi Sad in 1999

The results show the presence of substantial amounts of toxic components in the groundwater. A detailed investigation yielded the assessment of the time span of the pollution propagation in the direction of water supply source and the direction of DTD Canal of about 40 months (Figure 2).

The air pollution

On the basis of the constructed model it was possible to assess the level of emission into air of the gaseous pollutants and airborne particles, formed as a consequence of burning of the crude oil and oil derivatives from the Refinery. The results are presented in Table 5.

On the territory of the city of Novi Sad, maximum concentration of sulfiir dioxide of 380 μg/m^3 was registered on the Bistrica location on May 3, 1999, whereas the maximum lead concentrations of 543 μg/m^3 and 801 μg/m^3 were registered on the location of MZ Klisa and in Kać in May 1999 (Sokolović et al, 2000).

Table 4. Contents of phenols, chlorinated hydrocarbons, aromatic and polycyclic aromatic hydrocarbons in the water from the piezometers placed along the Refinery fence

Compound	Unit	Piezometer			
		PJC-3	PJC-2	PZ-2	SLO-40
Phenol	µg/1	<1	<1	<1	<1
Chlorinated hydrocarbons					
1,2-Dichlorethane	µg/1	25	9.0	3.0	5.0
Chloroform	µg/1	1.0	1.0	1.0	ND
Trichlorethane	µg/1	0.5	1.8	2.1	ND
Aromatic hydrocarbons					
Benzene	µg/1	1.0	1.2	traces	traces
Toluene	µg/1	0.8	1.0	traces	traces
Xylene	µg/1	traces	traces	traces	ND
PAHs					
Naphthalene	µg/1	0.0015	ND	ND	ND
Fluoranthene	µg/1	0.0001	traces	0.0001	0.0001
Pyrene	µg/1	0.0007	traces	0.0001	0.0004
Benzo[a]anthracene	µg/1	ND	ND	ND	
Chrysene	µg/1	ND	ND	ND	0.0008

ND-not detected; traces – ion identified, but the signal intensity allowed no quantification

Table 5. Results of the assessment of the amounts of pollutants emitted into the air after the burning of oil derivatives

Substance	Amount emitted to air (t)
SO_2	820
NO_x	15
Carbon, elemental	114
Arbon, organic	183
PAHs	18

RADIOACTIVITY LEVEL IN NOVI SAD AND THE SURROUNDINGS DURING THE NATO AGGRESSION

Since the first days of bombing, and especially after indications of the use of the ammunition containing depleted uranium, radioactive control of contamination of the components of the Novi Sad environment was carried out.

This control encompassed:

- field measurements of exposure dose and
- laboratory measurements by low-background γ- spectrometry.

Exposure dose in the air at different location of Novi Sad was systematically measured three times a day. No increased values compared with the background level, which, for the SGM-29 instrument is 34 pGy/s, were registered. The values of exposure dose were also systematically checked at all critical points after the missile strike, and the measured values did not exceed the given background level.

In Tables 6 and 7 there is given a survey of the results of the analysis of radioactivity level obtained for the environmental samples taken in the course of NATO aggression and in time after that.

The results showed that on the territory of Novi Sad city and its surroundings, no ammunition containing depleted uranium was used. As a consequence of a large number of takeoffs of NATO planes, numerous explosions, and extremely high air pollution caused by burning down of crude oil in the damaged refineries, serious disturbances of equilibrium in the atmosphere, along with substantial climatic changes have taken place. The manifold increase in the rainfall compared with the long-term average values for this territory resulted in the appearance of an increased level of activity concentration of cosmogenic, natural radionuclide ^{7}Be, so that after ample raining, foliar deposition of this nuclide has been registered, especially with the leafy vegetables (lettuce, spinach, etc).

Table 7. Results of γ-spectrometric analysis of water samples from the territory of Novi Sad and its surroundings during, and immediately after the NATO aggression

Sample	Activity concentration [Bq/m^3]				
	^{238}U	^{226}Ra	^{232}Th	^{7}Be	^{137}Cs
1. Water from the crater (Ribnjak) (August 1999)	<6	<2	<26	<11	<2
2. Water from the supply well (April 1999)	<7	<5	<4	<11	<1
3. Water from the supply well (April 1999)	<8	<7	<5	<11	<2
4. Water from the supply well (April 1999)	<8	<4	<3	<11	<1
5. Tap water (March 1999)	<4	<2	<2	<11	<1
6. Tap water (April 1999)	<4	<5	<2	<15	<2
7. Tap water (May 1999)	<4	<6	<2	<12	<1
8. Tap water (June 1999)	<4	<2	<3	<8	<1

CONTENTS OF CYANIDES AND HEAVY METALS IN THE TISA RIVER IN THE PERIOD OF THE ACCIDENTAL POLLUTION WAVE

The results of determining the cyanide contents in the Tisa river are presented in Figure 6. The highest cyanide concentration in the Yugoslav part of Tisa of 2.5 mg/1 was registered at the Martinos profile. The maximum contents of metal ions (mg/1) were as follows: Mn: 0. 3 5; Zn: 0. 14; Cu: 1.4; Pb: 0. 14 and Cd: 0. 02.

The wave of accidental pollution by high cyanide concentrations caused a severe fish kill.

Table 6. Results of γ-spectrometric analysis of soil samples on the territory of Novi Sad and the surroundings obtained in the course and after the NATO aggression

Sample	Activity concentration [Bq/kg]					
	^{238}U	^{226}Ra	^{232}Th	^{40}K	^{7}Be	^{137}Cs
1. Soil at the TV N. Sad-1 (June 1999)	<26	23.4±1.2	31±10	382±13	<23	<0.27
2. Soil at the TV N.Sad-2 (June 1999)	25±9	27.9±1.2	37.0±1.5	479±21	<40	0.6±0.4
3.Soil from the Refinery (tank) (April 1999)	11±6	10.6±0.4	11.0±0.5	219±11	<23	0.8±0.2
4.Soil from the Refinery (Gate 4) (April 1999)	20±6	18.7±0.5	20.3±1.1	281±17	<24	1.0±0.4
5. Soil from the Refinery (Oil Plant) (May 1999)	20±8	16.1±0.7	17.5±1.1	312±21	<24	0.5±0.3
6. Soil from the Refinery (Workshop) (May 1999)	20±11	12.5±0.6	12.3±1.1	273±14	<20	3.2±06.
7. Soil from the Ribnjak Settlement (Avgust 1999)	24±1	23.2±2.0	39.3±2.4	380±60	<14	<0.4
8. Soil at the TV tower on the Iriški Venac (June 1999)	12±5	19.5±0.4	24.1±0.7	325±13	<1.9	0.6±0.1
9. Soil, EPS Health Center on Iriški Venac (sept. 1999)	27±20	30.3±0.9	41.8±2.2	434±23	<24	<0.4
10. Concrete of the Žeželj Bridge (April 1999)	14±5	10.4±0.3	10.9±0.8	151±10	<27	0.7±0.2
11. Sands, Naftagas (September 1999)	19±11	17±1	3±2	290±20	3±2	0.8±0.4
12. Soil, Iriški Venac 1a (Septembar 1999)	80±30	46±2	62±4	560±50	<3	27±2
13. Soil, Iriški Venac 1b (September 1999)	56±23	54±3	49±3	450±40	<23	86±5
14. Soil, Iriški Venac 2 (September 1999)	80±30	46±2	62±4	580±40	<3	27±2
15. Soil, Iriški Venac 7 (September 1999)	64±20	41±2	60±3	730±40	<4	29±2
16. Soil, Iriški Venac 8 (September 1999)	80±30	52±3	58±4	560±50	<15	87±7
17. Soil, Iriški Venac 10 (September 1999)	35±27	138±7	44±4	440±70	<30	188±13
18. Soil, Iriški Venac 12 (September 1999)	54±17	39±2	55±4	680±40	<8	188±8
19. Sediment, DTD Canal, mouth to the Danube (September 1999)	33±10	31.3±1.4	30±2	459±27	41±20	25.1±1.6
20. Sediment, the Danube-Subić (September 1999)	55±10	49±2	32±2	408±29	<30	46±2

Comparative analysis of the soil sample from the endangered area:
*Bratoselce (Oct. 7, 1999) 2100±190 126±6 73±4 1180±60 <30 13±1

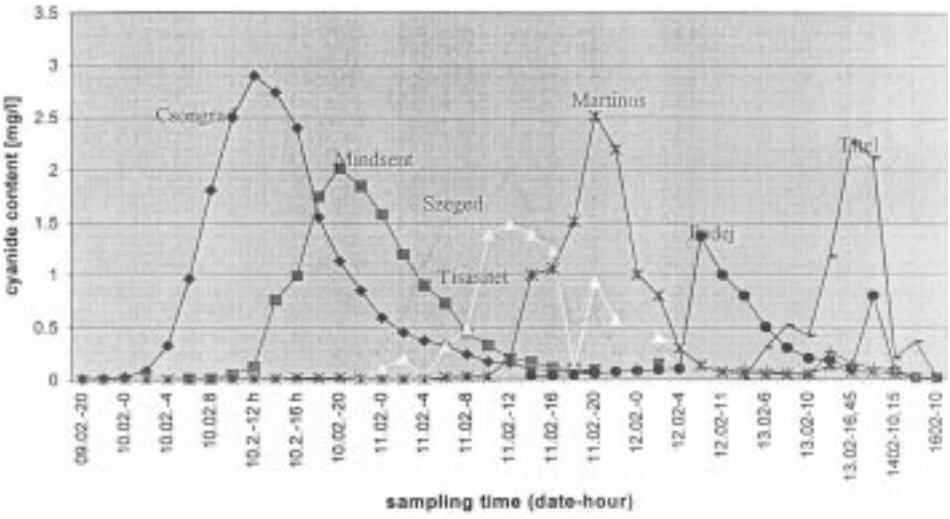

Figure 6. Results of measuring cyanide content in the Tisa river

The major portion of heavy metals has been retained by the Tisa sediment on the Hungarian territory. These metals, under the influence of various organic matter (e.g. humic matter), will be transformed into their soluble forms and they will permanently affect the living world in the water and, through the food chain, will reach people.

CONCLUSION

The results obtained by analysing samples of the Danube water and sediment show a decrease of the contents of crude oil and oil derivatives in the water in the period after the Refinery bombing, as concluded by monitoring the profile by the Ranney well BHD-7 (downstream of the sewage discharge site).

By analysing the Danube sediment a decrease of the contents of mineral oils and very toxic PAHs was also observed in the same period, which can be explained by the sediment movement downstream along the left Danube bank.

The contents of mineral oils in the aquifer water at the water supply source "Ratno ostrvo" in the period from August 1 to November 1, 1999 indicate the deterioration of its quality.

By sampling groundwater in the period of 6-8 March 2000, the presence of toxic components in the water at the location along the Refinery fence in the direction of water supply source was found. On the basis of this, the hydrogeological estimation gave a time period of pollutants penetration of about 40 months.

In the view of the above, it is necessary to carry out monitoring of the state of the environment on the endangered location in the course of a long period of time, as the oil pollution can have very severe consequences.

An estimation has been made of the amounts of pollutants formed by the incomplete combustion of oil derivatives on the territory of the city of Novl Sad in the course of the Refinery bombing.

On the basis of the results of the analysis of radioactivity levels in the environmental samples, an increased activity concentration of the cosmogenic, natural nuclide ^{7}Be was found.

The results related to the environmental accident of the discharge of cyanides and heavy metals from a gold mine in Romania into the Tisa river indicate the potential danger to the living world in the river and, consequently, to people as the last trophic level in the food chain.

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