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## The impact of Municipal Waste Water in Neredime River, Kosovo

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**Abstract.** Today, environmental protection is of great concern in Kosovo. Almost all waste water effluents from the localities are discharging in surface water and groundwater without being significantly treated deteriorating water quality in Kosovo's rivers. The aim of this paper is to analyze the level of pollution in the Neredime river created from municipal wastewater as well as to identify pollutants and their impact on the river. An attempt has been made to present the situation of the waters defining physicochemical water qualities of Neredime river from the source to the outskirts of town in the south-west of Ferizaj; this includes 5 (five) stations in different seasons. Determining the level of pollution is made using twelve physicochemical parameters such as: Temperature, Turbidity, pH value, Dissolved Oxygen (DO), Potassium Permanganate Demand, Chlorures, Ammonia, Nitrites, Nitrates, Iron, Manganese and Conductivity. Rating curves were drawn on the basis of results obtained in the laboratory for each parameter. The arguments have been used to classify the water quality in each of the study areas. According to the results of laboratory analysis of the samples taken, it is apparent that the river water shows major water quality changes from the source to the outskirts of town. It was observed that the values of physico-chemical parameters exceeded the tolerable limits at almost every station. This may be due to the high impact of human activities, unprotected areas along the river and direct discharge of municipal effluent which may include other individual pollutants. The river autoperification ability is low, especially during the summer when the pollution level is greater while the amount of river flow is low.

**Keywords:** Surface Water Pollution, River Autoperification Ability, Municipal Waste Water, Physicochemical parameters.

### 1. Introduction

Kosovo has limited water resources (surface water as well as groundwater) therefore protection and rational use of them is vital for society and for sustainable economic development of the country. As a result of their geographical position, the Kosovo rivers penetrate very little of its territory and quickly leave the territory. The continuous increase in demand for water, food and energy, and the continuous discharges of waste streams with no sanitary landfills and climate changes, are all indicators which obligates a different access to water as a limited resource. Today the rivers are used as collectors of all urban and industrial discharges. In regions with low density of population, problems of pollution of surface waters are not noticeable because of the river self-cleaning ability; these rivers fail to withstand direct wastewater discharges (untreated) especially in urban areas and for this reason are observing adverse effects on aquatic spaces, risk of infection, etc.

Thorough studies will accurately determine the current state of surface water and to what extent they are able to accept wastewater dischargers without harming the characteristics of clean water. Besides these it is necessary to conduct surveys on the prevention of discharge waste water in hydro resources over the limit values as defined by the permitted norms. [1]

With this research has been specified the level of water pollution in river Neredime, which passes international border through Lepenc river being poured into the Vardar River and then into the Aegean Sea. Therefore, this research aims to raise awareness of the region's population, that effective measures be taken to better management of the waters of the river in order to preserve the flora and fauna of the river Neredime and other rivers in the territory of Kosovo.

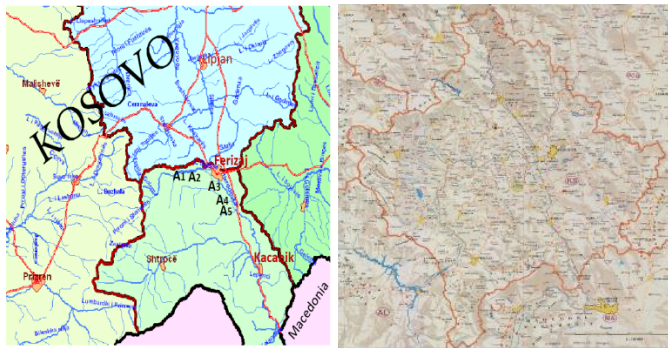
## 2. Materials and methods

In order to research water quality of the river Neredime made physic-chemical analysis of water samples at five sample-locations that flow along the river. Sampling is done after preliminary study of the river as well as the sample-places. Research periods of physical-chemical parameters have been developed in three seasons: in summer, autumn and winter, when it can be seen that there are different data depending on the season when the research is done. Sampling places are chosen so that it can be transmitted to water quality change with very little influence of anthropogenic factors (A1) as well as sample-places where we have big sources of pollutants, especially from municipal sewer. It holds serious account for distance between sample-places with aim to enable getting out of conclusions for compare their reciprocal. Sampling places are marked with A1, A2, A3, A4 and A5.

A1 - Place of the two junctions of river, in the village of Neredime; A2 - Before entering the town of Ferizaj; A3 - Place after leaving the town of Ferizaj; A4 - Place near municipal wastewater discharge, the second discharge of sewage city collector on the outskirts of the village Varosh; A5 - Near the village Gurëz respectively 600m from place of discharging the second wastewater city collector.

For the determination of physico-chemical parameters of contaminated water samples were used standard methods of chemical analysis such as: classical methods (Titrimetria) and spectrophotometric methods (UV-VIS spectrophotometer). During the experimental work there are used chemicals and solvents purity from different manufacturers such as "Merck" "Alkaloid", etc. Initially there are prepared base solutions and diluting their concentrations are prepared with the necessary solutions. Conductivity is measured with Conductometer "Conduktivty / TDS, Meter, HACH"; The turbidity with Turbidimeter "2100 P"; pH value with pH meter "Metrohm 632". Spectrophotometric determinations are made with photometer "Palintest 5000" and spectrophotometer "HACH 2010".

**Fig. 1.** Map showing location of sampling area in Neredime River at Ferizaj region, Kosovo



## 3. Sample Analyses

In the European Union Countries, the assessment of the results for quality of the surface water are reported based on the qualifying system, in which the quality of the water is considered to be satisfactory in the first category until the third. The water of the fourth category are considered as polluted water, whereas of the fifth category is considered extremely polluted water. Table 1 shows the qualification set by Economic Commission of the United Nations for Europe, UNECE. [2]

During the research we have followed the change of water quality of the river water Neredime in various site-sampling through these parameters; temperature, pH value, conductivity, turbidity, dissolved oxygen, chemical oxygen consumption, chloride, nitrite, nitrate, ammonia, manganese and iron. Analyses were conducted at the Institute of Public Health-Regional Institute in Ferizaj. Because of lack of the laboratory conditions, determination of heavy metals concentration was impossible.

Water samples were taken and preserved according to water sampling regulations (Dalmacija, 2000). [3]

**Table 1.** Classification of the river water according to UNECE (content mg/l)

| Category    | P <sub>total</sub> | NO <sub>3</sub> <sup>-</sup> | DissolvedO <sub>2</sub> | BOD <sub>5</sub> | COD   | NH <sub>4</sub> <sup>+</sup> |
|-------------|--------------------|------------------------------|-------------------------|------------------|-------|------------------------------|
| Quality I   | <10                | <5                           | >7                      | <3               | <3    | <0.1                         |
| Quality II  | 10-25              | 5-25                         | 7-6                     | 3-5              | 3-10  | 0.1-0.5                      |
| Quality III | 25-50              | 25-50                        | 6-4                     | 5-9              | 10-20 | 0.5-2                        |
| Quality IV  | 50-125             | 50-80                        | 4-3                     | 9-15             | 20-30 | 2-8                          |
| Quality V   | >125               | >80                          | <3                      | >15              | >30   | >8                           |

**Table 1.** Samples results in five (5) locations in summer season

| RESULTS       |                                    |       |       |       |       |       |
|---------------|------------------------------------|-------|-------|-------|-------|-------|
| Summer Season |                                    |       |       |       |       |       |
|               | Type of Analysis                   | A1    | A2    | A3    | A4    | A5    |
| 1             | Water Temperature, °C              | 15    | 16    | 16    | 18    | 18    |
| 2             | Air Temperature, °C                | 26    | 26    | 26    | 26    | 26    |
| 3             | Turbidity NTU/FTU                  | 7.06  | 5.79  | 5.13  | 12    | 11.31 |
| 4             | PH Value                           | 8.52  | 6.82  | 8     | 8.1   | 7.25  |
| 5             | Dissolved Oxygen, mg/l             | 7     | 6.5   | 4     | 1.5   | 2.5   |
| 6             | Potassium Permanganate Demand,mg/l | 4.74  | 8.22  | 12.64 | 30.12 | 30.97 |
| 7             | Chlorures, mgCl/l                  | 11.36 | 14.2  | 15.97 | 53.96 | 50.41 |
| 8             | Ammonia, mgN/l                     | 0.09  | 0.2   | 0.93  | >1.5  | >1.5  |
| 9             | Nitrites, mgN/l                    | 0.009 | 0.046 | 0.171 | 0.05  | 0.042 |
| 10            | Nitrates, mgN/l                    | 0.1   | 0.45  | 0.67  | 0.44  | 0.14  |
| 11            | Iron, mgFe/l                       | 0.02  | 0.14  | 0.34  | 0.49  | 0.51  |
| 12            | Manganese, mgMn/l                  | 0.06  | 0.1   | 0.2   | 0.5   | 0.45  |
| 13            | Conductivity, µs                   | 270   | 342   | 395   | 620   | 597   |

**Table 2.** Samples results in five (5) locations in autumn season

| RESULTS       |                                    |       |       |       |       |       |
|---------------|------------------------------------|-------|-------|-------|-------|-------|
| Autumn Season |                                    |       |       |       |       |       |
|               | Type of Analysis                   | A1    | A2    | A3    | A4    | A5    |
| 1             | Water Temperature, °C              | 5     | 8     | 8     | 10    | 9     |
| 2             | Air Temperature, °C                | 8     | 8     | 8     | 8     | 8     |
| 3             | Turbidity NTU/FTU                  | 24.16 | 3.89  | 6.44  | 23.35 | 16.12 |
| 4             | PH Value                           | 7.75  | 7.73  | 7.7   | 7.67  | 7.1   |
| 5             | Dissolved Oxygen, mg/l             | 7.5   | 6     | 5.5   | 2     | 2.5   |
| 6             | Potassium Permanganate Demand,mg/l | 5.37  | 8.85  | 11.06 | 24.65 | 25.91 |
| 7             | Chlorures, mgCl/l                  | 7.455 | 9.94  | 18.46 | 36.21 | 43.31 |
| 8             | Ammonia, mgN/l                     | 0.1   | 0.25  | 0.9   | >1.5  | >1.5  |
| 9             | Nitrites, mgN/l                    | 0.005 | 0.033 | 0.095 | 0.057 | 0.048 |
| 10            | Nitrates, mgN/l                    | 2.1   | 2.84  | 5.2   | 10.2  | 12.2  |
| 11            | Iron, mgFe/l                       | 0.03  | 0.1   | 0.3   | 0.55  | 0.5   |

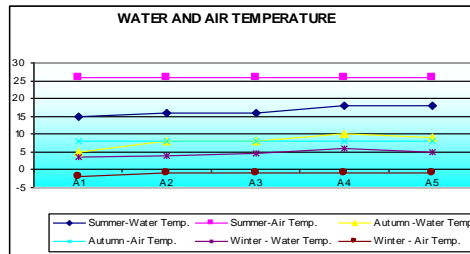
|    |                       |       |      |      |       |      |
|----|-----------------------|-------|------|------|-------|------|
| 12 | Manganese, mgMn/l     | 0.055 | 0.09 | 0.19 | 0.513 | 0.46 |
| 13 | Conductivity, $\mu$ s | 240   | 356  | 387  | 506   | 508  |

**Table 3.** Samples results in five (5) locations in winter season

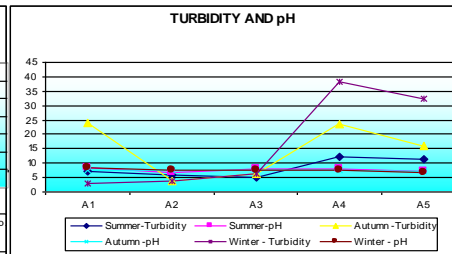
| RESULTS |                                    | Winter Season |       |       |       |       |
|---------|------------------------------------|---------------|-------|-------|-------|-------|
|         | Type of Analysis                   | A1            | A2    | A3    | A4    | A5    |
| 1       | Water Temperature, °C              | 3.5           | 4     | 4.5   | 6     | 5     |
| 2       | Air Temperature, °C                | -2            | -1    | -1    | -1    | -1    |
| 3       | Turbidity NTU/FTU                  | 2.86          | 3.77  | 6.26  | 38.23 | 32.56 |
| 4       | PH Value                           | 8.31          | 7.69  | 7.75  | 7.66  | 6.67  |
| 5       | Dissolved Oxygen, mg/l             | 8             | 6.5   | 5.5   | 2     | 2.5   |
| 6       | Potassium Permanganate Demand,mg/l | 3.16          | 6.32  | 12.64 | 26.54 | 27.81 |
| 7       | Chlorures, mgCl/l                  | 7.1           | 12.42 | 14.55 | 29.56 | 33.72 |
| 8       | Ammonia, mgN/l                     | 0.02          | 0.68  | 1.72  | >1.5  | >1.5  |
| 9       | Nitrites, mgN/l                    | 0.003         | 0.048 | 0.058 | 0.079 | 0.069 |
| 10      | Nitrates, mgN/l                    | 0.77          | 1.57  | 0.68  | 0.52  | 0.1   |
| 11      | Iron, mgFe/l                       | 0.02          | 0.22  | 0.4   | 0.34  | 0.36  |
| 12      | Manganese, mgMn/l                  | 0.031         | 0.181 | 0.272 | 0.571 | 0.537 |
| 13      | Conductivity, $\mu$ s              | 237           | 429   | 451   | 522   | 563   |

### Results and Discussions

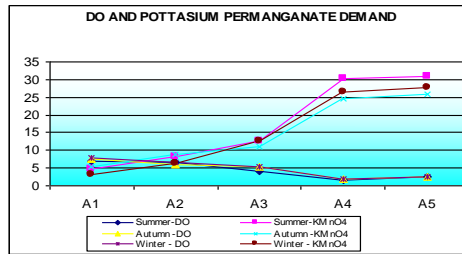
From the results experimentally obtained seen that by a clean river where water can be used for recreation, fishing, irrigation and even drinking water, due to the impact of pollutants in the exit from the city of Ferizaj, water of Neredime river suffers significant shift in quality.



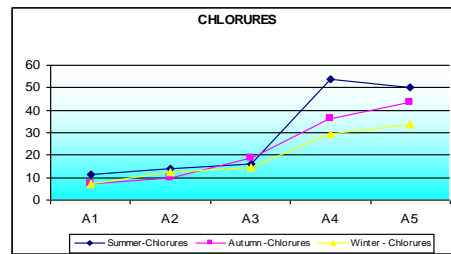
**Graph. 1.**



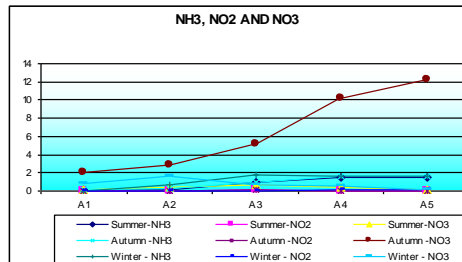
**Graph. 2.**



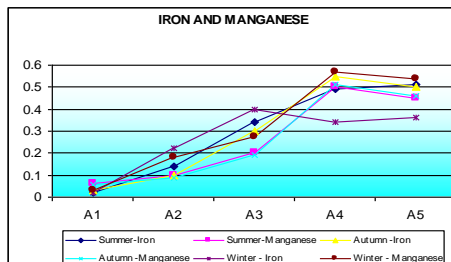
Graph. 3.



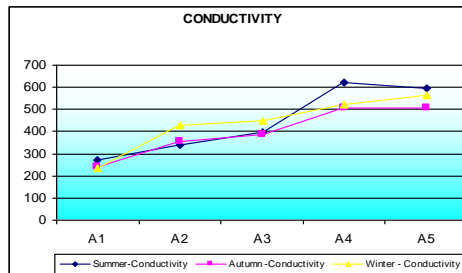
Graph. 4.



Graph. 5.



Graph. 6.



Graph. 7.

By comparing the average results of tests taken during the monitoring features of the classification of the quality of rivers by UNECE, the monitored water quality can be classified in the category of water quality II (A1), quality III (A2), quality IV (A3) and the quality V (A4 and A5). In these waters (A3, A4 and A5), there are no conditions for life to aerobic organisms, and at the same time can also be a potential source of various infectious diseases.

## Conclusion

After testing of the physico-chemical water parameters of river Neredime, southwest branch, in certain locations and at different periods of the seasons, we can draw the following conclusions: - Based on the results of laboratory analysis at the Institute of Public Health-Regional Institute of samples taken at the water river Neredime shows that the water of the river undergoes major differences from the source to the outskirts of the town Ferizaj. On the sampling place A1, the water is relatively clean. Characteristic is that in this location found a little bit of turbidity. It is present because the riverbed is stony and sandy as well as the high speed of the water flow. In sampling place A2, after crossing several villages and before entering the city, the parameters indicate that the water here has not essential physico-chemical changes in terms of pollution with organic matter. Comparing with the previous sampling place, in this locality observed low increase of pollution parameters. Higher pollution of the river water observed at the sampling place A3, the river segment at the exit from the city. Lower values of dissolved oxygen, increasing the presence of ammonia and especially

high values of nitrites in this location make this pool of highly contaminated river and unfavorable to the living environment. Especially in this location it was noted a large presence of solid waste such as paper, plastic masses, etc. In sampling place A4, near the discharge of municipal wastewater, there are observed major pollution exceeding every category and pollution in this level makes the river without life. High values of COD, chlorides, ammonia and especially small presence of dissolved oxygen make this segment of highly contaminated river. The values of organic parameters found experimentally in sampling place A5, about 600 m from the city sewage discharge, remain high compared to standard values. Characteristic of this is that the samples taken after the distance of the discharge, still the amount of dissolved oxygen remains low as well as other parameters have not suffered decrease, which shows that the water of the river is dead environment for aerobic organisms. Anaerobic bacteria can not live when dissolved oxygen is present. They use chemically combined oxygen such as nitrates (NO<sub>3</sub>) or sulphates (SO<sub>4</sub>). They are active in anaerobic digestion and are associated with treatment processes including: decomposition, odor and septic (infection). [4] Then, ammonia is the first product of the decomposition of organic materials. His presence over the values set by the EU clearly shows water loaded with organic matter. At high concentrations the ammonium very easily oxidized into nitrates. Ammonium content in drinking water is a sign of their microbial contamination (from sewage). Ammonia is acting as toxic to fishes, especially in the form of neutral molecules.[5] From this we can say that self-cleaning capacity of the river is minimal. This is because the amount of flow of the river is small compared with large discharges and this makes impossible to clean waste water from the river itself. With tendency to Kosovo to move towards European integration it needs to act to fulfill the preconditions for the ratification of the more environmental conventions and protocols. Since the most of the Kosovo rivers flow outside its borders, the Republic of Kosovo must pay attention to maintaining the quality of these waters and particularly the possibility of ratification of the Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Pollution knows no national boundaries. Pollutants emitted in a country by air currents, streams of water, food and in other ways, often carried in very large distances, and so often attack the countries that are not sources of pollution. Contamination of the environment by volume, types and consequences has reached such proportions that it has become the concern of all humanity. [6] Kosovo's national policy includes EU integration process. One of the challenges is to meet the EU environmental standards and the harmonization of national legislation with EU legislation. Kosovo is working to harmonize with EU directives through the Water Framework Directive (2006/12 / EC), the Directive on Urban Waste Water (91/271 / EEC), Drinking Water Directive (98 / 83 / EC) and Nitrates Directive (91/676 / EEC). [7]

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