The Chemical and Ecological State Evaluation of a Storage Lake

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The Secu Lake (in Caras Severin County) main use is the city drinking water supply. Therefore, to evaluate the water quality, there were analyzed the general chemical indicators monthly average values. Qualitative analyzes were performed in SC Aquacaras SA Central Laboratory, indicators monitoring being recorded within three years. The lake raw water assessment provides information in order to establish the required treatment methods for drinking water. From this study, it can be observed that the lake water satisfies the conditions stipulated by Romanian legislation on surface water quality (chlorides, sulfates, dissolved iron, and ammonia). However, if the recommendations and limits imposed by the World Health Organization are analyzed, for some indicators corrections must be made to ensure the human health protection.

Keywords: chemical indicators, ecological indicators, surface water, hydrographic basin, water quality

Aspects of chemical status for sustainable development of water resources

Global distribution of water resources is variable. Their quality is increasingly influenced by chemical pollutants resulting from domestic and industrial activities. For this reason it is necessary to adopt measures to monitor pollutants in order to develop environmental management plans to protect water resources.

Achievement of the sustainable development objectives depend to a large extent on the water resources integrated management.

For a qualitative and socio-economic quantitative development, without negative influences on ecosystems, it is necessary to apply a management system to concentrate the efficient use of water and hydrographic basins protection (water natural flow and nutrients maintenance, self-cleaning capacity, the requirements of water supply and payment services maintenance, maintenance and development of profitable and environmentally friendly economic activities, the ability to develop effective institutional structures for water management).

The integrated management of water resources is based on The Hydrographic Basin Management Plan which aims measures to achieve a water quality appropriate level of sustainable use [1].

Thus, in the Timiº river basin, aspects of the integrated water management of the Secu Lake, in Caras Severin were analyzed.

Secu Lake has an area of 105.67 hectares and a volume of 15132000m³ being used for: Resita water supply, the city flood defense and entertainment within the tourist resort.

In accordance with the Resita Management Plan during 2008 - 2010, proposed to improve the city water and sewerage system, rehabilitation works at the water treatment and purification station were completed. Recent studies from chemical point of view on the treated and purified water quality [2, 3], show that the recorded parameters indicate the necessity for further qualitative assessment of the raw water.

The lakes water quality influence factors

Surface water quality differs from that of the primary effluent. Especially this is often the case for storage lakes, their quality being influenced by the period of stagnation and natural atmospheric phenomena. Temperature variation, depending on season, determine stratification and destratification phenomena throughout the water mass. By modifying the content of bacteria, nitrogen and dissolved organic carbon, water color and flavor will be affected. The turbidity degree of water manifests itself differently depending on weather changes. Other causes of water pollution are radioactive and dust particles driven by precipitation and vegetation involvement in various stages of degradation due to soil washing.

As a result of domestic industrial and agricultural usage, surface waters are polluted with various organic and inorganic non-degradable or partially degraded substances resulted from treatment processes, chemical residues, bacteria, metals, herbicides, insecticides, etc.

The water quality varies in space and time due to both anthropogenic factors action, resulted from the waste water discharge, and natural, such as weather, geographic and geologic conditions, vegetation, seasons, and diurnal variation.

In terms of rainfalls and melting snow, the resulted waters are muddy, showing low hardness and high bacteria concentration, opposite to those of the arid areas which are characterized by high hardness and high mineral compounds concentration.

The soil type also influences the quality of the lake water. Thus, clay soils are causing the sludge production, while the cultivated land determines the water pollution with herbicides, pesticides, etc. The landslides have a significant contribution to the water quality degradation, because due to their sudden discharge, are increasing the amount of particles in suspension. The waste plant and vegetation fall directly into the water, being carried over by wind and floods.

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Experimental part

The average monthly evaluation of Secu Lake water chemical indicators

The Secu Lake, located in the Nemanu foothills belongs to Banat hydrographical basin characterized by various and complex geological conditions. Ground getic crystalline in the Semenic Mountains is represented by a meso-metamorphic series consisting of augen gneiss, amphibolites schist, mica schist, migmatite metal-imestone phyllite and metadolomic.

In geotechnical terms, the mountainous area offers optimal conditions for storage lakes formation due to the presence of crystalline schist and igneous bodies represented by granite bodies, and in tectonic terms, the conditions are unfavorable due to the presence of faults and fissures in the rock bodies [4].

The Barzava River, which flows through various geological areas, captures during its course many streams, causing a different water types mixture, resulting in one water type.

The anthrophic pollutants influence is significant. Therefore, it is necessary to analyze their level and impact on the Secu lake water quality, which is used to supply the city drinking water.

By taking into account that the surface lakes water is mainly used for the preparation of consumption drinking water, it is necessary to keep the limits imposed on specific indicators in order to reduce the water pollution and protect water against after degradation.

For this purpose, surface waters must be monitored and treated according to the treatment standard methods used to transform surface water from A1 category (simple physical treatment and disinfection), A2 category (normal physical treatment, chemical treatment and disinfection) and A3 category (physical and chemical treatment intense aeration and disinfection) in drinking water [5].

In order to evaluate chemical and ecological state of Secu Lake water, there were analyzed the monthly average values of the following general chemical indicators: chlorides, sulfates, dissolved iron, and ammonia. Qualitative analyzes were performed with the Central Laboratory of SC Aquacaras SA. The monitoring of these indicators has been achieved during a period of three years, 2008-2010 [6].

The source of chlorides occurrence in the lake water represented by the mineral soil, rocks and organic materials in the form of negative ions (Cl-).

Results and discussions

In figure 1, from chlorides average values plotting is can be observed that, compared to the permissible limits in Romania, for drinking-water (<250mg/L), the lake water is characterized by low chloride content, which requires a pre chlorination in order to prevent algae and bacteria [7, 8].

Concentrations below 10mg/L, specific to areas which are not arid are recorded throughout the monitored period, meaning that the water is acceptable in terms of human consumption. For this reason, it cannot be used directly, but requires treatment to ensure a less than 0.01mg/L free chlorine quantity at the consumer tap.

In the surface lake waters, sulphates are present in a concentration of 1000mg/L. When water is used for industrial purposes due to the combination reaction with calcium deposits, it precipitates resulting adherent deposits inside the installations. Therefore, concentrations above 250mg/L are not admitted.
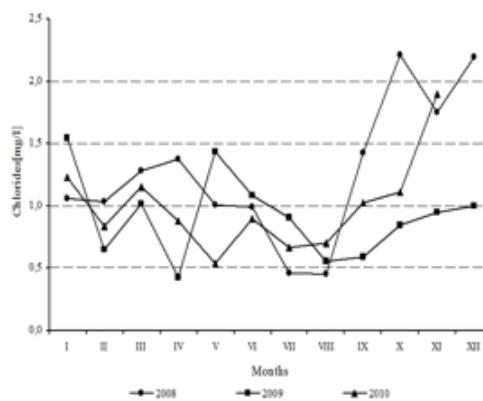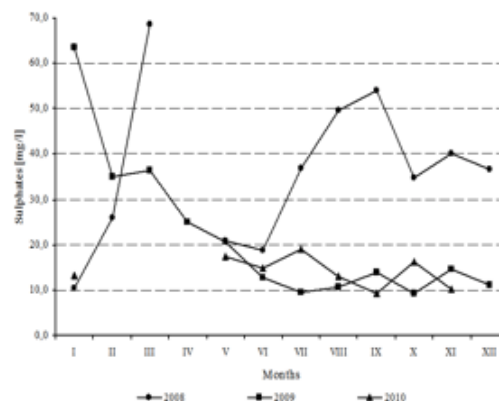

Fig. 1. Monthly average variation of chloride

Fig. 2. Monthly average variation of sulphates

By analyzing the sulphates concentrations present in the Secu Lake water (fig. 2) it can be noted that the values recorded, even if they were higher in 2008 and early 2009, do not endanger the human health and does not require correction.

In accordance with the legislation limits in force Romania [9], the iron concentration in drinking water should not exceed the value of 2mg/L. World Health Organization recommends a limitation of this indicator to 0.1mg/L and requires complying the limit of 0.2mg/L. For this reason it is necessary to treat the lake water by the A1 method [5].

Figure 3 shows that the raw water average monthly values are between 0.015mg/L and 0.35mg/L with a maximum of 0.57mg/L, recorded in April 2008, corresponding to the surface waters specific values. For this lake type, well aerated, the iron concentration above 0.1mg/L has negative influence on taste and smell, increasing the water turbidity.
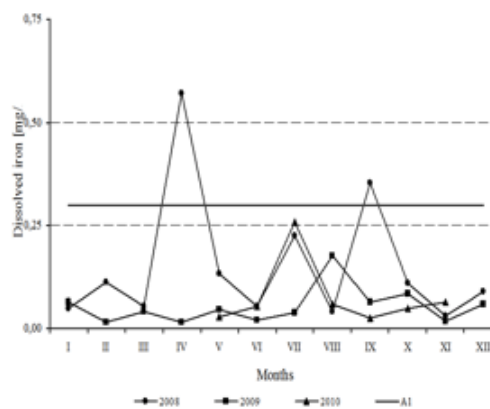

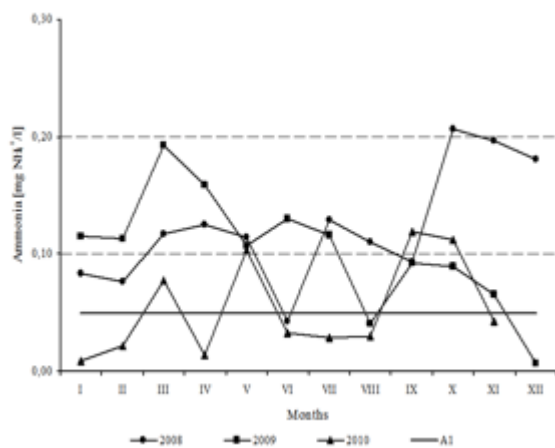Fig. 3. Monthly average variation of the dissolved iron

Fig. 4. Monthly average variation of ammonia

Excluding the maximum value recorded in the warmer months of the monitored years, the iron concentration in water is around 0.2mg/L, which makes it inadequate in terms of industrial use.

Regarding the potable water production, the lake water is not characterized by iron harmful concentrations.

The ammonia presence in the supplied water is limited by the rules recommended by the World Health Organization (WHO), to very small quantities (below 0.05mg/L) due to the harmful effects they can have on consumers [5].

According to the Romanian legislation [7-9] for the ammonia recorded values (fig. 4), there are not exceedances. If the values are reported to those recommended by WHO (A1) and European legislation, there is significant exedance which can derive from various causes [5].

Since most monthly average concentrations are above 0.05mg/L (A1), rapid filtration and disinfection are required.

Change in the concentration of NH4 ion is due to the nitrogen conversion potential, which in the precipitation samples is present as ammonia, nitrate and organic nitrogen [10].

The recorded ammonia quantities are due to both the rainfall regime during monitored years and degradation of organic matter containing nitrogen, protein and vegetable waste.

Regarding the oxygen dissolved in water, its concentration varies depending on water temperature, as the water is characterized by an oxygen absorption limit.

Conclusions

By taking into account the water quality importance, numerous studies regarding surface water phisycal and chemical particularities were accomplished[2, 3, 10-22].

The accomplished analysis shows that the Secu Lake water quality indicators are within the Romania legislation limits regarding the surface water quality.

However, in terms of consumer health protection, are required minor corrections of the analyzed indicators, such as chlorine, ammonia and dissolved oxygen.

For chloride, in order to obtain potable water, the raw water treatment by chlorination is required.

Where, in terms of WHO, ammonia exceeds the recommended limits, especially during periods of high precipitation regimes, it is necessary to apply simple physical treatment and disinfection.

The Secu Lake raw water evaluation by recording average monthly values of the analyzed indicators provides information necessary to establish treatment methods that imposed in order to produce potable water.

In addition to these indicators monitoring, there should be considered both the hydrographical basin characteristics and human activity impact. It should also be periodically monitored other indicators that are neglected because it is assumed that the lake water does contain them, but which can have negative effects on human health.

Based on these analysis results, there can be developed programs of measures in order to provide the ecological surface water.

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