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DETERMINING THE CONCENTRATION PARAMETERS OF QUALITY OF DRINKING WATER; A CASE STUDY IN BIRJAND, IRAN

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ABSTRACT

Many of people around the world enjoy the benefits of technological and economic developments and high standards of living, however, many scientists are aware that these developments cost a lot. Developments of human societies and industry result in bioenvironmental problems; pollution put the water, air and soil resources at risk. The objective of this study is to determine the quality of water in Birjand, a city located in the east of Iran. In this context, it was determined the factors of pH, total hardness, alkalinity, calcium, manganese, potassium, sulphate, ammonium, nitrite, cyanide, chlorine at seven stations. The Results showed that the concentration of pH, total hardness and ammonium were at 7.76, 348.09 and 0.06 mg/L, respectively. The mean concentration of nitrite, magnesium and chlorine were 0.006, 56.38 and 4.95 mg/L, respectively. Also, the mean concentration of cyanide was determined as 1 mg/L. Results also indicated that there were correlations among the measured parameters. Comparing the results with drinking water standards showed that the drinking water in Birjand, based on these parameters, is desirable. However, it belongs to the very hard water. Moreover, the analysis of data displayed a significant difference among the measured parameters in different stations

Keywords: Chemical Parameters, Water Quality, Urban Water, Iran

1. INTRODUCTION

Today the competition for scarce water resources is intense both in Iran and in many places all over the world. Many river basins do not have enough water to meet all the demands or even enough for their rivers to reach the terminal lake or sea [1]. This pressure is very severe in the arid zone of Northwest part of China, where the high demand is combined with limited resources [2]. Water pollution is a relatively new problem and increases the stress arising as a result of unprecedented population growth, urbanization, and industrialization since the 1990s [3]. The main sources of water pollution are discharge of domestic sewage and industrial effluents, which contain organic pollutants, chemicals and heavy metals, and run-off from land-based activities [4].

An important dimension of water sources that has not received due attention is its quality. Though contributed to economic developments, rapid industrialization in developing countries resulted in heavy losses to economic welfare in terms of effects on agricultural activities, human health and ecosystem at large through air and water pollution [5]. It is important to understand that chemical constituents in environmental

water bodies react in an environment far more complicated than if they simply were surrounded by a large number of water molecules. The various impurities in water interact in such ways that can affect their chemical behavior markedly. The water quality parameters defined above as controlling variables have an especially strong effect on water chemistry [6]. Considering the effects of human activities on water quality and bioenvironmental rules and those problems caused by water pollutants, it is of high necessity to notice the water sources quality. This paper aims to investigate the physical and chemical properties of water in Birjand in order to discover the water quality in this city.

2. MATERIALS AND METHOD

2.1 Site Description

The studied wastewater stabilization pond is located in East of Iran, Birjand, and the capital city of Southern Khorasan province. It is situated at latitude of 32˚ 86' N and longitude of 59˚ 21' E and about 1490 m above sea level. The climate of the city is semi- arid with cold winter and approximately 8 months dry season (from middle of April to December). Its average rainfall is 171 mm and unevenly distributed throughout the year. The average annual temperature is 16.5 ºC with the warmest month in July (average 28.5 ºC) and the coldest in January (average 3.5 ºC). The sunlight of the year is 255 days.

2.2 Methods

Some physical and chemical properties of Birjand water were measured from July to September 2010. These characteristics included pH measured by a Multi Parameter Analyzer (Consort, Model: C534T& Istek, Model: pdc815), and also total hardness and some anions and cations measured by a Photometer (Palintest, Model: 8000). One-way analysis of variance (ANOVA) was used to evaluate differences between the drink water quality parameters in stations of the city centre of Birjand, by Turkey's Honest. Pearson's correlation coefficients (r) were used when calculating correlations among these parameters. Data analyses were carried out using SPSS (Release 18).

3. RESULTS AND DISCUSSIONS

Measurement of pH is one of the most important and frequently used tests in water chemistry. pH is an important factor in determining the chemical and biological properties of water. pH, also influences the degree of ionization, volatility, and toxicity to aquatic life of certain dissolved substances, such as ammonia, hydrogen sulfide, and hydrogen cyanide. As the water quality should be in the range of 5 to 9, the study results showed that the pH mean was 7.76 which is in the desirable range.

Hardness is sometimes useful as an indicator proportionate to the total dissolved solids present, since Ca^{2+}, Mg^{2+}, and HCO_3^- often represent the largest part of the total dissolved solids. No human health effects due to hardness have been proven; however, an inverse relation with cardiovascular disease has been reported. Higher levels of drinking water hardness correlate with lower incidence of cardiovascular disease [6]. High levels of water hardness may limit the growth of fish; on the other hand, low hardness (soft water) may increase fish sensitivity to toxic metals [7, 8]. The investigations in Birjand water showed that the hardness mean ($CaCO_{3)}$ is 348.09 mg/l, so it may be included in very hard waters.

Table 1: Physiochemical properties of Birjand water

Parameters	stations						
	1	2	3	4	5	6	7
pH	7.8	7.8	7.9	7.8	7.7	7.7	7.4
Total hardness	305	330	340	335	375	405	365
Calcium	64	72.3	69	61.3	70	57.3	67
Ammonium	0.03	0.01	0.14	0.01	0.13	0.03	0.07
Magnesium	56.6	50	42.6	65.3	66.6	55	58.3
Nitrite	0.002	0.002	0.006	0.001	0.017	0.005	0.009
Sulphate	4	6.3	5	5.3	4.3	5	5.3
Methyl orange alkalinity	266.6	258.6	250	250.1	255	278.3	263
Phenolphthalein alkalinity	73.3	76.6	96.6	85	90.1	76.6	80
Potassium	8.8	10	6.9	5.7	5.5	4.8	4.5
Cyanide	1	1	2	2	2	1	1
Chlorine	5.2	4.6	4.8	5.5	4.6	5.2	4.5

Ammonia and other nitrogenous materials in natural waters tend to be oxidized by aerobic bacteria, first to nitrite and then to nitrate. Therefore, all organic compounds containing nitrogen should be considered as potential nitrate sources. Drinking water standards for nitrate are strict because the nitrate ion is reduced to nitrite ion in the saliva of all humans and in the intestinal tracts of infants during the first six months of life. Nitrite oxidizes iron in blood hemoglobin from Fe^{2+} to Fe^{3+}. The resulted compound, called methemoglobin, cannot carry oxygen. The resulted oxygen deficiency is called methemoglobinemia. It is especially dangerous in infants (blue baby syndrome) because of their small total blood volume [6]. The results showed that the ammonia concentration mean was 0.06 mg/l and in lower level. The existence of nitrite, more than 10 mg/l causes health problems for human. The desirable level of that is 0.006 and has no sanitary risks.

Using SPSS, the results showed that there was a meaningful level for methyl orange alkality, fenolfetalyn alkality $p<0.01$. These results showed that there was a correlation between total hardness and potassium ($r= -0.054$) in 0.05 ($p<0.05$), calcium hardness and methyl orange alkality ($r= -0.46$) in 0.05 ($p<0.05$) and between nitrate and fenolfetalyn alkality ($r= -0.44$) in 0.05 ($p<0.05$). The results, also showed that there was a correlation between fenolfetalyn alkality and ammonia ($r= 0.99$) in 0.01 ($p<0.01$), fenolfetalyn alkality and methyl orange alkality ($r= 0.99$) in 0.01 ($p< 0.01$). Hence, we may conclude that, by investigating different water stations in Birjand, water in this city has a desirable quality for drinking.

Table 2: Pearson's correlation coefficients of parameters drink water in Birjand

Parameter pair	r	*p*-value
Total hardness- Potassium	-0.54	<0.05*
Calcium hardness- Methyl orange alkality	-0.46	<0.05*
Nitrate- Fenolfetalyn alkality	-0.44	<0.05*
Fenolfetalyn alkality- Ammonia	0.99	<0.01**
Fenolfetalyn alkality- Methyl orange alkality	0.99	<0.01**
Total hardness- Nitrate	0.38	[a]NS
Magnesium- Sulphate	0.35	NS
Nitrate- Chlorine	-0.39	NS
Nitrate- Potassium	-0.30	NS
Calcium hardness- Chlorine	-0.35	NS

Significant at $p < 0.05$*, $p<0.01$**

[a] NS = not significant ($p>0.05$)

4. CONCLUSION

Water source is one of the most important limiting factors in the arid and semi- arid regions. At the end, way may come to the conclusion that, by considering the dry continental situation of Iran (more than 2/3 lands are dry and half dry) and especially the amount of rainfall and drought in this area (171 mm in a year). However, the results of physico-chemical parameters out of the drink water showed that using the water Birjand city has no problem in drink.

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