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SURFACE WATER POLLUTION IN THE COUNTY SATU-MARE, ROMANIA, IN THE PERIOD OF TIME 2000-2001

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ABSTRACT

The aim of our study was to reveal if there is chemical water pollution in the county Satu–Mare, Romania. As method we used retrospective descriptive longitudinal investigation of the primary evidences data relating with the surface water chemical properties. The most polluted water was in the river section Crasna, Berveni and in the river affluent-Turt. We revealed massive water pollution with iron, manganese, cupper and zinc along the affluent Turt and the river Tarna Mare. Also, we registered accidental water pollution with cyanides in February 2000. In conclusion, there was surface water pollution in the county Satu-Mare.

KEY WORDS:
surface water pollution, physical and chemical pollutants

1. BACKGROUND

Water is a major factor of human existence. The major role of water in maintaining the colectivity development along the centuries was demonstrated by the first forms of life borned in the aquatique environment, the first human shelters placed near the rivers. Water represints the place where the metabolic proccesses take place and the tissues and organs of the forms of life contain a great quantity of water.

The surface water without natural protection is intensive polluted and the concentrations of various chemical substances are very high.

Surface water has the greatest number of functions: water supply for drinking, in agriculture for irrigations and animal feeding, in industry, domestic purposes, swimming pools, nautical sports, and fun and rest ness purposes [1].

Considering all of these water purposes there are 3 types of water:

- Type 1 – drinking water used in alimentary industry, swimming pools and piscine.
- Type 2 – water used for place town salubrity, fun and nautical sports, rest ness and relaxing.
- Type 3 – water used in industry (except alimentary industry) and in agriculture [2].

The most important is drinking water that determines sometime water borne diseases as a result of chemical and biological pollution, with human immunodeficiency diminishing and chronic food borne diseases or carcinogenic and mutagenic forms of illnesses appearing [3].

2. MATERIAL AND METHOD

In this study we wanted to investigate if there are water pollution problems in the Satu-Mare County, during the period 2000-2001.

As objective we investigated the physical and chemical indicators of the surface water sources, using as material the primary evidences of the Public Health Department of Satu-Mare.

As physical indicators we considered: water temperature, ph, conductivity, total suspensions, and fix residue. The used methods for these indicators establishing were: for temperature – measuring with thermometer, for pH – pH indicator, for conductivity – in situu with special apparatus using fire method, for total suspensions – filtration and centrifugation followed by weight measurement, fix residue – evaporation and weight measurement.

As chemical indicators we investigated: nitrates, cyanides, phenols, detergents, phosphates, lead, undesirable substances (chlorates, sulphates, calcium, magnesium, natrium, kallium), dissolved chemical oxygen, ammonia, nitrous, metals (iron, manganese, cupper, zinc). The used methods for these indicators establishing were: for nitrates – diphenylamine, sulphuric and hydrochloric acid), for cyanides microdifusion with “Conway” modified cells method, phenols – with vapors moving and 4-amino-antipirina reaction in the kallium ironcianates presence, detergents – method of ethylene blue soluble in chlorophorm, phosphates ammonium molibdate, lead – method with ditizone, chlorates – precipitation with hidronitric acid and silver nitrate method, sulphates – barium chlorate method, calcium – EDTA, magnesium – complex solution, natrium – zinc-uranium- acetate of natrium reaction, kallium – radiation wavelengths measurement, water dissolved oxygen-manganese hydroxide method, organic substances–kallium permanganate oxidation, ammonia – Nessler reactive reaction, nitrous – azoic complex method, iron – reduction with ortophenantroline indicator reaction, manganese – oxidation in acid medium with silver ions as indicators, cupper – dibenzil dithio carbamate of zinc method, zinc – method with ditizone [4].

The investigation method was epidemiological longitudinal retrospective descriptive inquiry realized in a period of two years. As

statistical methods we used average, dispersion and statistical comparison.

Satu-Mare is a county situated in the northwest site of Romania, with an important minerals extraction industry. In this area there were great effects of lead extraction, and recently of gold extraction.

This study represents a first step in a larger area of research of the risk factors for Romanians health evaluation, represented not only by surface water pollution in this area.

3. OBTAINED RESULTS

The water samples were gathered in 11 collecting points, which were:

1 - Somes River – Tarna Mare Section;
2 - Somes River – Dara Section;
3 - Crasna - Supuru de Jos Section;
4 - Crasna River – Craidorolt Section;
5 - Crasna River – Berveni Section;
6 - Tur River – before Negresti Oas;
7 - Tur River – Micula Section;
8 - Valea Rea – before flowing in Tur;
9 - Turt Brooklet - before flowing Tur;
10 – Valea Rea - Negresti Oas absorption;
11 - Tarna Mare River - after Bocicau.

3.1. PHYSICAL PROPERTIES OF WATER (TABLE 1)

TABLE 1. ANNUAL AVERAGE VALUES OF PHYSICAL SURFACE WATER PROPERTIES, IN DIFFERENT COLLECTING POINTS OF COUNTY, DURING THE PERIOD 2000-2001

Collecting points	Temperature (^{0}C)		pH (units)		Conductivity (mcS/cm)		Total susp. (mg/l)		Fix residue (mg/l)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
1.	12.40	12.49	7.8	7.4	446	451	75	56	405	354
2.	12.49	12.55	7.6	12.5	743	590	106	60	401	359
3.	12.55	12.56	7.8	7.5	722	481	61	78	558	575
4.	13.53	12.60	7.8	7.5	684	1886	41	97	567	514
5.	12.43	11.74	7.9	7.6	696	775	60	79	539	519
6.	9.17	9.31	7.5	7.4	2460	432	45	27	64	70
7.	10.89	10.53	7.2	6.9	428	400	33	45	155	170
8.	9.13	11.24	7.5	7.2	439	318	29	31	110	105
9.	11.32	11.14	4.4	5.1	308	307	34	50	1155	954
10	9.07	10.62	7.5	7.4	-	-	118	21	70	68
11.	12.70	8.08	7.1	6.9	573	437	38	24	181	197

3.1.1. pH

Annual average values of physical properties of water along the period 2000-2001 in the county Satu-Mare revealed an pH = 4.4 u pH and fix residue = 1155 mg/l in the year 2000 and pH = 5,1 u pH and fix residue = 954 mg/l in 2001 in the Turt Brooklet. These results suggest acid waters and increased quantity of fixed residue of the flowing of Turt Brooklet in the Tur River.

Somes river in the Dara Section had in 2001 the most alkaline pH = 12.5, which surpassed evidently the exceptional admitted values (8.5 u pH).Tur river, also, before Negresti-Oas had the highest conductivity = 2460 mcS/cm, in the year 2000.

3.1.2. Water temperature

The monthly average of surface water temperature in the county Satu-Mare, were out of normal limits (7-15 degree Celsius) along the period 2000-2001.

In the summer months (May – August) greater temperatures than maximal admitted value (15^0C) and in the winter months (December – February) temperatures lower than minimal admitted value (7^0C) were registered. Annual average of the surface water temperature was in normal limits.

3.1.3. Conductivity

A higher surpass over the maximal admitted value (1000 mcS/cm) of the annual average surface conductivity was registered in Crasna River – Craidorolt Section in the year 2001 (1886 mcS/cm) and in the Tur River – Negresti Oas Section in the year 2000 (2460 mcS/cm).

3.1.4. Total suspension

The annual average of the total suspension in the surface water were maximal in Valea Rea – Negresti Oas water absorption (118.6 mg/l) and Somes River – Dara Section (106.7 mg/l) in the year 2000 and in Crasna River – Craidorolt Section (97.54 mg/l) in the year 2001.

3.2. WATER CHEMICAL PROPERTIES

3.2.1. Toxically substances (table 2)

TABLE 2. ANNUAL AVERAGE VALUES OF TOXICALLY SUBSTANCES, IN DIFFERENT COLLECTING POINTS OF COUNTY, DURING THE PERIOD 2000-2001

Collecting points	Nitrates (mg/l)		Cyanides (mg/l)		Phenols (mg/l)		Detergents (mg/l)		Phosphates (mg/l)		Lead (mg/l)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
1	5.62	7.53	0.001	0.00	0.001	0.001	0.108	0.052	0.045	0.093	0.001	-
2	6.29	5.69	0.001	0.001	0.001	0.001	0.118	0.063	0.055	0.086	0.001	-
3	7.77	7.73	0.001	0.001	0.001	0.00	0.110	0.060	0.318	0.229	-	-
4	5.07	6.00	-	-	-	-	-	-	0.132	0.408	-	-
5	7.38	7.72	0.001	-	0.001	0.001	0.066	0.049	0.383	0.298	-	-
6	4.29	3.84	-	-	-	-	0.020	-	0.029	0.100	0.01	0.013
7	4.95	4.66	0.001	0.00	0.001	0.001	0.077	0.035	0.143	0.043	0.022	0.015
8	3.42	4.06	-	-	-	-	0.028	0.070	0.029	0.055	-	-
9	5.25	2.40	-	-	-	-	-	-	0.080	0.067	0.113	0.110
10	3.92	3.46	-	-	-	-	0.030	0.042	0.025	0.038	-	-
11	3.67	3.09	-	-	-	-	-	-	0.043	0.110	0.065	0.047

Annual average of the surface water toxically substances investigation in different points of collection of Satu-Mare County, during the period 2000-2001 indicated important surface water pollution with phosphates of Crasna River and of Turt Brooklet before flowing in Tur River.

3.2.1.1. Nitrates

Along the period 2000-2001 monthly and annual averages of nitrates contained in surface water did not surpass the maximal admitted value (50 mg/l water).

3.2.1.2. Cyanides

In the surface water, monthly and annual averages of cyanides, in all the collecting points, during the period 2000-2001 did not surpass maximal admitted value (0.01 mg/l).

3.2.1.3. Detergents

The annual average concentration surpasses maximal admitted value (0.1 mg/l) in Somes River (the highest value) and Crasna River (Supuru de Jos section).

We did not register an exceeding of exceptional admitted concentration (0.5 mg/l) in Entire County.

3.2.1.4. Lead

The annual average of lead contained in the surface water surpassed maximal admitted value (0.05 mg/l) at Turt Brooklet before flowing in Tur River (0.113 mg/l) in 2000-2001 and in Tarna Mare River– after Bocicau (0.110 mg/l) in the year 2000.

3.2.2. Surface water hardness (table 3)

Sulphates registered a surpass of exceptional admitted value (400 mg/l) in the Turt Brooklet before flowing in Tur River (722 mg/l) in the year 2000 and maximal admitted concentration (200 mg/l) with established value - 387 mg/l in the year 2001.

TABLE 3. ANNUAL AVERAGE VALUES OF UNDESIRABLE SUBSTANCES, IN DIFFERENT COLLECTING POINTS OF COUNTY, DURING THE PERIOD 2000-2001

Collecting points	Chlorates (mg/l)		Sulphates (mg/l)		Ca (mg/l)		Mg (mg/l)		Na (mg/l)		K (mg/l)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
1	85.88	64.39	70.23	45.85	54.28	50.90	14.32	12.46	41.68	32.90	5.39	4.38
2	88.84	65.29	67.23	42.42	54.89	51.43	14.57	11.21	45.65	33.76	5.58	4.59
3	55.73	54.57	103	88.27	95.62	92.32	23.82	23.43	34.37	34.23	10.15	11.17
4	59.87	40.78	95	83.36	90.57	87.07	21.75	22.22	38.47	31.56	11.15	11.04
5	47.67	49.39	96.95	89.28	91.79	89.17	23.57	23.93	34.05	33.96	10.67	11.21
6	5.08	7.65	5.38	5.87	8.94	7.70	2.7	4.78	5.35	6.51	1.62	1.48
7	11.75	14.69	26.71	19.15	24.54	21.66	7.66	5.91	10.86	10.97	3.80	2.71
8	5.84	7.89	8.81	6.85	16.95	14.17	6.38	4.35	7.73	8.18	2.93	2.16
9	28.22	38.70	722	387	39.28	52.16	14.8	17.68	17.82	17.08	8.50	5.60
10	5.42	7.15	11.15	6.58	9.95	6.94	3.75	2.96	5.22	6.46	1.25	1.08
11	10.48	9.18	56.41	40.29	30.72	30.14	7.15	5.48	11.93	12.32	4.68	3.18

The Crasna River sections: Supuru de Jos, Craidorolt and Berveni presented increased values of Kallium (over 10 mg/l) and bicarbonates (over 270 mg/l) during the studied period 2000-2001. These results explain the possibility of alkaline water in this area, with risk of water borne diseases.

3.2.2.1. Chlorates

Chlorates, calcium, magnesium and natrium concentrations in the surface water of the county Satu-Mare, during the studied period were in normal limits.

3.2.3. Substances, which indicate water pollution (table 4)

We registered old persistent organic water pollution of the surface water in all rivers, especially Crasna River revealed by the increases of nitrates, important recent water pollution of the Turt Brooklet and Crasna, and less important of Somes and Tarna Mare rivers, revealed by ammonia values.

TABLE 4. ANNUAL AVERAGE VALUES OF UNDESIRABLE SUBSTANCES, IN DIFFERENT COLLECTING POINTS OF COUNTY, DURING THE PERIOD 2000-2001.

Collecting points	Dissolved O_2 (mg/l)		CBO_5 (mg/l)		CCO (mg/l)		NH_4 (mg/l)		NO_2^- (mg/l)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
1	10.04	10.32	3.82	3.35	12.05	8.76	1.82	1.02	0.182	0.085
2	9.86	9.54	4.29	4.20	12.84	12.14	1.55	1.30	0.145	0.099
3	7.14	7.56	3.71	3.67	9.47	13.09	2.31	2.31	0.689	0.530
4	8.80	9.60	4.18	4.48	8.65	9.94	3.68	1.32	0.355	0.236
5	6.92	4.92	3.47	3.13	9.74	12.35	2.95	4.50	0.693	0.520
6	11.20	11.48	2.83	2.93	7.58	5.17	0.39	0.38	0.033	0.015
7	9.50	9.61	2.84	2.51	8.88	7.80	0.75	1.01	0.091	0.126
8	10.74	10.67	2.75	2.48	7.78	6.96	0.54	0.39	0.051	0.034
9	9.22	9.84	2.73	3.10	27.70	9.48	4.62	3.05	0.073	0.049
10	11.22	11.46	2.57	2.59	9.12	3.44	0.39	0.26	0.034	0.018
11	7.45	9.60	2.95	2.88	17.47	7.50	1.46	0.79	0.046	0.019

3.2.3.1. Organic substances

Organic substances, global indicators of water pollution, surpass exceptional admitted value (12 mg/l) in the Somes River, Turt Brooklet and Tarna Mare River, in the year 2000.

3.2.4. The metals (table 5)

In the year 2000 was revealed intensive water pollution with iron, manganese, cupper and zinc in the Turt Brooklet before flowing in the Tur River, annual average of iron and manganese surpassed 100 hundred multiplied exceptional admitted values. Water pollution with iron and manganese was registered in 2001 in almost all collecting point of this area.

In the year 2001 we registered a metal water pollution of Turt Brooklet with less intensity, iron and manganese surpassed the maximal admitted limits in the year 2001, in all collecting points.

TABLE 5. ANNUAL AVERAGE VALUES OF METALS IN SURFACE WATER, IN DIFFERENT COLLECTING POINTS OF COUNTY, DURING THE PERIOD 2000-2001

Collecting points	Iron (mg/l)		Manganese (mg/l)		Cupper (mg/l)		Zinc (mg/l)	
	2000	2001	2000	2001	2000	2001	2000	2001
1	0.26	0.33	0.173	0.225	0.021	0.018	0.17	0.228
2	0.14	0.21	0.219	0.192	0.019	0.016	0.17	0.184
3	0.09	0.19	0.145	0.440	0.020	0.023	0.11	0.197
4	0.20	0.21	0.335	-	-	-	-	-
5	0.15	0.18	0.054	0.143	0.026	0.012	0.07	0.113
6	0.12	0.13	0,025	0.052	0.014	0.012	0.07	0.147
7	0.20	0.38	0,209	9.287	0.024	0.017	0.24	0.331
8	0.20	0.21	-	-	-	-	-	-
9	47.82	1.91	31.09	12.06	0.195	0.134	19.73	12.83
10	0.17	0.17	-	-	-	-	-	-
11	1.05	0.50	1.960	0.337	0.038	0.055	0.22	0.166

4. DISCUSSIONS

Physical properties of water pollution were modified in different areas of Satu-Mare County: incresed pH of Crasna River, Somes River – Dara Section which caused alkaline water and decreased pH in the Turt Brooklet with acid water; increased conductivity of the Tur and Crasna River and very high turbidity in the absorption area Negresti Oas; increased fix residue of Turt Brooklet indicated a possible water pollution.

There was a surface water pollution with lead of Turt Brooklet, phosphates, kallium, magnesium, iron and manganese in Crasna river.

At the beginning of the year 2000, Somes River was accidentally polluted with cianides.

Water was polluted with undesirable substances (kallium and bicarbonates).

Increased water pollution with organic substances, ammonia, nitrates and decreased values of disolved oxygen indicated the highest organic polluted water in the Crasna River – Section Berveni and in the Turt Brooklet.

There was a massive water pollution with iron, manganese, cupper and zinc of Turt Brooklet and of Tarna Mare River, especially in the year 2000.

5. CONCLUSIONS

- We can affirm surface water pollution in the entire Satu-Mare County, the most polluted being: Crasna River with the 3 sections, Turt Brooklet and Tarna-Mare River.
- Metals and toxically (lead) pollution of the Turt Brooklet and Tarna Mare River and acid water suggest the existence in this area of the pollution sources represented with the highest probability by Turt Mining Exploitation where extracted nonmetals minerals are.
- Accidentally water pollution with cyanides of Somes River, in February 2000, was a result of a barrage fissure of the Gold Society sewage storage pool, placed near the city Baia Mare.

- It is necessary to continue the investigation to demonstrate the pollution sources and the health effects in population. Chemical water pollution is a problem of human health and a source of food borne diseases [La Dou].

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