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Physical and Chemical Water Quality of Ilam Water Treatment Plant

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Abstract: Water usually has some dissolved elements such as solids and gasses. Existences of some elements in water are necessary for human health, but deficiency of many them can cause problems. At this research chemical and physical parameters of produced water in Ilam Water Treatment has determined and compared with Iran and world health organization (WHO) standards. In this study, samples were analyzed twice per month during 12 months 2008. Altogether in this survey, 16 physical and chemical parameters were measured in produced water of Ilam Water treatment plant. During this study, 24 samples were taken and analyzed according to the latest addition of standard method manual. Data were analyzed using the SPSS and Microsoft Excel software packages. Then the results compared to drinking water standards. The physical and chemical parameters of produced water of Ilam Water Treatment Plant are in range of WHO and Iran drinking Water standards and only fluoride value is lower than Iran standard limits. The chemical and physical quality of produced water does not have any health hazard problem. Fluoride is just lower than the standard range and many people use some methods to overcome this problem.

Key words: Chemical quality % Physical quality % Ilam water treatment plant % Water standards

INTRODUCTION

The water currently contains some dissolved constituents, suspended solids and dissolved gases. Some of mineral constituents are essential nutrient but higher concentration than permissible values may create disorders. Monitoring the drinking water quality is achieved with protection of water sources, controlling of treatment processes and water quality management of convey line and distribution network. Setting of guidelines is related to areal and national regulations which are based on social, economical and cultural conditions. Importance of chemical constituents differs with microbial agents. Unlike microbial agents, that need a short time to show their impacts, the chemical constituents need a longer time to show their impacts. In many conditions, it has seen that water is inconsumable because of taste, odor and insufficient clarity of water. Guideline values are available for many of chemical constituents. The value of a guideline is explanatory of the concentration of a constituent that didn't introduce a visible disorder because of long period consumption of it [1].

There isn't any guideline for pH based on health impact. Although the pH doesn't have undesirable direct effects, but it is one of the most important parameters in drinking water operation control. At published guideline by WHO in 1984, based on aesthetic aspect, the pH value in drinking waters established in the range of 6.5-9.5 [2]. The source of chloride in drinking water is due to natural sources, domestic and industrial wastewaters, urban runoffs which contain divalent salts and intrusion of saline waters to fresh waters. Heavy concentration of the chloride may cause corrosion in the distribution networks.

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This condition results in delivering the metals (pipeline materials) to the conveyed flow. Based on the taste creation, Cl^- concentration is set 250 mg/l and concentrations more than it, can create detectable taste [2].

The concentration of fluoride in earth nearby is 0.3kg/kg and the most source of fluoride in drinking water is from earth. The high concentrations of fluoride can cause skeletal disorders and low concentration of it can cause dental caries [3]. The cause of hardness in drinking water is due to calcium and lesser the magnesium and usually declaration as a calcium carbonate. Depending on content of the alkalinity, the hardness more than 200 mg/l can create precipitation, especially when the water being heating. Waters with the hardness lesser than 100 mg/l have a little buffer capacity and may cause corrosion in pipes [2].

One of the most plentiful of earth elements is Iron and in most water is in the range of 0.5-50 mg/l. The most concentration of the Iron is in ground waters and natural sources. It can also intrude to the drinking water distribution system due to use of ferric coagulants as well as steel pipes corrosion [4]. Existence of the sulfate in water may be due to natural or anthropogenic sources such as; atmospheric precipitation and industrial wastes. Based on observation, the sulfate concentration more than 1000-1200 mg/l in drinking water can cause diarrhea, dehydration and weight abatement [5]. The sulfate concentration more than 500 mg/l may create unpleasant taste and pipe corrosion [2]. In natural condition, the concentration of nitrate is very low in surface and groundwaters. The nitrate can intrude to the water sources via agricultural land runoffs, human or animal wastes, oxidation of ammonia and similar sources [6]. The manganese is one of the most plentiful elements in earth crust that usually along with iron. In natural condition the concentration of manganese is about 80-120 μg/l, although in acidic condition of groundwater the concentration of it may be near 10 mg/l [4].

The TDS is consisting of inorganic salts (chiefly calcium, magnesium, potassium, sodium, bicarbonates, chloride and sulfate) and less content of organic materials that are dissolved in water. The source of TDS in drinking water is due to natural sources, domestic wastewaters, municipal runoffs and industrial wastewaters. The high concentration of TDS (more than1200 mg/l) in drinking water may be objectionable for consumer and tasteless water will produce due to low concentration of it [7]. In water, sodium creates a taste and the value of it related to anions concentration and temperature. In room temperature the average concentration of sodium for creating the taste is 200 mg/l [2]. The origin of turbidity in drinking water is from particle matter due to inadequate filtration of water, resuspended of settled materials, settled materials in network, existence of inorganic material in some groundwater's and segregated biofilm in distribution system. Particle matters can protect the microorganisms against disinfectant agents and stimulate the microbial growth. The turbidity is used as an important operational parameter. If the values of turbidity is high in produced water, it can be demonstrator the disorder in the treatment processes specially coagulation, sedimentation and filtration [8].

MATERIALS AND METHODS

This study has been done in 2008 on produced water of Ilam Water treatment plant. In this investigating concentration of total dissolved solids (TDS), total hardness (TH), total alkalinity (TALK), bicarbonate, sulfate, chloride, nitrate, Iron, manganese, magnesium, calcium, potassium, fluoride, sodium and pH have been measured.

The total dissolved solids determined according to standard method manual by gravimetric method in 103-105 °C temperature [9]. pH is measured by means of pH meter set 3570 manufactured of Jenway Company and turbidity is determined by means of turbiditymeter PC compact Aqulitic model manufactured of Germany. Total hardness, total alkalinity and bicarbonate are measured by titration and Calcium concentration measured with EDTA solution titration method according to standard method manual [9]. Magnesium is measured by means of atomic absorption. Sodium and potassium are measured by use of flame photometric method. According to standard method manual Iron, sulfate and phosphate are measured by colorimetric with phenanthroline, turbidimetric and colorimetric method, respectively. Concentration of fluoride, manganese and nitrate are measured by use of spectrophotometer method in wavelengths of 570nm, 525nm, 530nm, respectively. The values of chlorine determined with iodometric method according to standard method manual [9].

After physical and chemical water quality analysis, the collected data were analyzed by use of the SPSS16.0 and Microsoft Excel software packages.

In this study, samples were taken twice per month during 12 months in 2007to 2008. Altogether in this survey we measured 16 physical and chemical parameters in produced water of Ilam Water treatment plant.

RESULT AND DISCUSSION

The maximum, minimum, mean and standard deviation values and WHO and Iran drinking water standards of these parameters have been shown in Table 1.

The results show that the average turbidity in produced water of Ilam Water treatment plant was equal to 1.04 NTU (Table 1). According to national standard of Iran drinking water it is lower than permissible value (5NTU) and almost higher than the desirable value (1NTU) [10]. Water turbidity is one of the daily monitoring parameters in water quality operation that affects on other quality features such as health, physical and especially on disinfection aspects [8]. Average pH in produced water was equal to 8.1 (Table 1) which is in the range of Iran water standard (6.5-8.5) [10]. The pH affects on measured chemical and quality parameters and it play a key role in creating, control and evaluation of corrosion in water [11]. The average hardness of water in this study was about 220mg/l (Table 1). The water is classified as hard water [10,12]. Although from view of health it has not any standard for water hardness, but from economical aspect, the maximum permissible values expressed equal to 500mg/l, which the hardness of produced water of Ilam Water treatment plant is in the range of expressed standard. The average of water alkalinity was about 136.4mg/l. from view of health it hasn't any standard for alkalinity in Iran drinking water standards, but it is recommended that it must not be higher than 500 mg/l [10, 13] (Table 1). Hardness and alkalinity are two parameters which affect on water corrosion and on other water quality features [14].

The average TDS in produced water was about 295mg/l and according to WHO and Iran drinking water standard it is lower than desirable (500mg/l) and permissible value (1500mg/l) [10,11] (Table 1). Also the average of fluoride in these water samples was equal to 0.38 mg/l which is lower than WHO and Iran drinking water standard values [9,10] (Table 1). The fluoride concentration lower than 0.7 mg/l may cause teeth caries in 12-14 aged peoples [4,10]. The results show that the average of chloride is equal to 12.08mg/l (Table 1) which is much lower than WHO (250mg/l) and Iran (200-400mg/l) drinking water standard values [9,10]. This indicated that the quality of Ilam drinking water from aspect of chloride is good. In addition of the undesirable impacts of Chloride on water quality in concentration more than standard value, it can accounts as an aggressiveness anion in corrosion problems. Also in concentration higher than 250mg/l, it can cause appearance of detectable taste in water [10,15]. The average of sulfate concentration was lower than WHO (250mg/l) and Iran (200-400) drinking water standard level [10,11] (Table 1). Sulfate in concentration higher than standard level also can

Table 1: The values of max, min, mean, S.D and EPA and Iran drinking water standards of measured parameters in produced water of Ilam Water Treatment Plant

						Iran standards		EPA standards
Parameter	Unit	S.D	Mean	Maximum	Minimum	Desirable value	Permissible value	MCL
Turbidity	(mg/l)	0.23	1.04	1.5	0.8	1	5	1
pH	-	0.14	8.12	8.45	7.85	7-8.5	6.5-9.2	6.5-8.5
TDS	(mg/l)	10.86	295	332	281	500	1500	500
Fluoride	(mg/l)	0.16	0.0379	0.71	0.13	0.7	1.5	2
Chloride	(mg/l)	2.49	12.08	17.8	7.81	200	400	250
Sulfate	(mg/l)	12.26	82.91	103.8	60.5	200	600	250
Carbonate	(mg/l CaCO3)	7.49	163	176.9	149.4	-	-	-
Nitrate	(mg/l)	2.52	6.02	10.1	2.01	0	45 (NO3)	10 (N)
Calcium	(mg/l)	3.56	60.43	67.2	52.8	75	200	-
Magnesium	(mg/l)	1.85	17.51	21.1	13.4	50	150	-
Sodium	(mg/l)	1.87	9.25	16.6	7.11	-	200	-
Potassium	(mg/l)	0.02	0.16	0.22	0.15	-	-	-
Iron	(mg/l)	0.04	0.07	0.17	0.01	0.03	1	0.3
Manganese	(mg/l)	0.006	0.01	0.02	0	0.05	0.5	0.05
Total Hardness	(mg/l CaCO3)	20.08	220	240	136	150	500	-
Total Alkalinity	(mg/l CaCO3)	6.48	136	147.5	125	-	-	-

cause appearance taste and accounts as aggressive anion in corrosion especially in biological corrosion as well as in higher concentration of it can cause dysentery in infants [5,15].

The average of Fe^{2+} and Mn^{2+} concentration in produced water were 0.07mg/l and 0.01mg/l, respectively (Table 1) which are very lower than standard values of WHO and Iran drinking water standards (0.3mg/l for Iron and 0.05 for Manganese) [9,10] and these metals haven't problem in drinking water of Ilam. Iron and Manganese in water are cause of discolor and distaste. Also the average of Ca^{2+} and Mn^{2+} in this survey was lower than the Iran drinking water standard values (150 and 250mmg/l respectively) [9,10] (Table 1). The average values of the Na^{+} and K^{+} in drinking water were lower than permissible value of the Iran drinking water standard (200mg/l for Sodium) [9,10] (Table 1). The concentration of Na^{+} and K^{+} may affect on flavor and taste of water. In this survey the average of the nitrate concentration was equal to 6.02 mg/l (Table 1) which is very lower than WHO standard (250mg/l) and Iran drinking water standard values (500mg/l) [9,10] and this indicate that The Ilam drinking water hasn't problem from view of nitrate which has important health impact. The nitrate concentration more than standard level can cause methemogolobinemia disease in infants and may cause health problems [16].

In a study by keramati et al., in 2007 on physical and chemical quality parameters of Gonabad city, it was found that except chlorine and pH there was no any difference between these parameters [17]. Also according to investigations on Bandarabbas drinking water chemical quality by dindarloo et al., remarked that the drinking water of this city hasn't any health problem [18].

Petra Judova and Bohumir Jansky in 2005 studied on the water quality of village area that use of Slapanka River and they determined that the concentration of nitrate in consumed water was high and yet the intake water quality is very down [19]. Also Akoto and Adiyian in 2005 in Ghana republic investigated the concentration of heavy metals and some physical and chemical parameters of drinking water in Brong Ahafo area and demonstrated that all parameters are in WHO drinking water standards range and in drinking water samples didn't had any statistics correlation between concentrations of heavy metals [20].

CONCLUSION

According to this survey the results show that the physical and chemical parameters of produced water of Ilam Water Treatment Plant haven't any health problems. By compare these results with WHO and Iran drinking water standards show that they are in standard range values, which is indicate that the produced water has suitable quality (Table 1) and just the fluoride and hardness have limitations. The fluoride concentration is lower than recommended permissible level and it must be added to this water. The hardness of produced Water is a little high but it is in range of Iran water standard values.

REFERENCES

1. Crittennden, J.C., R.R. Trussell, D.W. Hand, K.J. Howe and G. Tchobanoglous, 2005. Water Treatment: Principles and Design. 2nd ed, John Willy and Sons, pp: 54-60.
2. World Health Organization, 2006. Guidelines for Drinking-water Quality [electronic resource], incorporating ?rst addendum, Volume 1 Recommendations, 3nd ed, World Health Organization.
3. Mark, J. Hammer, 1996. water and wastewater technology. 3nd ed, Prentic hall Engewood Cliffs, New Jersey, Columbus, Ohiowater, pp: 249-252.
4. Chalkesh., A.M, 2007. Principles of water treatment, 6nd ed, Arkan, pp: 73-83.
5. Savari, J., 2006. Surveys the physical and chemical quality of Ahvaz city drinking water. The journal of Tehran University of Medical Science. School of Public health and research Institution, 5: 75-85.
6. Cemek., M., L. Akkaya, Y.O. Birdane, K. Seyrek, S. Bulut and M. Konuk, 2000. "Nitrate and nitrite levels in fruity and natural mineral waters marketed in western Turkey". Journal of Food Composition and Analysis, 20: 236-240.
7. Total dissolved solids in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality, 1996. Originally published in Guidelines for drinking-water quality, 2nd ed, Vol. 2, Health criteria and other supporting information. World Health Organization, Geneva.
8. Martin., J.A., W.B. Ronald, C. Ray, E. Steve, C. Hrudey and P. Pierre, 2008. "Ministerial Technical Advisory Committee", Prepared for The Minister of Health Province of British Columbia pursuant to Section 5 of the Drinking Water Act (S.B.C. 2001).
9. American Public Health Association, 2003. American water work association and Water environment federation. Standard Methods for the Examination of Water and Wastewater. 21th Edition, New York.

10. Industrial research and standard institute of Iran, 1997. Physical and chemical quality of drinking water, Fifth edn, No. 1053, Tehran.
11. EPA, 2004. Edition of the drinking water standards and health advisories, EPA 822- R- 04- 005, Office of water protection agency Washington, D.C.
12. Kawamura, S., 2000. Integrated design and operation of water treatment facilities, 2nd, John Wiley and SONS, INC., pp: 510-520.
13. Sheri, S.H. and L.M. Gerald, 1997. Effects of pH, calcium, alkalinity, hardness and chlorophyll on the survival, growth and reproductive success of zebra mussel (Dreissena polymorpha) in Ontario lakesCan, J Fish. Aquat.Scz., 54: 2049-2057.
14. Savari, J., J.N. Afarzade, A.H. Hasani and G.h. Shamskhoramabadi, 2008. Ccomparison of corrosion indexes in ahvaz drinking water distribution network, Second congress environmental engineering, Tehran University.
15. Sasidhar, P. and K.S.B. Vijay, 2008. Assessment of groundwater corrosiveness for unconfined aquifer system at Kalpakkam. Environ. Monit. Assess., 145: 445-452.
16. Michal, C., E.l. Ziv and E.R. Bruce, 2008. Systematic evaluation of nitrate and perchlorate bioreduction kinetics in groundwater using a hydrogen-based membrane biofilm reactor". Water Research Published online 11 October, 2009. 43: 173-181.
17. Keramati, H., A.H. Mahvi and L. Abdolnejad, 2007. Survey the physical and chemical quality of Gonabad city, The journal of Gonabad physician science and Public health school 13(3).
18. Dindarloo, K., V. Alipoor and G.H. Farshidfar, 2005. Water quality of Bandarabbas city. The journal of Hormozgan Physician Scince, 10: 57-62.
19. Petra, J. and J. Bohumir, 2005. Water quality in rural areas of the Czech Republic: Key study Slapanka River catchment, J. Limnologica, 35: 160-168.
20. Akoto, O. and J. Adiyiah, 2007. Chemical analysis of drinking water from some communities in the some communities in the Brong Ahafo region. Int. J. Environ. Sci. Tech., 4: 211-214.