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The physic-chemical and bacteriological contamination of water in Sitnica, Iber and Lushta rivers

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Abstract: The study on the physic-chemical and bacteriological contamination of water was carried out in three rivers of Mitrovica town, in Kosova. Water quality in the lowland rivers (like Sitnica which crosses central Kosova), Iber and Lushta is very poor owing to a lack of waste water treatment and waste disposal. According to the effluents received, six sampling station were selected.

The results obtained shows that bacterial contamination is very frequent, particularly with the pressure of coliforms. The inorganic contamination is also very high, particularly with nitrites, nitrates, phosphates, sulphures, manganese, aluminium and oxide aluminium. According to the results obtained, the sampling sites do not meet the established quality limits of recreational water, and presents potentional risk for aquatic organisms.

Key words: bacteriological and physic-chemical contamination, waste water, Sitnica, Iber and Lushta Rivers.

Introduction

Urban effluents are major source of pollution. Only 28% of present homes are connected to sewage system, while there is no waste water treatment. In villages and other settlements, waste water is disposed in open channels, which contaminates not only the surface but the groundwater as well (Anonymous, 2004). As a result there is high incidence of water borne diseases. Industrial waste is not treated either and the effluent is discharged directly into the river of Sitnica.

Municipal waste water is the aggregate of all water used and disposed of in a community. The mean per capital domestic waste water flow rate from 200-500 L per person per day. While the three Mitrovica rivers at source are good quality, this changes as the rivers pass town and industry nearby. Since the waste water from households and factories in Mitrovica is not treated and flows directly into rivers, this leads to rivers in Mitrovica being highly contaminated and also posses a threat to the ground water in the long-run.

The studying includes the sample taking at six stations in order to determine the physic-chemical and bacteriological contamination of rivers Sitnica, Ibër and Lushta. Samples are taken before and after the discharging point of the waste water into above-mentioned rivers.

Methods

Sampling stations

In order to choose the sampling stations several aspects were considered, including places usually used for recreations, water supply pipes and effluent discharging zone. Six stations were established. Station 1. River Lushta close to Primary school "Skenderbeu". The sample is taken 1000m before the discharging point and is marked with L1. Station 2. River Lushta, the sample is taken after the discharging point. The sample is marked with L2. Station 3. River Iber close to the Sports Hall 1000 m before the discharging point. The sample is marked with I1. Station 4. River

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Iber the sample is taken after the discharging point and marked with I2. Station 5. River Stinica close to the industrial complex Trepça 1000m from the discharging point. The sample is marked with S1. Station 6. The sample is taken after the discharging point and marked with S2.

Sample collection

Bacteriological evaluation: Samples are taken in plastic sterile bottles at 30cm depth, cooled in icebox, immediately transported to laboratory and were examined on the same day. The coliform bacteria were evaluated at 30°C (agar plate) according to probable number technique (MPN) 100ml. Total bacteria of faecal origin were evaluated at 44°C (endo agar plate). Total mesophylic bacteria were evaluated at 37°C (plate count agar) according to "colony star" (Frank Gerber), 1MPN technique. Sulphide reducing anaerobe bacteria were evaluated at 37°C (sulphite agar plate).

Physic-chemical analysis: samples were obtained also at 30cm depth. Physical analyses: smell, turbidity, colour, odour, taste were evaluated by standardized methods (Korça,, 2003) .

Chemical analysis: pH, alkalinity, ammonia nitrogen, nitrite, nitrate, chlorines, sulphate, manganese, aluminium, oxide aluminium, chromium, copper, fluorides were considered HACH water analyses handbook procedures (standard methods for the examination of water). The following figure illustrates the place were the samples were taken.

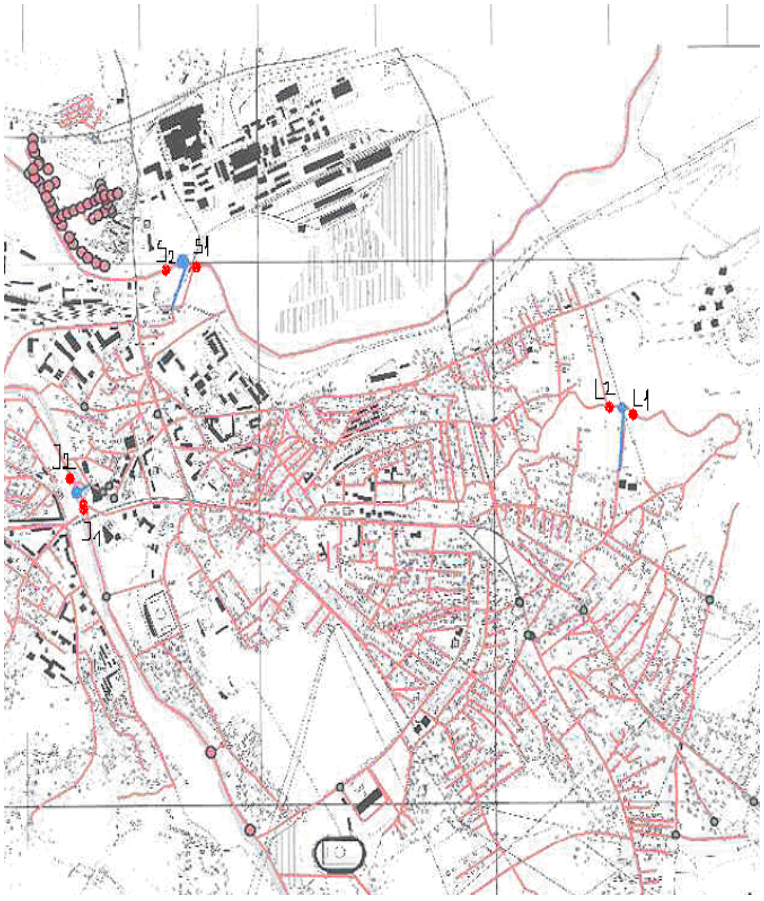

Figure 1. Figurative presentation of the place where the samples are taken in rivers Lushta, Iber and Sitnica.

Results

Physic-chemical and bacteriological parameters have been monitored during six month period. In the following tables are presented results of period May 2008 (Tables 1 & 2).

Table1. Physic-chemical parameters of water

Parameter	Limited values	L 1	L2	I 1	I 2	S1	S 2
Turbidity (NTU)	1.2-2.4	2.70	48.3	1.60	1.40	15.0	17.0
Colour	0-10	22	52	29	224	56	205
Odour	odourless	bad	bad	bad	bad	bad	bad
Taste	tasteless	bad	bad	bad	bad	bad	bad
pH	6.8-8.5	6.75	7.78	7.68	7.23	7.20	7.24
NH_4^+-N (mg/L)	0.1	0.02	0.19	0.04	0.12	0.10	0.20
NO_2^- (mg/L)	0.005	0.0019	0.0068	0.0094	0.0140	0.0023	0.0074
NO_3^- (mg/L)	10	2.8	20.0	1.3	27.4	2.3	4.6
Dissolved O_2 (mg/L)	2	2.82	69.84	3.21	10.28	4.39	16.63
Demanded $KMnO_4$ (mg/L)	8-12*	11.16	275.9	12.71	40.61	17.36	65.72
Hardness (°dH)	30	13.44	10.08	9.24	11.76	14.84	15.12
Alkalinity (mval /L)		53	43	48	43	46	48
Acidity (mval/L)		0.04	0.03	0.025	0.0325	0.03	0.025
Chlorine (mg/L)	200	18	48	12	26	30	31
SO_4^{2-} (mg/L)	200	27.4	80.0	14.4	71.1	71.2	67.0
PO_4^{3-} (mg/L)	0.25	0.769	3.0	0.164	1.214	1.269	2.390
Conductivity (µScm-L)	600-1500	453	760	298	446	506	538
Mn^{4+} (mg/L)	0.05	0.107	0.241	0.031	0.366	0.294	0.105
Al^{3+} (mg/L)	0.2	0.035	0.203	0.008	0.196	0.008	0.031
Al_2O_3 (mg/L)	0.2	0.13	0.77	0.03	0.74	0.03	0.12
Cr^{6+} (mg/L)	0.05	0.022	0.090	0.004	0.019	0.010	0.033
S^{2-} (mg/L)	0.000	0.013	0.016	0.002	0.002	0.046	0.002
F^- (mg/L)	1.0	0.02	0.77	0.02	0.49	0.09	0.02
Cu^{2+} (mg/L)	0.1	0.0009	0.0131	0.0078	0.0067	0.0063	0.0075

Table 2. Bacteriological parameters of water

Microbiological Parameter	L1	L2	I1	I2	S1	S2
Total Coliform bacteria in 100ml	>24,000	>240,000	>24,000	>240,000	24,000	240,000
Coliform bacteria of faecal origin/100ml	9,600	240,000	1,600	20,000	24,000	38,000
Total number of aerobic bacteria/1 ml	230,000	3,000,000	320,000	1,080,000	>24,000	52,000,000
Sulphide reducing bacteria /100ml	1,000	1,100	200	1,000	600	300
Streptococcus of faecal origin/100ml	0	21,000	2,100	2,200	1,500	15,000

Discussion

Physicochemical factors are very important aspects of water. Certain range of these factors enhances the bacterial growth and it also determines the quality of water. High concentration of ammonia in Lushta and Sitnica rivers coincided with the increased number of coliforms which influenced the turbidity, colour, taste and odour of the water.

The colour, taste and odour were not found within the WHO permissible levels. The pH level was well within the acceptable range (pH 6.8 to 8.5 of limited values specified on the table 1.) The conductivity and total hardness are within the limits of acceptable standards. The maximum alkalinity recorded was 53 mval/l in river of Lushta.

The high dissolved oxygen-DO and demanded KMnO4 values are indicative of the presence of organic and inorganic pollutants. Concentration interval for the DO indicator of water quality in our samples, are 2.85-69.84 mg/l. These parameters are responsible for odour and taste as well.

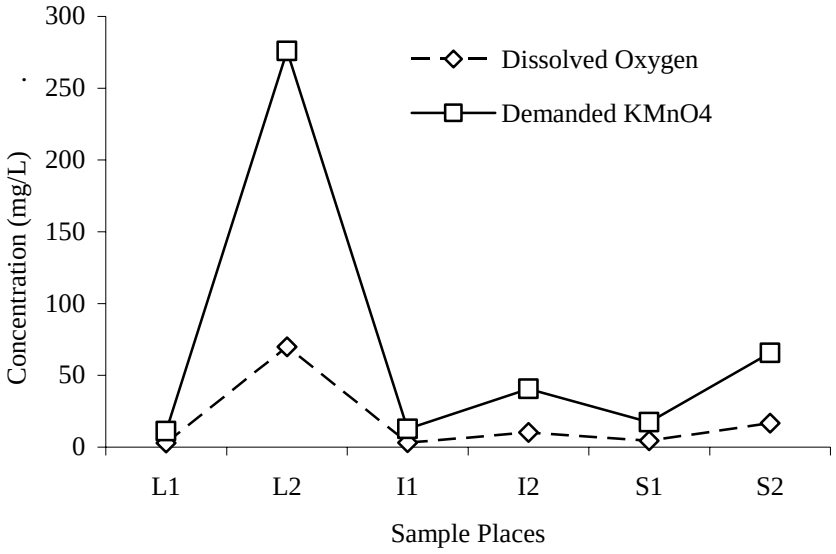

Figure 2. Concentration of Dissolved Oxygen and Demanded $KMnO_4$

From the nutritional point of view the rivers water may not be good source of minerals as well. Concentration of nutrient salt of nitrogen in water as ammonia, nitrites and nitrates are causing the process of eutrophication (Davis, M., Masten, S., 2002). Ammonia concentration in our measurements is from 0.02- 0.20 mg/l. The concentration of ammonia presents the potentional risk for the aquatic organisms. Nitrates as last products in process of nitrification, in higher concentration are toxic for organisms of new age. Concentration of nitrates is 1.3 to 27.4 mg/l.

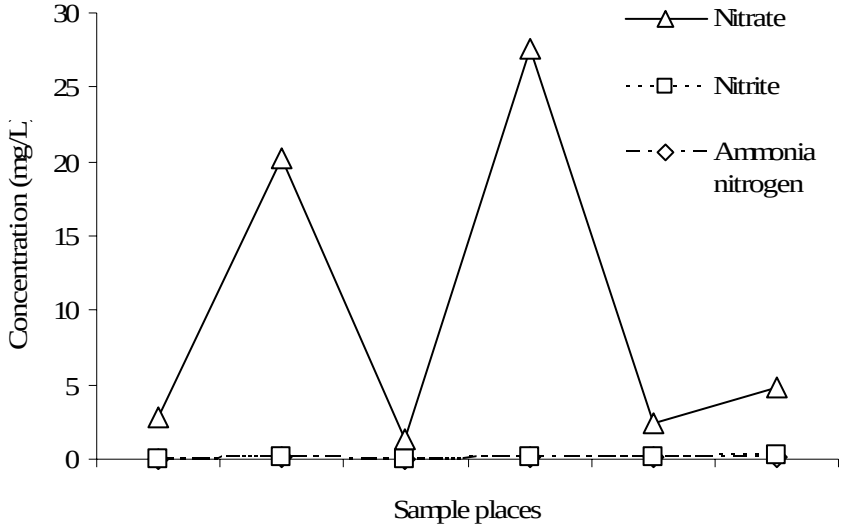

Figure 3. Concentration of Nitrogen Ammonia, Nitrates and Nitrites.

Along the sampling, chlorines and sulphates were found within the limited values, while the sulphures shows an increase mainly after discharging points. The concentrations of sulphures were 0.002 to 0.46 mg/l. The increased level of phosphorous has negative impact on the water. Excessive concentration of phosphate can quickly cause extensive growth of aquatic plants and algal blooms (Davis & Masten, 2002). Excessive algae and plant growth can lead to depletion of the dissolved oxygen, which effects many organisms and can cause fish kills.

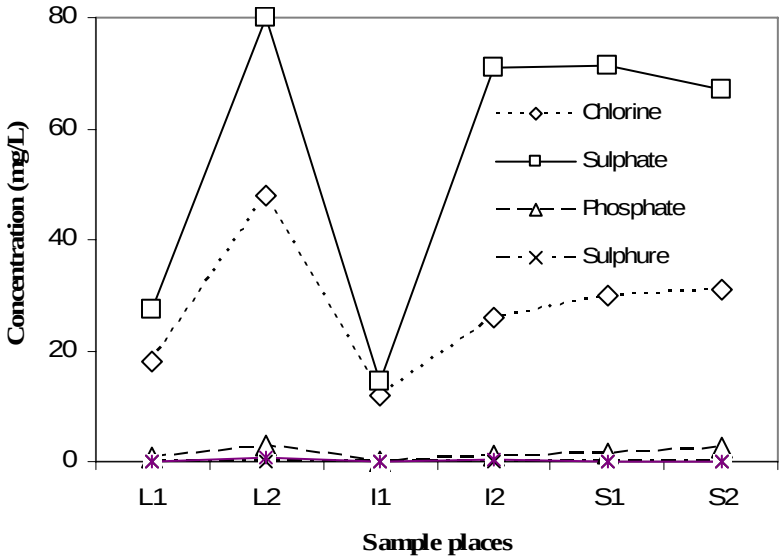

Figure 4. Concentration of Chlorine, Sulphate, Phosphate, Sulphure and Fluoride

With the discharge of waste water into rivers it comes to a considerable quantity of metals (such as manganese, aluminium, oxide aluminium and chromium). These concentrations exceed maximal values in some of the samples. (Table 1.) The copper concentration does not exceed the limited values.

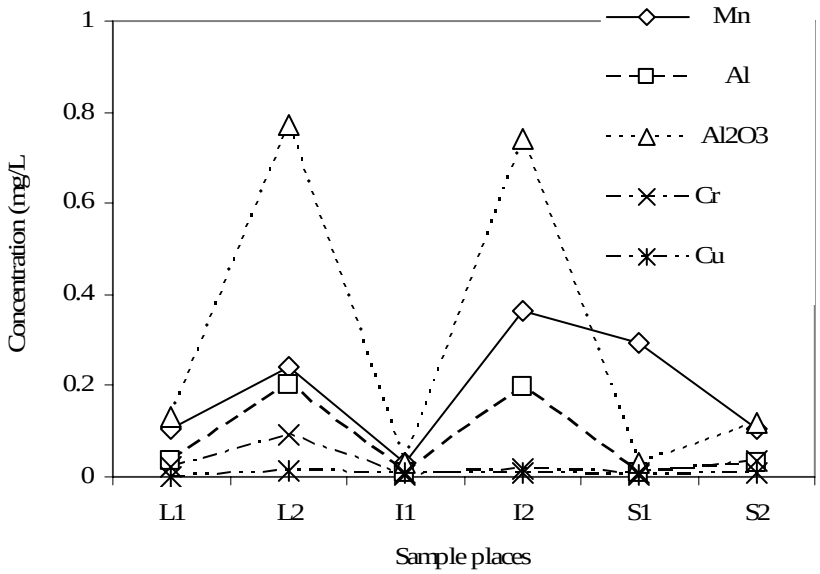

Figure 5. Concentration of Manganese, Aluminium, Oxide aluminium, Chrome and Copper.

A big number of coliforms, mesophylic bacteria, sulphide reducing bacteria and streptococcus showed the faecal contamination of rivers water. The physic-chemical and bacteriological conditions of receiving water effect the quality of water, the water at this point can be classified as Class IV for Sitnica and Lushta rivers and class III for Iber river. This means that the water can not be used for any recreation potentional.

Conclusion

The physic-chemical and bacteriological analysis shows that three rivers of Mitrovica are highly polluted and may not be used for any needs without treatment. A long and uncontrolled discharge of municipal waste water inflicted the change of water quality.

Due to this fact there is a necessity to create a working strategy by water companies in collecting and treating the contaminated water. First of all the existing water supply and sewage system must expand in order to increase the level of connections to the water system and sewage system. This way we would have a well controlled and administrated system. Set up of collectors within different phases will enable a sufficient flow of these waters. The strategy on waste water treatment will support not only the economical developments but also environment influences.

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