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Study on the Water Quality of District Swabi Pakistan

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Abstract

Arsenic content in water has proven deadly in many areas of Pakistan due to the lack of knowledge in regard to the purification of the content of water. One such area of District Swabi, Pakistan, has been included in the following study where arsenic content can be found in water at an elevated level. Arsenic content of more than 18 ppb was found. The water quality analysis indicate the concentration of pH, color, turbidity, chloride, TDS, nitrates and Total Coliform was observed to be 9.3, 5.5 units, 5.2 NTU, 105 mg/L, 922 mg/L, 2.3 mg/L, and 35 MPN/100mL. Both lime and alum are the cheapest available options to remove arsenic. Using 08 mg/L of alum can remove more than 55% arsenic and 61% turbidity. Whereas, lime at an optimum concentration of 16 mg/L, can removed more than 51% arsenic and 47% turbidity.

Key words: Drinking water, arsenic, coagulants, alum

1 Introduction

Groundwater is a vital resource. Groundwater resources area very few in comparison and they are liable to pollution and overuse. In most of the developing countries the availability of drinking water has become a huge problem. The reason for contamination of water is most of the time because of mixing of various compounds and elements directly or indirectly into the water [1]. The bulk of the water in Pakistan comes from groundwater resources and surface water reservoirs.

It's been established through several recent studies that the source of most of the communicable diseases is water. These diseases cause morbidity and mortality. In developing countries like Pakistan, despite of the high death rate particularly within the infants, no alternation is being given to the drinkable quality. However, in some places some remedial measures like filtration are taken however they are no way near enough and are mostly present in urban areas [2,3].

According to the WHO report, four-hundredth deaths in developing countries occur thanks to waterborne diseases and five hundred million diarrheic episodes occur annually in kids beneath five years in Asia. About 4.1 percent of daily international burden of illness is taken by the water borne diseases, and it causes 1.8 million human deaths annually [3,4,5,6].

Currently, the water purification management in Pakistan has not been applied in an exceedingly sufficient and correct manner in regard of purifying it from all the dangerous compounds found in it and additionally not up to the WHO set standards as a result waterborne diseases are growing daily and hence individuals are suffering [7,8]. One critically important thing is that funds are not allocated for water purification. There are various ways to purify the water and make it drinkable. The most important hazardous compound present in drinking water causing harmful diseases in people is arsenic [8]. Therefore, in this particular study water samples of District Swabi, Pakistan were analyzed. The main focus was to study the water quality of the subject area, and to work out low-cost possible technique for arsenic mitigation.

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2 Materials and methods

Tordher village of the subject area was selected for sampling points on account of the presence of various public organizations over there, like the hospitals, schools, etc. The samples were designated as A, B, C, D, E and F depending upon the various locations mentioned on the sampling points. The samples were then tested for various water quality parameters using AWWA standards as shown in the Table 1 [9].

Table 1 Water quality analysis techniques

Parameter	Techniques
pH	pH meter
Turbidity	Nephelometric Method
Color	HACH Colorimeter
EC	Conductivity meter
TDS	Gravimetric technique
Nitrates	UV spectrophotometric screening method
Total Hardness	EDTA method
Chlorides	Argentometric method
Total coliform	Membrane filter technique
Fecal coliform	Membrane filter technique

3 Results and analysis

The results are illustrated in the Figure 1-8. Temperature of every sample was noted with thermometer soon after it was assembled and also when different parameters were checked. Moreover, the water samples from different water taps are found to be colorless, odorless and tasteless. These are the most common symptoms for the assessment of water quality. Color and odor of all collected samples were non objectionable. Maximum color concentration was observed in the location "E", i.e. 5.2 units.

Refer to Figure 2, the concentration of turbidity is quite reasonable. It may notify the presence of disease causing organisms. They include bacteria, viruses, parasites and organisms that can cause symptoms like nausea, cramps, diarrhea and headaches. Suspended particles may provide a place for damaging microorganisms to reside. The suspended particles may provide a breeding space for bacteria [10,11]. The APHA specifies drinking water turbidity shall not exceed 5 NTU's. However, the turbidity in the water samples was within the WHO permissible limits.

Figure 3.0 shows high concentration of chloride gives a salty taste to water. Taste threshold for the chloride for the chloride anion depend on the associated caution and are in the range of 200-300 mg/L for sodium, potassium and calcium chloride. Concentration in excess of 250 mg/L is increasingly likely to be detected by taste. No health based guide line value is proposed for chloride in drinking water. In all the water samples collected for testing, value of chlorides were found to be below than test threshold of 250 mg/L. In high levels, chloride may corrode stainless steel and be toxic to plant life.

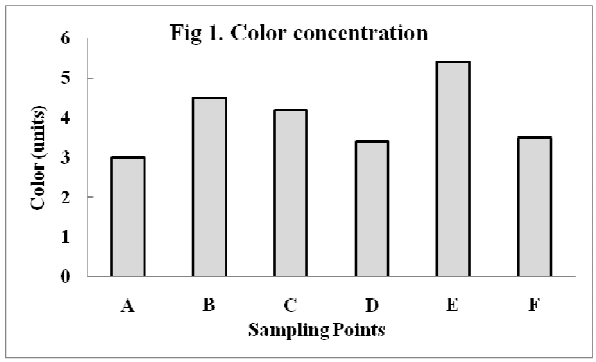
Figure 4 indicates that the pH of all the samples from water taps were within WHO guidelines for drinking water. The generally accepted range for pH in water is 6.5-8.5 with an upper limit of 9.5, and all the samples were found to be in this range in case of sample "E".

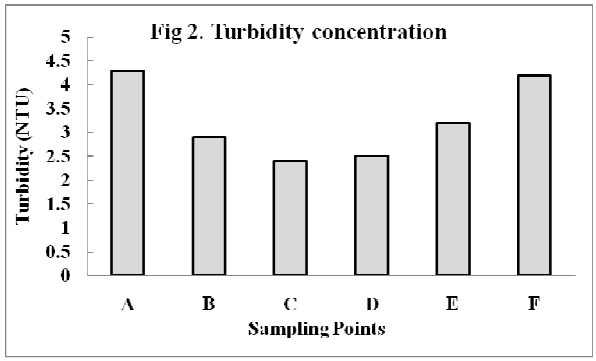
WHO guidelines for Nitrate is 10 mg/L, all the water samples were within the permissible limit. Nitrate has an element of toxicity. Nitrate is often an indicator of contamination by human or livestock wastes, fertilization or seepage from the dump sites. The samples showed that the nitrate contamination was well within the safe limits by USEPA, Canadian water quality guidelines and other international standards [12,13]. The highest recorded value of nitrate was 2 mg/L which is well below 10 mg/L; the standard set by WHO. Excessive amounts can contribute to methaemoglobinemia, infant death and adult illness. Figure 5 illustrate the nitrates concentration in the sampling points.

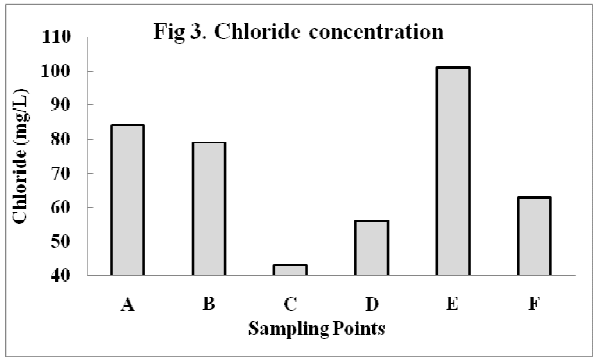
Figure 6 shows the concentration of TDS in the subject area. WHO guidelines for total dissolved solids is 1000 mg/L, the samples tested showed the total dissolved solids to be within the WHO limits. The total dissolved solids in water consist of inorganic salts and dissolved materials.

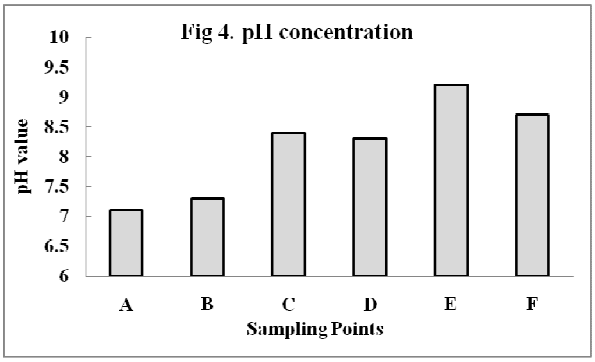
Water which looks clear may still be microbiologically contaminated. The biggest risk to life is microbiological contamination as diarrheal diseases can spread rapidly in environments where large number of people is living in poor condition and in close proximity. All the water samples taken from different water taps are found not safe for drinking water. Total Coliform is present in all the samples and was violating the WHO limits [14,15]. Figure 7 illustrate shows the concentration of Total Coliform in the subject areas. Figure 8 shows the arsenic concentration in the subject area. It was observed to be 40 ppb (0.04 mg/L). The results obtained indicate that the sample contained arsenic content well above the set standard values (10 ppb or 0.01 mg/L) of the WHO.

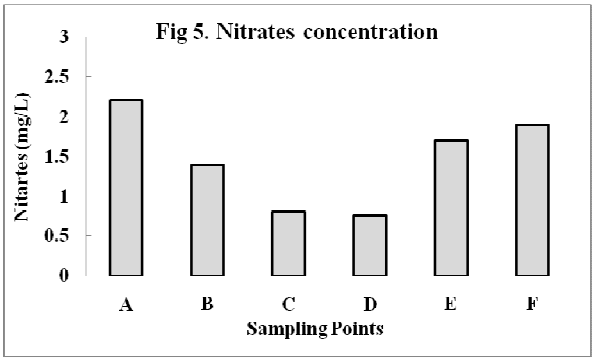
Figure 9-10 illustrates the results of Jar Test performed by using lime and alum as coagulants. An optimum dosage of alum and lime was observed to be 08 mg/L and 16 mg/L, respectively. Corresponding to optimum alum dosage more than 55% arsenic and 51% turbidity removal was observed. Whereas, with reference to an optimum lime dosage, more than 61% arsenic and 47% turbidity was observed to be removed.

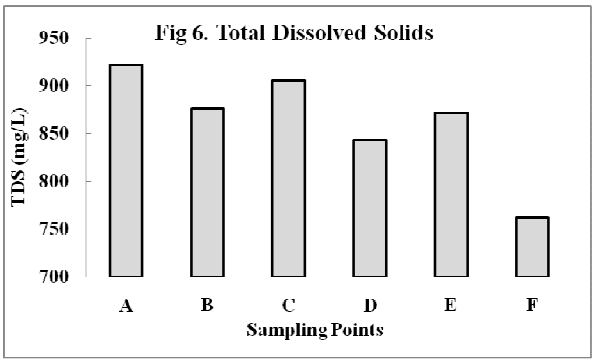


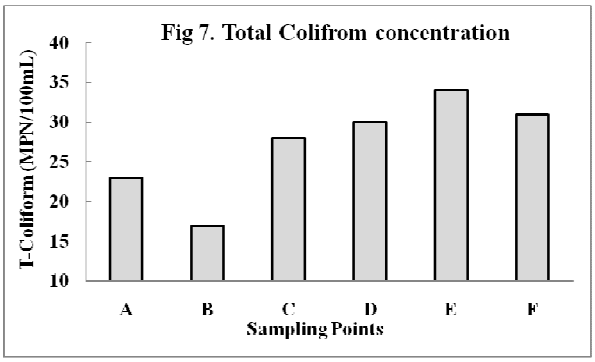


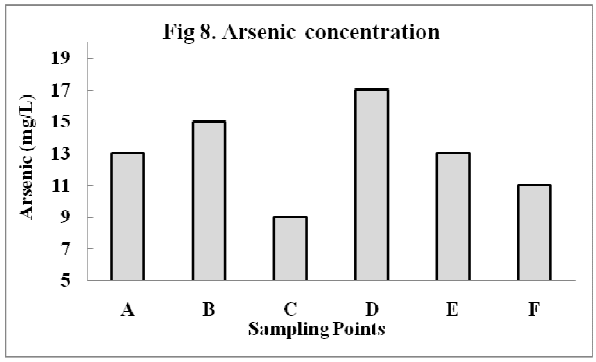


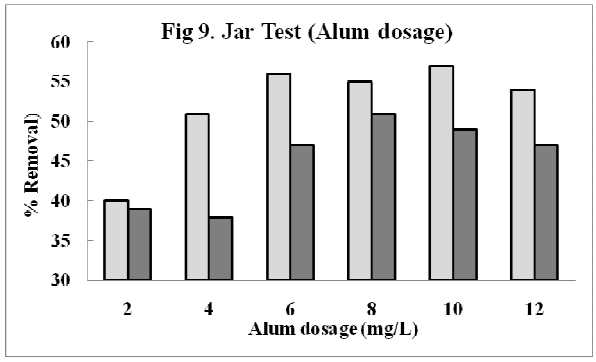


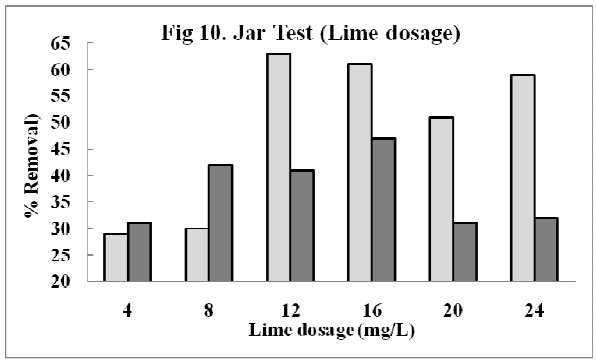












4 Conclusions and recommendations

The conclusions and recommendations drawn from the results of the present study are;

Drinking water of subject area is highly contaminated in terms of microbial and arsenic concentration. The maximum Total Coliform and arsenic concentration is found to be more than 34 MPN/100mL and 13 ppb. Both lime and alum are the cheapest available options to remove arsenic. Using 08 mg/L of alum can remove more than 55% arsenic and 61% turbidity. Whereas, lime at an optimum concentration of 16 mg/L, can removed more than 51% arsenic and 47% turbidity.

Comprehensive and long-term study is required to evaluate the arsenic contamination in the same area for at least 1.0 year. Laboratory techniques required to be designed at local level to monitor the concentration of arsenic in water at cheaper rate in the subject area. Different aluminum and iron salts alone or in

combination need be tried to determine more reliable and effective coagulant dosage for arsenic removal.

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