Journal of Environmental Treatment Techniques, 2013, Volume 1, Issue 1, Pages: 23-26

Journal of ENVIRONMENTAL Treatment Techniques

Enviro. Treat. Tech.

Journal web link: http://www.jett.dormaj.com/

Study on the Water Drinking Water Quality of Swabi District, Pakistan

Zulfiqar Ahmed[1], Muhammadullah[1], Arshad Ali[2], Jamila Begum[2], Ali Khan[2]

1-Northern University, Nowshera Cantonment, KPK, Pakistan
2-College of Civil Engineering (MCE-NUST), Risalpur Cantonment, KPK, Pakistan

Receive: 06/08/2013 **Accept:** 20/08/2013

Abstract

Water pollution is a major problem in the global context. Pakistan's current population is growing rapidly and the per capita water availability has dropped from 5,600m^3 to 1,000m^3. Results from various investigations and surveys indicate that water pollution has increased in Pakistan. In several areas, increased arsenic, nitrate and fluoride contamination was detected in drinking water. Therefore, this study was design to evaluate the drinking water quality of various locations of District Swabi, Pakistan. And to evaluate the treatability potential of different coagulants like alum, lime and magnesium sulfates. Samples were collected from various points and were tested for different physical, chemical and biological characteristics of water. The results obtained illustrated that the drinking water is highly polluted in terms of microbial, arsenic, nitrates and fluoride, i.e., 16ppb, 3.2mg/L, 36mg/L and 104MPN/100mL, respectively. Alum, lime and magnesium sulfate were tried as coagulants ranging from 4-48mg/L, 2-24mg/L and 1.5-18mg/L, respectively. Lime was observed to be the most effective coagulant.

Keywords: Drinking water, Arsenic, Coagulants, Lime

1- Introduction

Pakistan's current population of 141 million is expected to grow to about 221 million by the year 2025. This increase in population will have direct impact on the water sector for meeting the domestic, industrial and agricultural needs. Pakistan has now essentially exhausted its available water resources and is on the verge of becoming a water deficit country. The per capita water availability has dropped from 5,600m3 to 1,000m3 [1]. The quality of groundwater and surface-water is low and is further deteriorating because of unchecked disposal of untreated municipal and industrial waste water and excessive use of fertilizers and insecticides. Results from various investigations and surveys indicate that water pollution has increased in Pakistan. The water quality deterioration problems are caused by the discharge of hazardous industrial wastes including persistent toxic synthetic organic chemicals, heavy metals, pesticide products and municipal wastes, untreated sewage water to natural water bodies. Poor drinking water quality and sanitation lead to major outbreaks of waterborne diseases. In addition, many service providers do not even cover the costs of operation and maintenance due to low tariffs and poor efficiency [2]. Consequently, the service providers strongly depend on government subsidies and external funding. In Pakistan, the water pollution dilemma is quickly propagating, presently 82% of the people do not have an access to safe water, 30-40% hospitalized patients are due to water borne diseases, and about 80% of the infant death is only because of the polluted water that causes diarrhea, cholera, dysentery, gastro-intestinal problems [3].

According to the most recent report of Pakistan Council of Research in Water Resources, the water quality in most of the water supply schemes in Pakistan have crossed the limits of drinking water quality standard set by the WHO. The major water quality problem being faced currently is the microbial, arsenic, nitrate and fluoride contamination in most part of the country. Almost 64% of the drinking water supply is contaminated with Total Coliform (microbes) [4,5]. This study was conducted to investigate the drinking water quality problems of District Swabi in Pakistan. The main objective of the study was to evaluate the water quality in terms of microbial, arsenic, fluoride and nitrate contamination.

2- Material and methodology

Samples from various part of District Swabi were collected, as per AWWA Standards. These samples

Cooresponding Author: Arshad Ali, Northern University, Nowshera Cantonment, KPK, Pakistan, E-mail: aliarshad08@yahoo.com.

were collected in a sterilize glass bottles with minimum capacity of 1.0L each. The samples were then immediately transferred to the laboratory for analytical test [7,8]. The date, hour, and exact location, the water temperature and pH values were recorded on the site. Table 1.0 illustrates the water quality parameters used during this study [9].

Table 1.0 Various water quality parameters used during this study

Parameter	Techniques
pH	pH meter
Turbidity	Nephelometric mMethod
EC	Conductivity meter
TDS	Gravimetric technique
Nitrates	UV spectrophotometric screening method
Sulfates	Spectrophotometer determination
Chlorides	Argentometric method
Total coliform	Membrane filter technique
Fecal coliform	Membrane filter technique

The minimum arsenic removal efficiency 5.2%, fluoride removal efficiency of 14.6%, nitrates removal efficiency of 7.6% and microbial removal efficiency of 22.1% were observed by using an alum dosage of 4-8mg/L. Whereas, the maximum arsenic removal efficiency 10.1%, fluoride removal efficiency of 31.8% nitrates removal efficiency of 14.6%and microbial removal efficiency of 41.1% were observed by using an alum dosage of 40mg/L, 48mg/L, 12mg/L and 48mg/L, respectively. The optimum arsenic, fluoride, nitrates and microbial contamination by using an alum dosage of 28mg/L were observed as 7.7%, 22.7%, 11.3% and 33.5%, respectively.
Also to determine the optimum dosage of lime coagulant, varying dosages ranging from 2mg/L to 24mg/L were tested to check their treatability performance against arsenic, fluoride nitrates and microbial contamination removal as shown in the Figure 2.

3- Results and discussion

The results obtained from the physical, chemical and biological analysis of water samples obtained from various sources are shown in table 2.

The minimum arsenic removal efficiency 5.7%, fluoride removal efficiency of 11.5%, nitrates removal efficiency of 8.1% and microbial removal efficiency of 61.2% were observed by using an lime dosage of 2mg/L, 2mg/L, 2mg/L and 24mg/L, respectively. Whereas, the maximum arsenic removal efficiency 13.1%, fluoride removal efficiency of 25.4% nitrates removal efficiency of 22.3%and microbial removal efficiency of 77.7% were observed by using a lime dosage of 24mg/L, 2mg/L, 24mg/L and 14mg/L, respectively. The optimum arsenic, fluoride, nitrates and microbial contamination by using a lime dosage of 10.5mg/L were observed as 9.2%, 18.6%, 15% and 77.7%, respectively.

Table 2: Water Quality Analysis of the Ground Source

Ser#	Parameter	Unit	Result	WHO	Remarks
1	pH	-	8.0	6.5-8.5	2
2	Temperature	oC	22	--	--
3	Turbidity	NTU	4.2	5	1
4	Arsenic	ppb	16	10	1
5	Fluoride	mg/L	3.2	1.5	1
6	Nitrates	mg/L	11	10	1
7	Total Coilform	No/100 mL	21	Nil	1

Beyond the limits
Within the limits

Table 3: Water Quality Analysis of the Surface Source

Ser#	Parameter	Unit	Result	WHO	Remarks
1	pH	-	11.10	6.5-8.5	1
2	Temperature	oC	26	--	--
3	Turbidity	NTU	13	5	1
4	Arsenic	ppb	8.2	10	2
5	Fluoride	mg/L	1.8	1.5	1
6	Nitrates	mg/L	36	10	1
7	Total Coilform	No/100mL	104	Nil	1

Beyond the limits
Within the limits

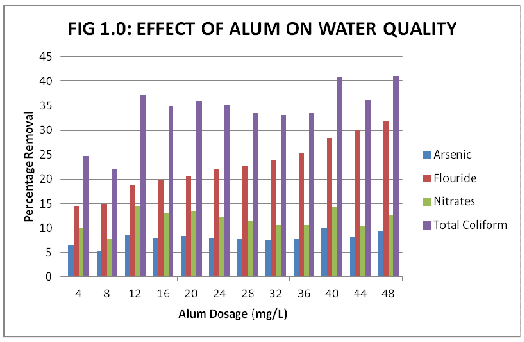
Table 4: Water Quality Analysis of the Tap Source

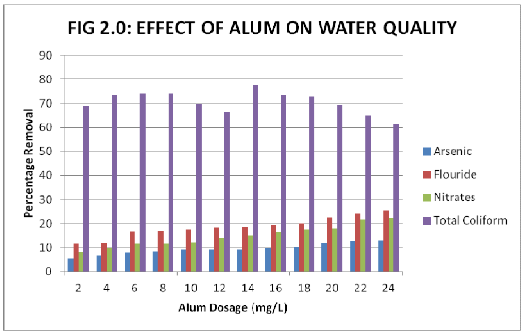
Ser#	Parameter	Unit	Result	WHO	Remarks
1	pH	-	7.9	6.5-8.5	1
2	Temperature	oC	19	--	--
3	Turbidity	NTU	4.3	5	2
4	Arsenic	ppb	14	10	1
5	Fluoride	mg/L	2.1	1.5	1
6	Nitrates	mg/L	19	10	1
7	Total Coilform	No/100mL	35	Nil	1

Beyond the limits
Within the limits

In order to determine the optimum dosage of alum coagulant, varying dosages ranging from 4.0mg/L to 48mg/L were tested to check their treatability performance against arsenic, fluoride nitrates and microbial contamination removal as shown in the Figure 1.

Selection of coagulant on the basis of cost comparison was carried out. Since, the optimum dosage determine by the Jar Test for alum, lime and magnesium is 28mg/L, 14mg/L and 16.5mg/L, respectively. To select the cost effective coagulant the following analysis was carried out for the water flowing at the rate of 100L/min (assumption). The detail cost analyses are given in Table 4.





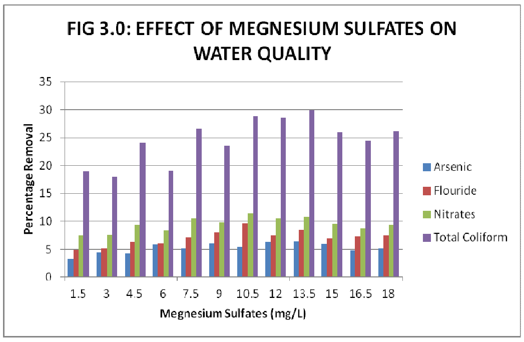


Table 4: Selection of Optimum Coagulant Dosage

Coagulant	Dosage (mg/L)	Unit Price (Rs/kg)	Daily Cost (Rs)
Alum	28	35	1.50
Lime	14	20	0.5
Magnesium Sulfates	16.5	32	0.82

From the cost and treatability analysis, lime is determined as the most effective coagulant for the treatability performance of polluted water containing arsenic, fluoride, nitrates and total coliforms [10,11]. The total cost required per day for the optimum treatability of water quality is determined as 0.5 USD.

4- Conclusion and recommendations

The following conclusions have been derived from working on the water quality samples analysis and using various coagulants; The water quality in most parts of the subject area is polluted in one way or the other, but the main pollutants are arsenic, fluoride, nitrates and microbial contamination.

The maximum pollutants concentration observed in the subject area in terms of arsenic, fluoride, nitrates and microbial contamination is 16ppb, 3.2mg/L, 36mg/L and 104 colonies/100mL, respectively. The optimum alum, lime and magnesium dosage for arsenic, fluoride, nitrates and microbial contamination removal is 28mg/L, 14mg/L and 16.5mg/L, respectively. Using maximum arsenic, fluoride, nitrates and microbial contamination removal efficiency by using the coagulants is 9.2%, 22.7%, 15% and 78%, respectively.

The total cost of lime required per day for the water treatment flowing at the rate of 100L/min is 0.5 USD. A long-term study is required to carry out the complete water quality analysis for at least twelve months to study the characteristics changes subjected to seasonal variations and flow rates. Different types of coagulants and filter media should be used to evaluate a better treatability performance.

References

1- Arshad A, Intikhab AQ, Durray S. (2011). Low-cost filter for flood affected areas of Pakistan. Electronic Journal of Environment Agricultural and Food Chemistry, 10(10):2945-2950
2- Enrique J L, E Silva, A B Harold, Jackeline L. (2007). Combined Anaerobic/Aerobic Secondary Municipal Wastewater Treatment: Pilot-plant Demonstration of UASB/Aerobic Solids Contact System. ASCE Journal of Environmental Engineering, 133(1):397-403
3- Hrishikesh AD, L Barnes, S Schiewer, Daniel M. (2007). Total Coliform Survival Characteristics in Frozen Soils. ASCE Journal of Environmental Engineering, 133(1):1098-1105
4- J Stephen, F Gregory, W Characklis, Rachel T. (2006). Attachment of Fecal Indicator Bacteria to Particles in the Neuse River Estuary, N.C. ASCE Journal of Environmental Engineering 132(4):1338-1345
5- Ping W, Lewis C, L Richard, Batiuk C. (2006). Surface Analysis of Chesapeake Bay Water Quality Response to Different Nutrient and Sediment Loads. ASCE Journal of Environmental Engineering, 132(4):377-383
6- AWWA. (2005). Standard Methods for the examination of water and wastewater. Washington DC: APHA Publication USA
7- KH Ziai (1999). Investigation of rational effluent and stream standards, Hudiara Nullah and River Ravi - A case study. National workshop on Water Resources Achievements and Issues in 20th Century and Challenges or the Next Millennium, Islamabad, Pakistan
8- Khan U. (1996). To study the effects of Deg Nullah on the groundwater quality of nearby residential areas. MSc Thesis, IEER UET Lahore, Pakistan.

9- Balfours (1987). Feasibility of treatment of wastewater discharges from city of Lahore. Report of Punjab Province, Pakistan.
10- Lamb C. (1985). Water Quality and its Control. John Wiley & Sons, UK
11- Metcalf and Eddy (1979). Wastewater Engineering Treatment, Disposal and Reuse. McGraw-Hill New York, USA.