

## SOIL QUALITY AFTER THE CLOSURE OF THE ACTIVITY ON SC SIN SA BUCHAREST

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**Key words:** soil, environmental survey, heavy metals

**Abstract:** paper presents the impact of the activity SC SIN S.A. on soil from the emplacement. The material is based on a environmental study performed at the closure of the activity on SC SIN SA BUCHAREST. On this location soil cover is represented by Anthropic Regosol (RG ah), and the soil is characterized by the presence of various building materials such as debris of bricks, sand, scrap of masonry etc. The specific activity - processing of the fats – do possible that the society to pollute the soil with organic compounds and resulted in very high organic carbon content in some points on the emplacement. In some points was a significant pollution of the soil with zinc and cadmium (with values over intervention threshold for less sensitive use). Here was recommended an intervention. After depollution, total content of Zn and Cd was situated this time below the intervention threshold for less sensitive use. Since the free surface of the unit was covered mostly concrete, excepting small green spaces landscaped, technological possibility of soil pollution with emissions was very small. The company is located in an industrial area (Dudesti), being surrounded by other companies with different activity profiles. Analyzing sources of pollution both own and from vicinity can see that there may be a potential for pollution in the area, including traffic and is very hard to differentiate as sources.

### **Introduction**

SC SIN SA is located in the industrial platform Dudesti, Bucharest and has a land area of 91,023 m<sup>3</sup> occupied mostly by construction, fleet of tanks, railway plant, concrete platforms, access roads and only a 13 677 m<sup>2</sup> green area. Protected areas - residential neighborhoods are situated at distances between 600 m and 2500 m from the emplacement of the company.

The specific activity was the fats processing. The products manufactured by SC SIN SA were: distilled fatty acids (animal and vegetable products), Olein A and B, glycerine 88% and 99%, hydrogenated fatty acid distillates, emulsions for wood impregnation, oils for emulsification, naphthenic acids and hydrogen.

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This paper presents the impact of the activity SC SIN S.A. on soil from the emplacement (Lăcătușu and all., 2008-2009).

### **1. Materials and methods**

The material is based on an environmental survey requested by the beneficiary after activity closure (in December 2008 production was stopped). In this moment is not known the destination of this emplacement in the future.

To underline the soil quality on the emplacement in SC SIN SA, was necessary the soil analysis, in emplacement and its vicinity in terms of physical and chemical properties

We collected soil samples (32 soil samples on 16 points) located in the representative points in order to study the effect of all society activities on the emplacement.

According to methods commonly used in laboratories ICPA, standardized, the following determinations were made: pH, carbonates, humus, total nitrogen content (Nt), mobile phosphorus (PAL) and mobile potassium (KAL), total forms of Zn, Cu, Mn, Fe, Pb, Cr, Ni, Co and Cd, total soluble salts content, total polychlorinated biphenyl compounds (PCB), total petroleum hydrocarbons (THP), (ICPA, 1981, 1986).

### **2. Results and discussion**

The soil from this emplacement is characteristic for the Bucharest area and is represented by Preluvosol Chromic (LC vr) from the Class Luvisols (WRB-SR-1998, in Florea and Munteanu, 2003).

These soils have been modified by various human interventions and resulted the Anthropogenic Regosol (RG ah), that cover the largest part of the Bucharest, including this emplacement - SC SIN SA.

What characterizes these soils is the presence of the profile of various building materials such as debris of bricks, sand, scrap of masonry etc.

These materials greatly change the physical and chemical properties of these soils. Thus, the existence of the different calcium-rich material makes these soils can be classified as weakly alkaline, unlike Preluvosols Chromic, on account of which were formed, which are weak acid - neutral.

Possible sources of soil pollution as a result of work carried out has been virtually reduced due to technological and structural solutions adopted by society.

Since the free surface of the unit was mostly concrete except for small green spaces landscaped, possibilities of soil pollution with emissions released into the air were much lower.

Tab. 1 - Analytical data on the soil reaction, carbon content and total content of the soluble salts on SC SIN SA emplacement

Location	Deep	pH	Carbonates	Total soluble salts content
	cm	unit. pH	%	mg/100 g sol
P1 Distillation - split	0-5	7.84	2.0	52
	20-30	7.85	1.9	54
P2 Tanks park	0-5	7.70	3.1	62
	20-30	8.10	3.9	57
P3 Purification fat	0-5	7.98	1.4	61
	20-30	8.03	0.8	57
P4 Oxygen alley	0-5	8.07	2.9	48
	20-30	8.22	3.3	46
P5 Electrolysis	0-5	8.14	4.1	54
	20-30	8.28	7.1	45
P6 Heating station	0-5	8.43	12.8	85
	20-30	8.52	13.8	70
P7 Emulsions	0-5	8.37	5.7	51
	20-30	8.33	2.0	49
P8 Vacant land	0-5	7.99	0.4	52
	20-30	8.06	1.0	49
P9 Evacuation draw	0-5	8.34	9.4	70
	20-30	8.35	9.7	62
P10 Fuel station	0-5	8.30	11.7	68
	20-30	8.32	13.1	55
P11 Heating station	0-5	8.23	7.1	60
	20-30	8.30	7.9	53
P12 Plafar (external)	0-5	8.03	1.4	79
	20-30	8.25	1.9	45
P13 Water treatment station (external)	0-5	8.17	2.0	64
	20-30	8.32	2.0	53
P14 Purification station (indoor)	0-5	8.04	1.9	60
	20-30	8.12	1.4	56
P 15 Cooling Tower	0-5	8.02	12.1	116
	20-30	8.20	4.1	55
P 16 Transformers	0-5	8.24	1.4	469
	20-30	7.50	0.4	357

The soil pollution depended on the specifics of each installation and as a result of the society activity as a whole.

Specific activity of this company (processing fats) can determine the pollution with organic residues that can make an additional contribution of soil organic matter.

Effect on soil and vegetation: the fat covers the soil, reduces gas and water exchange with the atmosphere, covers plant foliage, inhibiting photosynthesis, destabilizes soil biological activity and appear changes of the ratio C/N.

Analyzing the soil samples collected on the emplacement and in its vicinity were obtained values of soil indicators, presented below.

Tab. 2 - Analytical data on the total nitrogen, humus, organic carbon, mobile phosphorus and potassium on SC SIN SA emplacement

Location	Deep	Humus	C <sub>organic</sub>	N <sub>total</sub>	C/N	P-AL*	K-AL
	cm						
P1 Distillation - split	0-5	3.18	1.84	0.162	13.3	107	596
	20-30	1.56	0.90	0.109	9.7	71	310
P2 Tanks park	0-5	6.96	4.04	0.279	16.9	57	437
	20-30	3.48	2.02	0.137	17.2	9	277
P3 Purification fat	0-5	7.20	4.18	0.313	15.6	36	619
	20-30	3.36	1.95	0.184	12.4	12	364
P4 Oxygen alley	0-5	4.62	2.68	0.218	14.4	39	477
	20-30	1.98	1.15	0.113	11.9	7	286
P5 Electrolysis	0-5	5.16	2.99	0.263	13.3	62	368
	20-30	3.12	1.81	0.152	13.9	22	273
P6 Heating station	0-5	15.36	8.91	0.598	17.4	63	1096
	20-30	11.34	6.58	0.352	21.8	32	659
P7 Emulsions	0-5	4.32	2.51	0.204	14.3	8	528
	20-30	1.32	0.77	0.093	9.6	6	314
P8 Vacant land	0-5	1.92	1.11	0.141	9.2	15	346
	20-30	0.54	0.31	0.067	5.4	10	241
P9 Evacuation draw	0-5	4.08	2.37	0.176	15.7	25	687
	20-30	3.72	2.16	0.164	15.3	23	532
P10 Fuel station	0-5	3.60	2.09	0.188	13.0	32	459
	20-30	2.10	1.22	0.127	11.2	13	304
P11 Heating station	0-5	7.44	4.32	0.253	19.9	79	477
	20-30	5.34	3.10	0.127	28.5	33	323
P12 Plafar (external)	0-5	3.96	2.30	0.212	12.7	48	505
	20-30	2.52	1.46	0.125	13.7	46	678
P13 Water treatment station (external)	0-5	4.92	2.85	0.204	16.3	35	386
	20-30	2.64	1.53	0.127	14.1	24	450
P14 Purification station (indoor)	0-5	3.96	2.30	0.202	13.3	84	441
	20-30	3.78	2.19	0.184	13.9	68	423
P 15 Cooling Tower	0-5	15.54	9.01	0.574	18.3	36	541
	20-30	6.96	4.04	0.321	14.7	31	328
P 16 Transformers	0-5	4.68	2.71	0.420	7.5	123	1287
	20-30	3.00	1.74	0.287	7.1	83	816

\* Values corrected according to soil reaction

Soil on the emplacement has a weak alkaline reaction with pH values in the range from 7.50 to 8.52. The soil contains carbonates, with values between 0.4% - 13.8% (tab. 1).

Total content of the soluble salts, determined by means of conductivity, show that soil samples are non salinized. The values are smaller than of the salinization limit of 100 mg soluble salts / 100g soil. On the point P16 (transformers) is a moderate salinization, chlorides type.

Total nitrogen content is medium to large, in surface horizon and very small to medium in horizon 20-30 cm.. High values between 0.598 and 0.279% were

found in surface horizons in points P2 and P3 and in both horizons in points P6, P15 and P16 (tab. 2).

Tab. 3 - Date analysis on the total microelements (heavy metals) of soil on SC SIN SA emplacement

Location	Deep	Zn	Cu	Fe	Mn	Ni	Pb	Co	Cr	Cd
	cm	ppm								
P1 Distillation - split	0-5	143	41.3	22873	589	45.5	77.4	10.8	32.9	2.03
	20-30	106	24.6	23098	617	43.3	56.3	9.7	34.1	1.01
P2 Tanks park	0-5	964	114.5	27028	595	251	351	10.6	137	20.0
	20-30	692	79.3	24163	581	175	149	10.1	133	6.82
P3 Purification fat	0-5	189	36.3	25340	681	84.4	116	10.9	59.7	1.52
	20-30	154	34.2	26254	748	68.3	80.9	12.6	55.0	0.762
P4 Oxygen alley	0-5	1966	96.5	22754	608	300	401	20.7	70.3	14.1
	20-30	893	64.7	23009	577	207	163	13.8	52.6	4.36
P5 Electrolysis	0-5	226	31.2	23113	585	55.5	94	11.5	33.3	1.29
	20-30	149	32.2	24068	582	43.7	52.9	13.1	29.9	0.858
P6 Heating station	0-5	890	74.6	18668	728	78.9	238	13.4	49.8	6.33
	20-30	1965	70.5	18066	726	60.6	301	11.1	38.7	7.78
P7 Emulsions	0-5	238	31.4	24508	686	49.8	84.3	11.7	41.0	15.1
	20-30	127	29.8	25933	734	38.9	56.1	11.1	32.4	1.63
P8 Vacant land	0-5	91	25.7	23139	640	29.2	44.0	8.6	24.2	0.331
	20-30	75	21.3	23159	733	28.9	35.0	8.7	25.2	0.028
P9 Evacuation draw	0-5	113	28.6	22716	643	34.3	58.8	11.4	28.1	0.895
	20-30	143	29.5	22377	634	36.2	57.4	10.5	30.2	1.00
P10 Fuel station	0-5	163	25.2	22522	599	37.0	65.8	9.7	47.2	0.969
	20-30	118	23.7	22601	612	36.8	54.7	10.9	30.9	1.16
P11 Heating station	0-5	266	45.2	35189	771	193	151	11.2	34.4	4.42
	20-30	152	54.8	33071	597	158	104	10.9	25.7	1.09
P12 Plafar (external)	0-5	145	33.2	22889	698	100	91.2	9.6	43.3	1.64
	20-30	112	31.6	24022	716	45.3	71.4	10.9	32.6	1.21
P13 Water treatment station (external)	0-5	104	30.3	22863	648	46.1	65.3	8.1	28.2	0.908
	20-30	98	28.8	24080	685	40.8	55.1	10.6	26.1	0.627
P14 Purification station (indoor)	0-5	150	65.7	23523	654	38.9	88.1	9.4	41.9	1.74
	20-30	122	50.6	21935	585	36.3	75.2	9.3	38.5	1.22
P 15 Cooling Tower	0-5	1161	98.8	40971	1753	217	219	9.3	66.9	26.0
	20-30	541	57.7	29451	1159	157	141	10.2	50.8	19.0
P 16 Transformers	0-5	155	32.3	22292	623	41.6	102	10.5	32.3	1.42
	20-30	134	29.4	22622	622	36.7	68.7	24.0	28.3	1.08
<i>Normal Value *</i>		100	20		900	20	20	15	30	1
<i>Alert threshold, less sensitive areas *</i>		700	250		2000	250	250	100	300	5
<i>Intervention threshold, less sensitive areas *</i>		1500	500		4000	500	1000	250	600	10

\* Order MAPPM no.756/1997 for approving legislation on soil pollution assessment

Values determined for the humus content were higher in surface horizons than in horizon 20-30 cm and were situated by small to very large. These values can not be attributed only the soil organic matter.

Specific activity of this company (processing fats) can induce organic pollution, expressed by means of the values of organic carbon (C organic). The highest values of organic C content were found in points P6 - Heating station , P15 - Cooling Tower and then to P2 - Tanks park, P3 - Purification fat and P11-Heating station.

The analyzes (humus, organic carbon, total N and the ratio C / N) showed that there is an additional contribution of organic matter, reaching the highest values in the points P6 and P15.

The report C / N is an indicator of organic matter decomposition. It reached higher values in many points of harvesting, where there is the possibility of loss of raw materials or fuels on the ground: P2 - Tanks park, P3, - Purification fat, P6 - Heating station , P9 - Evacuation draw P11 - Heating station, P13 - Water treatment station (external), and P15 - Cooling tower.

Obtained values show an increase in heavy metal content in soil, about on 2 - 12 times elder than normal content , but below the alert threshold for less sensitive use in most cases (Order MAPPM no. 756 / 1997). Generally, the soil was not polluted with heavy metals. (Table 3).

In following points was a significant potential pollution, concentrations of heavy metals exceeded the alert threshold for less sensitive use (Order MAPPM nr.756/1997) : P2 (Tanks park) and P15 (Cooling tower) - for Zn, Ni and Pb, P4 (Oxygen alley) - for Ni and Pb, P6 (Heating station) - for Pb and Cd.

In some points, the concentrations of Zn and Cd exceeded the threshold of intervention for less sensitive use and has been a major pollution: P4 (Oxygen alley) and P6 (Heating station) - for Zn; P2 (Tanks park), P4 (Oxygen alley), P7 (Emulsions) and P15 (Cooling tower) for Cd.

As expected, the lowest contents for metals was determined on the vacant land (P8) from the northern side of the emplacement, with values below normal concentration of the soil.

It was recommended an dilution action in these locations where soil was polluted with Cd and / or Zn by mixing the upper horizons with surface soil horizons from (P8) or deep plowing.

They complied this recommendation and then were taken back soil samples from locations with significant pollution of Zn and Cd. The data presented in Table 4 shows that values of total content of Zn and Cd are situated this time below the intervention threshold for less sensitive use. In this situation the soil on this emplacement is not polluted with heavy metals.

Was examined total hydrocarbons content (THP) in soil, in two locations on the emplacement where was possible the contamination: P10 - Fuel station and P11 – Heating station (tab. 5).

The soil from P10 - Fuel station has a content of three times greater than the normal concentration in soils (NC) (Order MAPPM nr.756/1997) but is below the alert threshold for less sensitive use. In the P11 - Heating station surface horizon has a content of 16 times greater than normal concentration and eight times greater than normal concentration in 20-30 cm horizon, but is below the intervention threshold, respectively alert threshold for less sensitive use.

Tab. 4 - Contents of Cd and Zn in points with significant pollution, in soil after intervention

Location	Deep, cm	Total content, mg/kg	
		Zn	Cd
P2 Tanks park	0-5	-	2.64
P4 Oxygen alley	0-5	252	1.11
P6 Heating station	0-5	463	-
	20-30	123	-
P7 Emulsions	0-5	-	5.63
P 15 Cooling Tower	0-5	-	6.16
	20-30	-	3.29
<b>Normal Value *</b>		<i>100</i>	<i>1</i>
<b>Alert threshold, less sensitive areas *</b>		<i>700</i>	<i>5</i>
<b>Intervention threshold, less sensitive areas *</b>		<i>1500</i>	<i>10</i>

\* Order MAPPM no. 756/1997 for approving legislation on soil pollution assessment

Total content in biphenyls polychlorinated compounds (PCBs) from the point P16 (Transformers) is below normal concentration in the soil.

Tab. 5 - Analytical data on total hydrocarbon content (THP) of soil from P10 and P11

Location	Deep, cm	Total hydrocarbon content	
		%	mg/kg
P10 Fuel station	0-5	0.03	290
	20-30	0.03	333
P11 Heating station	0-5	0.16	1585
	20-30	0.08	837
<b>Normal Value *</b>			<i>&lt; 100</i>
<b>Alert threshold, less sensitive areas *</b>			<i>1.000</i>
<b>Intervention threshold, less sensitive areas *</b>			<i>2.000</i>

\*Order MAPPM no. 756/1997 for approving legislation on soil pollution assessment

**Potential impacts of adjacent activities.** The company is located in an industrial area (Dudesti), being surrounded by other companies with different

activity profiles. The emplacement is likely to be influenced not only by activities in SC SIN SA but also by activities from the vicinity.

Analyzing sources of pollution both own and from vicinity can see that there may be a potential for pollution in the area, including traffic and is very hard to difference as sources. In the soil, the dust of the traffic does not change the physical properties, but contains small amounts of heavy metals, with harmful effects for chemical and biological soil properties.

### **Conclusions**

- This paper presents the impact of the activity SC SIN S.A. on soil from the emplacement and is based on a environmental survey;
- On this location soil cover is represented by Anthropic Regosol; soil is characterized by the presence of various building materials such as debris of bricks, sand, scrap of masonry etc.;
- Soil on the emplacement has a weak alkaline reaction, contains carbonates and is non salinized;
- Total nitrogen content was at very low to high and humus content was at small to very large; humus values can not be attributed only for the soil organic matter;
- Specific activity of this company (processing fats) can induce organic pollution, expressed by means of the values of organic carbon;
- Total heavy metal content in soil is about on 2 -12 times elder than normal content, but is situated below the alert threshold for less sensitive use in most cases;
- In some points, the concentrations of Zn and Cd exceeded the intervention threshold for less sensitive use and has been a major pollution; it was recommended an soil dilution action in these locations by mixing the upper horizons with non polluted soil or deep plowing;
- After intervention the total content of Zn and Cd are situated below the intervention threshold for less sensitive use; in this situation, the soil on emplacement is not polluted with heavy metals;
- Total hydrocarbons content in two points are higher than normal concentration in soils, but below the alert threshold for less sensitive use;
- Total content in biphenyls polychlorinated compounds is below the normal concentration in the soil;
- Because the free surface of the unit was mostly concrete, except for small green spaces landscaped, possibilities of soil pollution with emissions released into the air were much lower;



- The emplacement is possible to be influenced not only by activities in SC SIN SA but also by the activities from the vicinity (industrial area), including traffic;
- In the soil, the dust of the traffic contains small amounts of heavy metals, with harmful effects for chemical and biological soil properties.

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