Nutrients Regime in the Urban Waters

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Abstract: Deterioration of water quality due to the pollution with nutrients is one of the most serious issues in Moldova. Analysis in many countries of the world shows that nitrogen and phosphorus circulate in environment and reach water ecosystems, causing eutrophication (alge-bloome) of water ecosystems situated far from the place of introducing of fertilizers particularly in urban landscapes. This study aims to demonstrate whether urban landscapes become a source for water pollution.

Key Words: Nitrogen, Phosphorus, Eutrophication, Environment, Ecosystem

Introduction

Nitrogen and phosphorus are one of the most important elements in the creation of organic substances (proteins, lipids, nucleic acid, etc). Their average concentration in the natural waters is – 0,3-0,7 mg/l in oligotrophic waters, in mezotrophic- 0,7 – 1,3 and in eutotrophic 0,8 – 2,0 mg/l for N and 0,005 – 0,200 mg/l (in unpolluted waters) for P. They are one of the most biofilic elements in living organisms, playing important role in the different biochemical processes. These elements are also widely used in different types of mineral and organic fertilizers introduced under agricultural crops. So as, Moldova is an agricultural country (80% of the territory is covered by agricultural lands), with intensive agricultural practice, these elements are playing an important role in its economy and in the changes of the state of environment.

Deterioration of water quality due to the pollution with nutrients is one of the most acute issues in Moldova. Environmental Action Plan of Moldova presumes actions on the reducing of the impact of pollution environment with nutrients. That is why National institute of Ecology of Moldova is elaborating complex of measures aimed on the rational use of water recourses including urban areas.

Experience accumulated in many countries of the world shows that nitrogen and phosphorus circulate in environment and reach water ecosystems, causing eutrophication (alge- bloome) of water ecosystems situated far from the place of introducing of fertilizers.

This phenomena becomes much worth in the urban landscapes, where discharges of the wastewaters in environment and run off originated from different sources (tragic, recreation, rubbish and municipal wastes) in the towns add additional amounts of nutrients. Thus, urban landscapes can become a serious source of pollution of water ecosystems, reduce biodiversity and create unfavorable conditions for different water users.

This problem is very acute and for town Chisinau, capital of Moldova, which is surrounded by agricultural lands, with high level of mineral and organic fertilizers use. Recently, National Institute of Ecology of Moldova is carrying out a study aimed on the development of the complex scheme for rational water resource management of urban water resources and the present study was conducted in the frame of this activity.

Two lakes are situated in different parts of the town with different sources and types of feeding and pollution were selected for the case study. First lake is situated in the parking and recreation part of town. Mainstream entering into the lake drainage agricultural area with intensive fertilizers use (250 kg of N and P per hectare at the end of 80 and 50 – actually), enterprise for detergents, village with 10000 inhabitants, without centralized sewer system and wild rubbish deposits along the stream. Second one, has not tributaries influenced by agriculture, and is surrounded by park and living area with multi-storied living blocks with centralized sewer system. Main source of water for this lake is underground and shallow water aquifers.

Main results of the study were discussed with the specialists from National Institute of Ecology and Department for Environmental Protection of Moldova and were included in the final report for the complex water scheme of water use in the town.

Methodology of the Study

Recent study was made using standard field and laboratory methodology and equipment. Field trips were held on the lakes, described above. Lakes were sampled by using bathometer, which allowed receiving water samples from the depth 1; 2; 3 and 4 meters. The last level characterizes water volume near bottom, where physic chemical conditions (pH, temperature, oxygen demand and concentration etc,) strongly change. All sample were put into the clean glass battles, which were also washed by sample water before taking sample.

Oxygen, pH and temperature of the water were measured directly during the field trips by using portative oxygen-, pH and temperature meters equipment. All collected sample were analyzed in the same day in the laboratory conditions. Laboratory studies were made by using photo- calorimetric equipment and methodology. All samples were filtered and then analyzed. Ions of NO3 were analyzed with sodium (natrium) salicylate, with further evaporation, dilution with distilled water and colouring final solution with 7H NaOH. Then the liquid part was colorimetered.

Ions of NO2 were analyzed with GRISS reactive. This chemical was used for receiving of the colored solution, which color density was also colorimetered by using photo colorimeter.

Ions of NH4 were analyzed with NESSLER reactive. The density of its colored solution was also measured with the same equipment.

The photo calorimetric methodology was also used and for analyzing of the ions of PO4. Its colored water solution was received by using of the SnCl2.

Each sample for each ingredient was analyzed 3 times and average concentration was calculated from 3 meanings by using standard statistical procedure.

All analyses were made in the filtered water solutions, conform standard methodology for filtration.

The results of the analyses were stored in the database format. All graphics and tables were created in Microsoft Office and Excel.

Results and Discussions

Obtained data show that amount of phosphorus is slightly decreasing with the depth. In the same time its concentration is declining and due to the increasing of the temperature of the water. These phenomena can be legated with the consuming of this element by water organisms the same time concentration of NO3 practically does not change. The concentration of another form of nitrogen NH4 is reducing in correspondence with the temperature growing. So as, ammonia is more acceptable for the initial stage of mineral feeding of water organisms in the spring season, the concentration of this form of nitrogen is also decreasing. Another form of nitrogen – NO3 cannot be utilized due to the low concentration of phosphorus, which is used for biological energy consumption.

Conform scientific data the most optimal ratio between N and P is 10: 1. In our cases total amount of mineral nitrogen is around 3-4 mg/l, while for phosphorus it varies from 0,001 to 0,003 mg/l. Thus, ratio between this elements in studied lakes varies around 1000: 1. It allows to say, that very insignificant part of nitrogen can be used for the development of organic substances in water ecosystems.

Concentration of the NO3 form practically does not change in water ecosystems in studied lakes. Increased amounts of this ingredient were determined in the lake which tributaries drainage rural area, with private households without sewer system and agricultural area with intensive agricultural practice and fertilizers use.

Concentration of NH4 in the studied water ecosystems also indicate on much higher pollution of the lake, which has tributaries from agricultural lands and village with private households without sewer system. The difference between these two lakes by ammonia concentration is more significant 10: 1in the period with low temperature and till 2: 1 in the period of increased temperature. In the same time this ratio for NO3 is 2: 1. These phenomena, probably, can be explained by the fresh organic pollution originated from organic wastes from rural area. The lower ration for NH4 was found in the lake, which is fed by underground water and surrounded by multi-storied houses with centralized sewer system can be explained by less direct discharges of wastes (no emissions and wild rubbish deposits were observed during the field trips).

Increasing of concentration of NO3 was observed in the lake with tributaries from agricultural fields and rural area. These phenomena can be explained by growing of the pH meaning, which normally increases near bottom level. It varied in this lake from 7,5 near the surface and other levels, while near the bottom, where oxygen concentration significantly reduces and is not enough for oxidation of organic substances, accumulated in sediments. Conform estimations of humus concentration in the sediments of the lakes, made by National Institute of Ecology of Moldova in 1992, it is on the level of 5-6 % (while in soils – 2-

3%). Higher humus concentration, in the sediments, in comparison with soils, demands significant amounts of oxygen for decomposition of organic compounds.

That is why, we can presume lower oxygen concentration in the near bottom water level, in comparison with the previous ones and increasing of the pH. Such processes can presume poor destruction of organic compounds and its accumulation.

Distribution of NO2 ions shows its increase in the water period of time, when speed of physic-chemical reactions is strongly growing (Le-Shatelie postulate). So as, this form of nitrogen is transition form between NH4 and NO3 and vice-versa, we can presume that this increasing is connected with much more intensive transforming of the ammonia form into NO2 form and further to NO3.

Conclusion

On the base of the study, held in April- May 1997 in different types of lakes (different sources of pollution, sources of water etc.) in the town of Kishinev (Chisinau), capital of Moldova next conclusions can be made:

1. Consuming of nitrogen for creating of the organic substances is limited by the low concentration of phosphorus. Ratio between N and P is 1000: 1 during whole period of study. This ratio is relatively constant in independence of the sum of concentration of different forms of nitrogen and phosphorus.
2. Decreasing of the ratio between concentration of ammonia and nitrate forms of nitrogen as function of temperature indicates on the utilization of the ammonia forms primary to the nitrate ones.
3. Agricultural and rural areas populated with private households, not connected to the centralized sewer system are important source of pollution of urban water ecosystem with nutrients via tributaries. Analyses showed much higher concentrations of studied ingredients in the streams of this lake.
4. Recent state of environment in the surrounding of the studied lakes shows that mesh organic pollution comes from the rural populated area without centralized sewer system. Underground feeding lake has much lower concentration of ammonia, which can indicate on poor pollution of groundwater with NH4. Its concentration in shallow waters is much lower than in the lake 1.

Recommendations for Actions

1. One the base of the results obtained from the recent study future proposals can be made for improvement of the state water resources in urban landscape.
2. So as, main limit factor for the further eutrophication in the studied lakes is phosphorus concentration, it is necessary to elaborate, measure aimed on the phosphorus, emission reduction (first of all use detergents with low P- content, removal of unauthorized rubbish deposits of municipal wastes, sanation of urban territory etc.

3. To intensify scientific activity in the field of influence of phosphorus and ratio of these element with nitrogen on the state of water ecosystems and to precise relevant standards for nitrogen.

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