Assessement of Water Quality Parameters in Some Potential Pollutant Areas from Romania

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Monitoring of environmental factors allows the achievement of some important objectives regarding water quality, forecasting, warning and intervention. The aim of this paper is to investigate water quality parameters in some potential pollutant sources from northern, southern and east-southern areas of Romania. Surface water quality data for some selected chemical parameters were collected and analyzed at different points from March to May 2017.

Keywords: parameter, environment, surface water quality, indicator

Surface water can be affected by agricultural or industrial practices, pollution and environmental change. The type and concentration of chemical elements and compounds in a freshwater system are subject to change by different natural processes-chemical, physical, biological, hydrological - caused by climatic and geological conditions. Monitoring allows the achievement of some important objectives regarding water quality, forecasting, warning and interventio [1,2].

Water quality monitoring is based on available quantitative information related to the physical, chemical, and biological characteristics of water via statistical sampling. The type of information sought depends on the objectives of the monitoring programme. Water quality monitoring is a fundamental tool in the management of freshwater resources and it provides details of sampling and analytical methods [2].

The composition of surface waters is dependent on natural factors (geological, topographical, meteorological, hydrological and biological) and varies with seasonal differences in runoff volumes, weather conditions and levels. Monitoring and assessment of the environmental state of surface waters are performed by numerous regional and national authorities [2,3].

Water is a limited resource and it is considered a natural heritage that must be protected and defended. There are many areas that are affected by different extremes: very high temperatures, rain, drought and flooding. These phenomena are caused by many factors, but it is certain that climate change intensifies both their frequency and severity [3-5].

A significant message of the Fifth Global Environment Outlook of the United Nations Environment Programme (UNEP) is that some major water *problems facing* the world can be solved efficiently with an integrated management approach directed to the sustainable use of water. In order to achieve this goal, it is essential to use effective water-monitoring programmes, together with data management [4,5].

Measurable water quality characteristics can be grouped into the following categories:

-General variables (e.g. temperature, conductivity, colour, discharge) used for a general characterization of water quality.

-Suspended particulate matter (e.g. suspended solids, turbidity and organic matter).

-Organic pollution indicators (e.g. dissolved oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD)).

-Organic micropollutants, such as pesticides and other toxic chemicals used in industrial processes (e.g. PCB, HCH, PAH).

-Indicators of acidification (e.g. *p*H, acidity, alkalinity, phytoplankton and diatom sampling).

-Specific ions (e.g. Cl^-, NO_3^-, SO_4^{2-}, Na^+, K^+, Ca^{2+} and Mg^{2+}) as essential factors in determining the suitability of water for most uses (public water supply, livestock watering and crop irrigation).

-Metals (e.g. cadmium, mercury, copper, zinc).

-Indicators of radioactivity (e.g. total alpha and beta activity, ^{137}Cs, ^{90}Sr).

-Microbiological indicator organism (e.g. total coliforms, faecal coliforms and faecal streptococci bacteria).

-Biological indicators (e.g. phytoplankton, zooplankton, zoobenthos, fish, macrophytes) [3].

The indicators that give information about the presence of organic substances in water are Chemical and Biochemical Oxygen Demand. The dissolved oxygen concentration normally varies between 4-6 mg/L, depending on the category of use, lowering this limit having the effect of stopping the aerobic processes, with very serious consequences [5].

Water hardness is a crucial parameter that characterize the final use of water for different industrial branches *and it* is the result of dissolved minerals presence. [4] The main reason for abundance of calcium ions in water is the natural occurrence in the Earth's crust. Generally, rivers contain 1-2 mg/L calcium, but in lime rivers area calcium concentrations up to and exceeding 100 mg/L are common. [5]Calcium and magnesium salts, the most common *cause* of hardness in *water,* can engage in reactions that leave insoluble mineral deposits, which make hard water unsuitable for many uses [7]. *Water hardness* is based on the chemistry concentrations *of the major* polyvalent metallic ions from sedimentary rocks and runoff from soils. Mg^{2+} and Ca^{2+} are present in many sedimentary rocks, the most common being limestone and chalk. Only a minor contribution to the total hardness of water is made by other ions, such as: Ba^{2+}, Al^{3+}, Mn^{2+} and Zn^{2+} [5,7]. Excessively hard water can also lead to corrosion problems. Soft water that is not stabilized has a great tendency to cause gradual decay and deterioration of metal surfaces and pipes, resulting in the presence of

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certain heavy metals, such as cadmium, copper, lead and zinc in drinking-water [7].

Common inorganic pollutants include ammonia from wastewater effluent discharges, nitrates and phosphates arising from agricultural land, heavy metals (e.g. lead, copper, zinc, cadmium and mercury). The toxicity of metals varies greatly with water hardness, *p*H, dissolved oxygen levels, salinity, temperature and other parameters [8].

The most common elements which are monitored from surface waters are sodium, potassium, calcium, magnesium, sulphur and chloride. Chloride ion (Cl^-) is the main ion in seawater and it is widely distributed in the environment, as salts with sodium, potassium and calcium. Elevated levels of sodium and *chloride occur* naturally in the immediate seacoast areas [3].

Ammonia is a form of nitrogen, that is directly toxic to aquatic life. It is used either directly or indirectly in industries and comes from wastewater treatment plants, animal waste or air pollution and runoff from agricultural land. Environmental factors, such as *p*H and temperature, can affect ammonia toxicity to aquatic organisms. *Ammonia* in *water* may occur either as *ammonium* ion (NH_4^+) or as free *ammonia* (NH_3). Natural reactions of different atmospheric forms of nitrogen with rainwater result in the formation of nitrate and ammonium ions [3,8].

The most important organic substances of natural origin are: tannin, lignin, carbohydrates. Synthetic organic pollutants can occur from refinery processing of the different substances (gasoline, diesel oil, organic solvents etc.), organic chemical and petrochemical industry (hydrocarbons, halogenated hydrocarbons, detergents).[3-5] In recent years, due to massive industrial growth, a large quantity of non-biodegradable organic compounds has been produced and they have a significant impact on the environment. Organic chemicals exist in many forms in the aquatic environment, but the most serious hazards posed for fish and water quality are those falling under the broad classification of pesticides, which are used pervasively in large scale in agriculture and back yard gardening [3,9].

Phenolic compounds are *toxic* and they are considered known human carcinogens. Phenol and phenolic compounds are common organic water pollutants, most of them being a major by-product of the chemical, pulp and paper or petroleum industries [10,11]. N*atural* sources of phenol in *aquatic* media are the products from the decomposition of aquatic vegetation, but the most important anthropogenic sources are the industrial effluents and domestic sewage [10,11]. Considerable amounts of phenol emissions are generated by phenolic resins, which are used as a binding material in insulation materials, dyes and casting sand foundries. Phenolic chemicals, with their high persistence and toxicity, causing allergy and even carcinogenic are of growing concern as water pollutants [12-16]

Water quality analyses may be performed using traditional sampling and *testing procedures*, such as collecting representative water samples and analyzing them or on-site, by hand-held electronic meters. [4] Monitoring data are compared to surface water quality Romanian guideline (Normative benchmarks for surface water quality classification - 1146/2002 Order), to evaluate the suitability of water for specific uses [5].

The aim of this study was to establish the values of some important water parameters in some potential pollutant sources from *northern,* southern and east-southern areas of Romania and if these indicators are between legal admitted levels.

Experimental part

Water samples were collected from different points of Romania southern, east-southern and *northern* areas and they were analyzed during March, April and May 2017. The values of conductivity and the sampling sites are presented in table 1.

The *data* from *water quality* monitoring points confirm the influence of the anthropogenic factor through different activities, such as wastewater discharges from households and chemicals uses for crops.

Water samples were collected in polyethylene bottles, from the surface to a *depth* of 0.20-0.30 m. Experimental analyses were performed in the Chemistry Research *laboratories, Faculty of Petroleum Refining* and Petrochemistry.

The Total hardness of water was determined by STAS 3326-76 method *(EDTA* method).

The conductivity of water samples was measured with a conductivity meter with electrode, (conductivity range from 0.01μS/cm to 200.0 mS/cm).

Phenols were determined by using International Standard ISO 6439 (4-Aminoantipyrine spectrometric methods).

Determination of ammonium *ion content* was performed by Standard method *STAS* 6328-85. Determination of chloride ion content was performed by Standard method STAS 6364-78.

Results and discussions

The water quality in the sites which were chosen for this study is strongly influenced by the anthropogenic factor through different activities, such as: chemical products or industry and mining activities, extracting underground resources, agriculture and wastewater discharges from households.

The monitored parameters were: conductivity, water hardness, chloride ion, ammonia ion and phenol content. The *sampling sites* where *surface water quality data* were collected in our study are presented in table 1.

The *conductivity* of *water provides information* on the degree of impurity in the samples analyzed and on its chemical composition. *Conductivity* or specific *conductance* is also the measure of salinity; dissolved salts mainly increase the water conductivity due to their ionizing effect, thus giving the possibility to intensify the process of electrochemical corrosion. Hydrogen sulfide is the most corrosive component that can be found in the water reservoir [17].

The increase of conductivity is caused by an increasing of ions mobility with temperature, when the *p*H is continuously decreasing. The higher conductivity may be due to contamination of conducting materials in water [12].

Water hardness is a crucial parameter that characterize the final use of water, for different industrial branches, depending on Mg^{2+} and Ca^{2+} ions presence.

Total hardness, expressed in german degrees had values greater than admitted limit stipulated in 458/2002 Law, for some points (e.g. P6, P7, P12, P19, P21).

Ammonium is a nutrient for plants, but can also have toxic effect, especially on fish, when its concentration is higher than 0.2 mg/L. The toxicity of ammonia is dependent on *p*H and temperature and added the buffering effect which masks any additional toxicity over *p*H = 8. To avoid ecological damage, we have to consider *p*H fluctuation caused by photosynthesis, which is difficult in the case of ammonia as a wide range of parameters such as concentration, *p*H and temperature.

Sample number	Sampling sites	Water source
P1	Onești	Fountain
P2	Tomșani	Springwater
P3	Mizil	Fountain
P4	Balta Doamnei	Springwater
P5	Argeș	Fountain
P6	Parepa	Fountain
P7	Paltinu	Fountain
P8	Tătărani	Fountain
P9	Balta Doamnei, Băra	Springwater
P10	Paltinu	Fountain
P11	Ploiesti	Fountain
P12	Starchiojd	Fountain
P13	Roman	Fountain
P14	Techirghiol	Lake
P15	Paulesti	Fountain
P16	Tatarani	Groundwater (from 13m depth)
P17	Băicoi	Drinking water
P18	Brașov	Mountain water
P19	Paltinu	Fountain
P20	Cornu	Fountain
P21	Parepa	Fountain
P22	Paltinu	Fountain
P23	Paltinu	Fountain
P24	Dâmbu	River
P25	Constanta	Sea water
P26	Podenii Noi	Fountain
P27	Parepa	Fountain
P28	Băicoi	Fountain
P29	Vălenii de Munte	Fountain
P30	Tătărani	Fountain

Table 1
THE SAMPLING SITES FOR SURFACE WATER QUALITY DATA

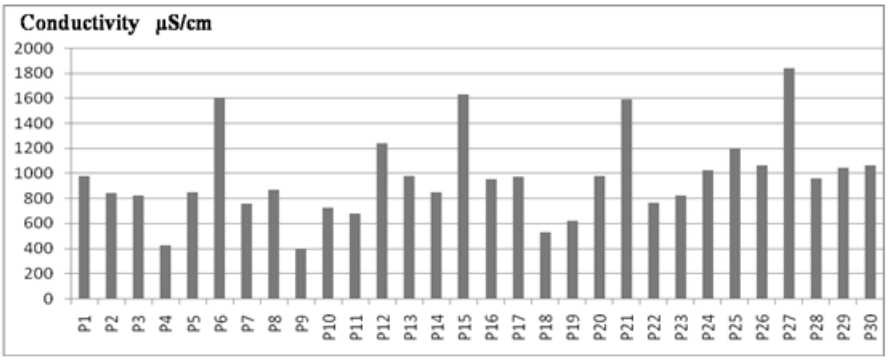

Fig.1. Conductivity (µS/cm) of water from the sampling sites

The values registrated for ammonium content were between legal admitted limits.

Chlorides are not usually harmful to people. High concentrations of dissolved salts in water compromise its use for domestic or agricultural purpose. The presence of chlorine in the disinfected water has a great sanitary importance because this is the proove that the distribution water network is safe [18].

The values registrated for chlorine ion content were over the admitted level in some cases (e.g. P14, P15, P18, P24, P26). Higher concentration of chloride which was observed in these cases may be due to natural processes such as the passage of water through natural salt formations in the

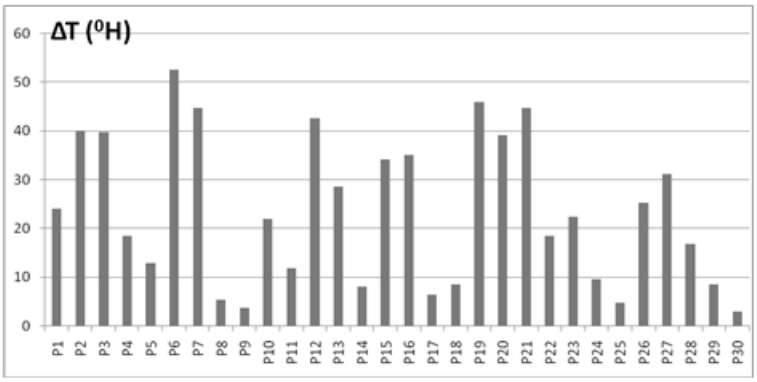

Fig. 2. Total hardness of water samples collected from different points of northern, southern and east-southern areas of Romania

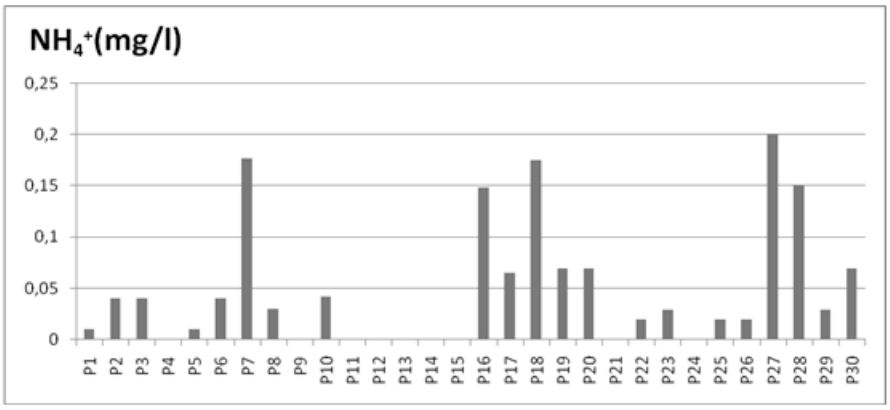

Fig.3. Ammonium content of water samples collected from different points of northern, southern and east-southern areas of Romania

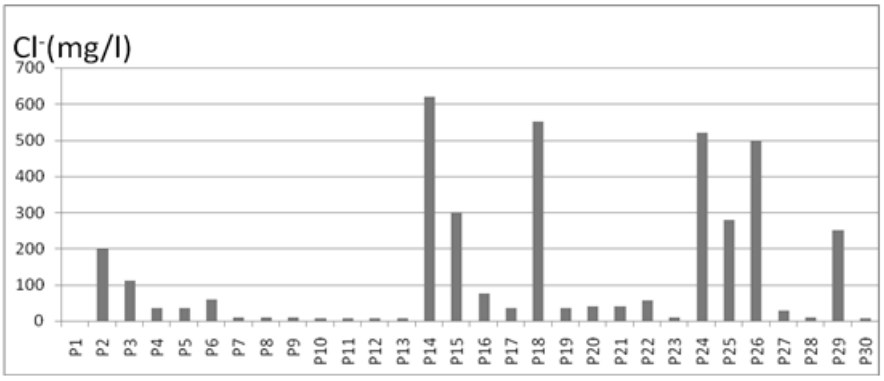

Fig. 4. Chloride concentrations in the water samples collected from different points of northern, southern and east-southern areas of Romania

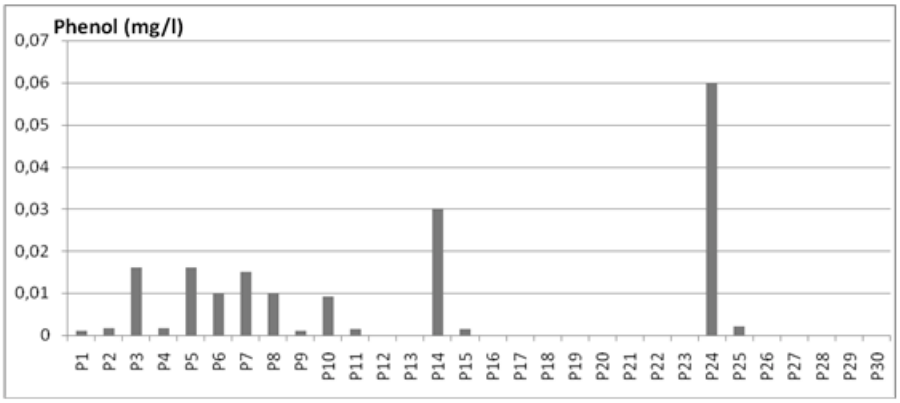

Fig. 5. Phenol concentration in the water samples collected from different points of *northern*, southern and east-southern areas of Romania

earth or it may be an indication of pollution from industrial or domestic use [19].

The values registrated for phenol content were between legal admitted limits (fig.5).

Conclusions

Environmental factors monitoring allows the achievement of some important objectives regarding water quality, forecasting, warning and intervention. Monitoring provides the essential information which is required for an assessment of water quality.

Water pollution needs serious immediate action and continuous monitoring of pollution level because of its importance in maintaining the human health, plants and agriculture protection.

Some *water quality* parameters were monitorized in potential pollutant areas from *northern*, southern and east-southern areas of Romania.

Surface water quality data for some selected chemical parameters, collected from 30 different points were analyzed during March, April, May 2017 and they were compared to the maximum admissible limits NTPA 001/ 2002 and 458/2002.

Pollution indicators, such as ammonium and chloride ion exceed the admissible limits for several sampling sites due to the high development of *farming* and *agricultural activities,* economy activities and chemical industry. These

results suggest that continuous monitoring should be conducted to prevent pollution from industry and anthropogenic activities. It is also advised to take the necessary precautions before water is used for drinking or irrigation.

Environmental protection requirements must be integrated into all policy fields with the general aim to ensure the sustainable development of the economy. Water regulations are important to enforce the preservation of the environment and water resources.

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Manuscript received: 20.10.2017