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Quality Characteristics and Treatment of Drinking Water of Faisalabad City

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ABSTRACT

This study was designed to assess the quality of drinking water and treatment of polluted samples of underground water of Faisalabad through indigenously prepared column to make it as clear as possible. This column contained activated carbon, ion-exchange resin and liquid chlorine. Forty five samples analyzed for chemical parameters pH, electrical conductivity, dissolved oxygen, (DO) chemical oxygen demand (COD), total dissolved solids (TDS), hardness and plate count test. The DO and COD was found to be between 3.0-4.1 mg/L and 121.3-464.5 mg/L, respectively after the treatment of self-designed column. TDS value was 509.2-1472.3 mg/L while hardness was 100-200 mg/L after application of treatment. The bacterial load was reduced to $8x10^3$-$19.4x10^3$/100 mL sample from $43x10^3$-$102x10^3$/100 mL. Such results obtained after treatment were satisfactory which shows that there is great contamination in ground water of Faisalabad. It was concluded that the indigenously prepared column can be successfully used for water.

Key Words: Water; Quality; Treatment; Faisalabad

INTRODUCTION

The quality of drinking water is of vital concern to mankind, since it is directly associated with human life. It is a matter of history that faecal pollution of drinking water caused water-born diseases, which wiped out entire population of cities (Bashir *et al*., 1999). Water is only essential for well being of human, animals and plants but is also important for industrial development (Rehman *et al*., 1991). Due to water related diseases, the death rate is high especially in women and children. One hundred million cases of diarrhoeal diseases are being registered in hospitals of Pakistan within one year (Tahir & Rashid, 1997). Faisalabad is densely populated city and due to tremendous increase in population, the demand for water has been increased among population, which is increasing every year. Faisalabad has a lot of textile mills and water from the manufacturing process could be generated from the washing out of impurities as well as in discarding of chemicals used in the processing of fibers. Generally, these wastes are organics, have a high COD and are extremely alkaline. Water used for drinking, cooking and food processing should have no color, no odour and essentially no turbidity (Katyal & Satake, 1990).

Dissolved oxygen is an essential requirement for potable water especially for ground water because in the absence of dissolved oxygen, purification capacity of water is low and this condition supports the growth of anaerobic microorganisms. Electrical conductivity is used to determine the degree of mineralization of potable water. pH is also very important and most frequently used test in water chemistry which tells about the nature of chemicals present in the water. Organic matter is extremely harmful for living things and easily assessed by COD-Test as water with high COD is not useful for drinking purpose. Inorganic ions contaminating potable water, produces various harmful effects like excess of calcium causes renal stones and its deficiency can cause osteoporosis and rickets (Khurshid, 1998). The present study was, therefore, envisaged to sample location for physico-chemical analysis and the treatment of polluted underground water to assess its suitability for domestic use.

MATERIALS AND METHODS

A total number of 45 water samples were collected from three colonies of Faisalabad city. Gulistan Colony, Samanabad and Nishatabad water samples were analyzed for various physico-chemical parameters like pH, electrical conductivity (EC), chemical oxygen demand (COD), dissolved oxygen (DO), total dissolved solids (TDS), hardness and plate count test (PCT). pH was determined by using pH meter while EC by conductivity meter (Arnold *et al*., 1992). COD and DO were measured through COD and DO apparatus directly (Arnold *et al*., 1992).

Total dissolved solids. TDS was determined by evaporation method as described by Arnold *et al*. (1992). A 30 mL of filtered water sample was taken in china dish and evaporated in a water bath at 100°C till constant weight. TDS was calculated by given formula:

$$TDS = \frac{(A-B) \times 100}{\text{Sample volume}}$$

Where, A = Weight of dried residue + china dish (g)
B = Weight of china dish (g)

Hardness. An EDTA method was applied for hardness estimation 25 mL of sample was taken in titration flask and

diluted to 50 mL by dist. water 1-2 mL of buffer (ammonium hydroxide-ammonium chloride) of pH 10 was added in the flask and 2-3 drops of indicator (Eerichrome Black-T). This solution was titrated against standard EDTA titrant with continuous stirring until the reddish tinge disappeared from the solution. The last few drops were added at 3-5 sec. interval and end point was blue.

Calculations:

$$\text{Hardness} = \frac{(A \times B) \quad 100}{\text{Sample volume}}$$

A = Titrant for sample (mL)

B = $CaCO_3$ equivalent to 1 mL EDTA (mg)

Plate count test. The water samples were subjected to plate count test for the determination of bacterial load by the method of Anonymous (1970). Most polluted water samples were passed through the indigenously prepared column, which was used for the removal of color, hardness and bacteria in polluted water.

A glass column, which had the length of 2 feet and 1 inch diameter was used, which was divided into three portions. In 1st/lower most portion, the activated carbon was added to column upto 5-6 inches. The ion-exchange resin i.e. hydrogen zeolite was placed in the central portion of the column. A small bottle filled with liquid chlorine was taken in upper most part of column. Most polluted water samples were taken and treated one by one. The tap of glass column was opened and 25 mL of sample was passed via column, which was collected. Then these were re-analyzed for the above mentioned parameters for seeking the effect of treatment.

RESULTS AND DISCUSSION

pH. The values of pH of all water samples appeared to lie between 6.3-7.8 and after treatment its value ranged from 6.7-7.6 (Tables I & II), which is well within permissible limit. pH provides the information about acidity or alkalinity of water (Katyal & Satake, 1990). It also provides or mean of clarifying and for collecting other characteristics or behavior such as corrosive activity (Ghandour *et al.*, 1985). As eye irritation and exacerbation of skin disorder have been associated with pH value greater than 11. So regarding the pH, all values of samples are within safe limit.

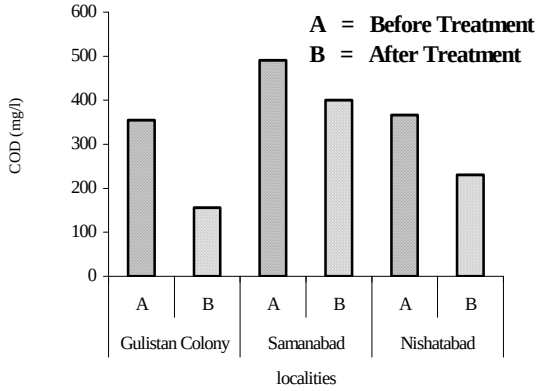
Electrical conductivity. The variation of EC revealed a wide range of values from 0.47-3.28 dS/m and after treatment by indigenously prepared column it was recorded from 0.32-1.39 dS/m (Tables I & II). The results show that EC values in the samples of Nishatabad and Gulistan Colony are higher than the permissible limit that is 0.5-1.5 dS/m as recommended by WHO (Rizvi, 1994). Such difference may be due to reason that the composition of water between areas, which is not uniform geographically. Since, EC is a measure of ability of aqueous solution to carryout electrical current. This ability depends on the presence of ions, on their total concentration, mobility and on the temperature of measurement.

Dissolved oxygen. The level of DO in water samples in the present study ranged from 3.7-7.8 mg/L and after treatment it ranged from 3.0-4.1 mg/L (Tables I & II). These findings are comparable as recommended by WHO i.e. 4-6 mg/L (Rizvi, 1994). However, excess of dissolved oxygen might not be harmful for health. Very low concentration of dissolved oxygen supports the growth of anaerobic microorganisms and limits the purification capacity of water (Sawyer, 1994) while too much dissolved oxygen causes the corrosion of metal pipes (Rizvi, 1994).

Chemical oxygen demand. The mean values obtained about COD are placed in Fig. 1 which are 355.2, 490.5 and 366 mg/L before treatment and 155.8, 4.00 and 230.5 mg/L after treatment of Gulistan Colony, Samanabad and Nishatabad, respectively. These observed values are much higher than the standard value of 4 mg/L. It indicates the problem of highly organic contamination, strong chemical oxidants making it harmful to humans. It might be due to the agricultural and cattle practices, which are rich source of organic pollution (Makia *et al.*, 1999). As COD is mean of measuring organic strength of domestic and industrial waste.

Total dissolved solids. The findings of TDS obtained in this study are in range of 666.7-3666.6 mg/L while the values obtained after treatment are between 509.2-1472.3 mg/L. The detailed results are given in Tables I and II. The values of untreated samples are very high than normal i.e. 500-1500 mg/L as reported by Rizvi (1994) which are approved by WHO. The reason for so high TDS values is due to presence of large number of organic salts as carbonate, bicarbonate, sodium, potassium and calcium etc. and also some non-volatile organic substances, which are solid at room temperature. This parameter is used for the domestic use of water. Usually water with TDS near 500 mg/L is good for drinking (Sawyer, 1994). Our treatment proved to be of better sensitivity as these are corrected with in the

Fig. 1. Comparison of analysed parameters for COD before and after treatment in different localites



range. So, it is recommended to use such column treatment for TDS parameter.

Hardness. Hardness values of water samples lie between 1360-6600 mg/L and after application of treatment its value ranged from 100-200 mg/L (Tables I & II). The values of water samples of these colonies are much higher than standard values by WHO for ordinary potable water which is 250 mg/L. The hardness of water takes place when, it come in contact to soil and rocks. According to Sawyer (1994). The hardness of water varies considerable from place and in general, surface water is softer than the ground water.

Plate count test (PCT). It is the method used for counting the bacteria in water samples. Bacterial load in water samples is in between $43x10^3$-$102x10^3$/100 mL; while these were greatly reduced to $8x10^3$-$19.4x10^3$/100 mL of samples (Tables I & II). The recommended value is ≤0.1/100mL by WHO (Rizvi, 1994). The water pollution has a special interest now-a-days. The water pollution especially takes place by pathogenic organism, which may cause intestinal infection like entire fevers, cholera, dysentery and food poisoning. Chlorine as a gas is used with combination to other chemicals as disinfectant and it is recommended that our prepared column and more improved techniques are helpful in this concern.

Table I. Values of different parameters of polluted water samples

No.	pH	EC (dS/m)	DO (mg/L)	TDS (mg/L)	Hardness (mg/L)	PCT No. /100 mL
			Gulistan Colony			
1	6.3	2.19	4.5	2238.2	6600	$67x10^3$
2	6.3	2.19	4.6	2800.0	6200	$70x10^3$
3	6.5	1.72	4.1	2300.0	4400	$70 x10^3$
4	6.6	2.97	4.2	2800.0	5720	$71 x10^3$
5	6.4	2.50	5.1	2529.0	5680	$70 x10^3$
6	6.8	2.34	4.7	2400.0	4840	$76 x10^3$
7	6.6	2.34	4.1	2000.0	4400	$72 x10^3$
8	6.8	2.60	4.7	1700.0	4000	$65 x10^3$
			Samanabad			
1	6.5	0.63	3.7	1000.0	6600	$56 x10^3$
2	6.6	0.63	4.6	1700.0	4880	$63 x10^3$
3	6.8	0.47	4.9	666.7	4480	$63 x10^3$
4	6.4	1.09	4.7	1666.7	4840	$60 x10^3$
5	6.5	0.47	5.0	800.0	4400	$52 x10^3$
6	6.5	0.78	4.4	1200.0	4400	$43 x10^3$
7	6.5	0.97	4.6	1320.0	4000	$58 x10^3$
8	6.5	0.63	4.1	1479.0	4000	$51 x10^3$
			Nishatabad			
1	7.8	2.66	7.8	3000.0	2520	$65 x10^3$
2	7.7	2.34	5.7	2666.6	2040	$102 x10^3$
3	7.1	2.34	5.3	3666.6	1920	$98 x10^3$
4	7.8	3.13	7.8	3333.3	1760	$63 x10^3$
5	7.2	2.97	7.2	3000.0	1360	$101 x10^3$
6	7.5	2.66	7.5	3666.6	1566	$96 x10^3$
7	7.6	2.97	7.6	3000.0	1840	$71 x10^3$
8	7.8	3.28	4.3	3666.6	1400	$100 x10^3$

Table II. Values of different parameters of samples water after treatment

No.	pH	EC (dS/m)	DO (mg/L)	TDS (mg/L)	Hardness (mg/L)	PCT No./100 mL)
			Gulistan colony			
1	6.9	1.20	3.2	1230.7	200	$15 x10^3$
2	6.8	1.09	3.5	1400.0	200	$11 x10^3$
3	7.0	0.88	3.0	1172.1	100	$12 x10^3$
4	7.0	1.08	3.2	1020.1	160	$19.4 x10^3$
5	6.7	0.88	3.7	900.0	160	$19 x10^3$
6	7.0	0.95	3.1	973.0	120	$8 x10^3$
7	6.9	1.17	3.8	1000.0	100	$17 x10^3$
8	7.0	1.39	3.9	893.3	100	$16 x10^3$
			Samanabad			
1	6.9	0.39	3.0	632.1	200	$15 x10^3$
2	6.9	0.27	3.9	782.1	120	$18 x10^3$
3	7.0	0.36	4.1	509.2	120	$10 x10^3$
4	6.9	0.60	4.0	921.8	100	$12 x10^3$
5	7.0	0.32	3.8	539.8	100	$12 x10^3$
6	7.0	0.43	3.3	739.8	100	$18 x10^3$
7	7.0	0.53	3.7	750.3	100	$15 x10^3$
8	7.1	0.42	3.3	981.1	100	$13 x10^3$
			Nishatabad			
1	7.2	1.31	4.1	1472.3	100	$15 x10^3$
2	7.0	0.73	4.0	832.8	200	$17 x10^3$
3	7.0	0.79	4.1	1233.4	120	$18 x10^3$
4	7.6	1.12	3.9	1200.0	120	$11 x10^3$
5	7.2	1.09	3.8	1098.0	100	$14 x10^3$
6	7.2	1.94	4.0	1293.2	100	$9 x10^3$
7	7.4	1.18	3.7	1192.1	100	$12 x10^3$
8	7.4	1.20	3.3	1342.3	100	$18 x10^3$

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