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QUALITY ANALYSIS OF GROUND WATER RESOURCES OF PAHARANG DRAIN FAISALABAD, PAKISTAN

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Abstract: Water is an important inorganic liquid that exists naturally on earth and it cover about 70% of the earth surface. Almost 97% of total water found in the Ocean and just over 3% constitute as fresh water. In this study that was conducted in Ayub Agriculture Research Institute Faisalabad to determine the contamination of ground water due to sewage water and its suitability for drinking purposes. In two surveys, wastewater and ground water samples were collected from 3 different locations from the paharang drain Faisalabad city. It was used to estimate physicochemical parameters like pH and electrical conductivity by using portable, direct reading instrument and concentration of total suspended solids was determined by titration method. The value of some anions like nitrates was estimated by direct ion meter. The concentration of major cations such as chlorides were determined by silver nitratre method and some traces heavy metals (Zn, Cu, Cd, Pb) through atomic absorption spectroscopy. The pH value of these samples was within the permissible range i.e. 7.11-7.34. The electrical conductivity was 5.72 to 5.92 which exceeded the standard values guided WHO (3 dSm^{-1}). The concentration of total suspended solids was in the range of 3661.75 to 3790.25 mg/L that was higher than the standard value which is (1000 mg/L). The nitrate concentration (31.25 to 74.49 mg/L) also exceeded the permissible limit set by WHO (50mgL^{-1}). The chloride concentration was between the ranges of (24.375-39.375 meq/L) which were higher than the standard value given by WHO (7.04 meq/L). The concentration of carbonate which was between (6.38 to 7.5 meq/L) and bicarbonate which was within the range (1.075 to 0.2375 meq/L) were also within the permissible limits (8.3 meq/L) set by WHO. Overall result indicated that most of the parameters showed higher values then the standards values, which indicated that sewage waste water damaging the quality of ground water (drinking water) adversely.

Key words: Sewage and Ground water, EC, TSS, Nitrates, Chlorides etc.

1. Introduction

Water is the precious gift of God without which life cannot exist. Water is basic requirement for all living things [1, 2, 3, 4, 5].

It is very important for human and all other living beings as food. So, it is one of the most abundant and widely distributed substances in nature. Water has unusual physical properties.

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It is essential that supply of water for human consumption should be free from unpleasant or harmful impurities [6]. The ground water is generally considered a good source of drinking water due to its hidden storage in the aquifers and inherent purification properties of soil. However, it is proved to be polluted through leaching from dumping sites, improper sewage disposal and industrial activities [7].

The water bodies that carry polluted water pose great threat to stream, river and sand qualities. The continuous availability of such waters into unlined drains is permanent sources of chemical leaching to ground water. Quality of ground water varies from place to place [8]. One of the major worldwide problems is the availability of safe drinking water which people are going to face in future. In Pakistan, people get drinking water from various sources. In cities it comes in the form of piped water and in the villages hand pumps, wells, open tanks filled canal and river water directly are the major sources of drinking water. The pipes carrying drinking water mostly go side by side with sewage system. Therefore, back pressure, pipes leakage and improper cleaning of the overhead water tanks are the major source of the drinking water contamination [9].

Municipal sewage discharge is one of the problems and sewage water treatment is the most challenging environmental problem in all over the world [10]. Because WHO survey showing that 80% of all illnesses in developing countries are water related. A quarter of children born in developing countries die before the age of 5, the majority of them from water related diseases each day. Overall, about 30,000 people die from water related diseases each day. At any one time there are likely to be 400 million people suffering from gastroenteritis. 200 million with schistosmiasis, 160 million with malaria and 30 million with onchoceriasis. All of these diseases can be water related although other environmental factors may also be important [11]. These problems are due to sewage water commonly contains both solids wastes and liquid wastes generated by various human activities along with various trace metals and metal compounds. Now a day, both surface and ground water resources are contaminated by various sources like industrial effluents, agricultural discharge and municipal waste water associated with large amount of inorganic and organic toxic pollutants along with harmful pathogens. Various efforts and research are being vigorously pursued for complete treatment and healthy discharge or reuse sewage water and industrial effluents [10].

Faisalabad is situated in the center of the Punjab Province. The existing sewage system of this city is divided into two distinct zones formed by the Rakh branch canal and the railway line passing through the middle of the city. Each zone has independent sewage collection and

disposal system. Sewage from the existing systems is discharged untreated into Maduana drain and treated or untreated in Pharang drain in the East and West respectively [11]. It tremendously effect the ground water resources of that residential area. The wastewater is highly viscous with high-suspended solids and total dissolved solids. Therefore, pollution of water resources needs a serious and immediate attention through periodical checkup of water quality [12]. However due to rapidly increasing population the demand for fresh water are also increases every year. By considering the importance of ground water, the present study was carried out to monitor the ground water contaminants to assess the present water quality through analysis of different parameters at various distances.

2. Material and method

The present Study was conducted at the laboratory of Ayub Agricultural Research center Faisalabad for the analysis of water quality parameters. Grab samples were collected to know about the conditions of ground water within the range of Paharang drain Faisalabad. Effluent and ground water samples were collected 2 times in the whole study and were estimated for Physical parameters such as color, taste, odor, pH, EC and TSS and also some other chemical parameters such as nitrate and concentration of major anions like chloride and also some heavy metals. pH was estimated by a pH meter. System consists of a combination of electrode and display the results in either milli volts or after conversion in pH units. A glass electrode was placed in 100 ml beaker containing distilled water and then pH meter was calibrated according to manufacturer's recommendations. The beaker of distilled water was removed carefully and glass electrode was dipped into the other beaker having water sample. The deflection of readings was observed from rest position and when it was in stable condition, the pH of sample was read directly and noted.EC was measured by the eletrical conductivity meter (Model DDS-120W). For measurement of EC same procedure was carried out like pH estimation.

Phenolphthalein alkalinity was determined by titration to the phenolphthalein end point and registered the total hydroxide and one half of the carbonates present. Total alkalinity was determined by titration to methyl orange end point, which included all the hydroxides, carbonate and bicarbonate. Reagents are given below;

Hydrochloric acid	0.1 N
Methyl orange indicator	0.1%
Phenolphthalein indicator	0.5%

100 ml of water sample was taken with a 100 ml graduated measuring cylinder and transferred into a 250 ml titration flask. For measuring the Phenolphthalein alkalinity 2-3 drops of phenolphthalein were added as indicator and swirled to mix the solution. A 50 ml burette was filled to the zero mark with 0.1 N HCL standard solutions. While swirling the flask, titrated the sample until the solution color was changed from pink to colorless. The volume of 0.1 N HCl standard solution used for titration was V_{pa} ml.

Total alkalinity estimated when 2-3 drops of methyl orange indicator were added to the above titrated sample and swirled to mix. It was titrated with 0.1 N HCL standard solutions until color changed from orange to red. The volume of 0.1 N HCl standard solution used for titration was V_{ma} ml.

2.1. Calculation

Phenolphthalein alkalinity = $V_{pa} \times 0.1 \times 50 \times 1000 / 100$

$V_{pa} \times 50$

Total alkalinity = $v_{ma} \times 0.1 \times 50$

$V_{ma} \times 50$

Total suspended solid determined by EC value multiple with 640.

TSS (mgL^{-1}) = $EC \times 640$

The value of nitrate of ground water samples was estimated directly by ion meter. The electrodes were calibrated with standard solution of KNO3.

For chloride determination the silver nitrate was used. The silver nitrate was used as a titrant and potassium chromate as an indicator. 10 to 100ml of water sample was taken by pipette and transferred into 250 ml titration flask. Added 1.0 potassium chromate as an indicator and swirled the flask to mix. A 50 ml burette was filled to the zero mark with 0.1 N silver nitrate standard solutions. While swirling the flask, titrated the sample until brick red color appeared. The volume of 0.1 N silver nitrate standard solution used for titration was Va ml.

2.2. Calculation

Chloride (mg/l) = $Va \times 0.1 \times 35.45 \times 1000$ / sample volume

The value of heavy metals from ground water samples was estimated by atomic absorption spectroscopy (AAS 550). Prior to analysis samples were acidified with N/10 standard solution and blanks were run at the time of analysis, absorbance/concentration were measured (APHA, 1989).

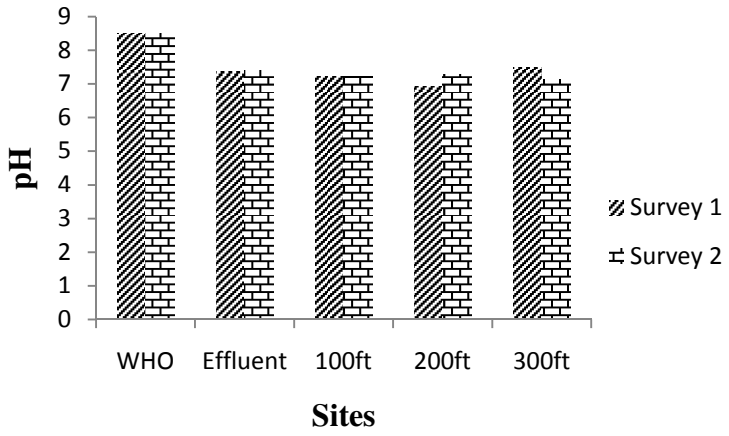
3. Results And Discussion

The various parameters of groundwater of area around the Paharang Drain are discussed individually as follows:

3.1. pH

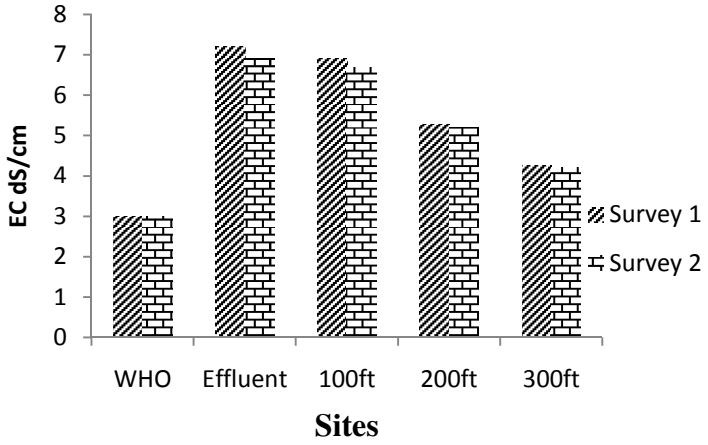
The pH value for effluent samples for 1st and 2nd survey was (7.35-7.41) and there was no significant difference between these values as shown in (Fig. 1). The pH values of ground water samples having less value than the sewage water samples in both surveys. At 100 and 200ft pH of ground water samples was decreased except at 300ft.

Same pattern was observed in 2nd survey, values of ground water samples were within the range of (7.21-7.28) except at site 3(300ft) as shown in fig 1. The overall pH values are within the permissible limit set by WHO (7-8.5) which shows the slightly alkalinity of water samples. Some other studies are accordance this that few water samples were slightly alkaline along with high dissolved solids [13] some other studies also shows the permissible limit of pH values [14]



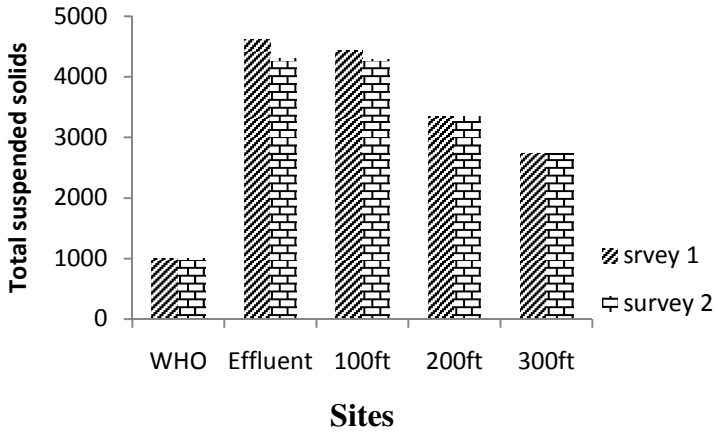
3.2. EC

The EC value of sewage water in 1st survey was 7.21 $dScm^{-1}$ and in 2nd survey was 6.9 $dScm^{-1}$. In the case of comparison of EC, values for 1st and 2nd survey, the EC value of sewage water in 1st survey was higher than the value of 2nd survey sewage water as shown in figure 2. Overall EC value of sewage water was significantly higher than other ground water samples in both surveys. The values of EC were decreased with increasing the distance in both surveys. These values were higher than the standard value prescribed by WHO ($3dScm^{-1}$). The results showed that the ground water is affected by sewage water by exceeded value of EC. Similar works were also carried out to check the characteristics of water [15,16]



3.3. Total suspended solids:

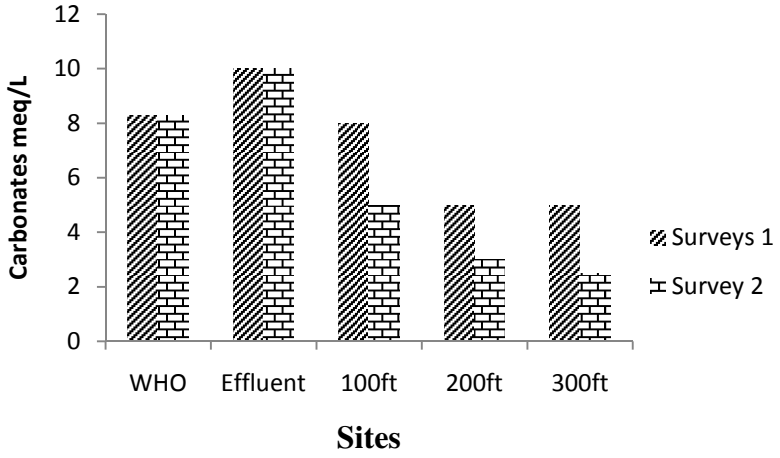
The TSS values of effluent samples in both of the surveys 1 and 2 was (4614, 4300) showing the smaller difference between them. In 1st survey the value of TSS was within the range of (4228mg/L-2733mg/L) at three sites of distances 100ft, 200ft and 300ft. The order of values decreased with increasing distances as shown in fig 3. The same pattern was seen in 2nd survey in all three sites their values were in the range of(4281-2726). The results show that the values of TSS in two surveys exceed the permissible limit that prescribed by WHO (1000mg/L). These findings indicate higher values of TSS in ground water sample in any site that was under the study. The higher value of TSS had been already studied in ground water samples in different locations [17].



3.4. Carbonates:

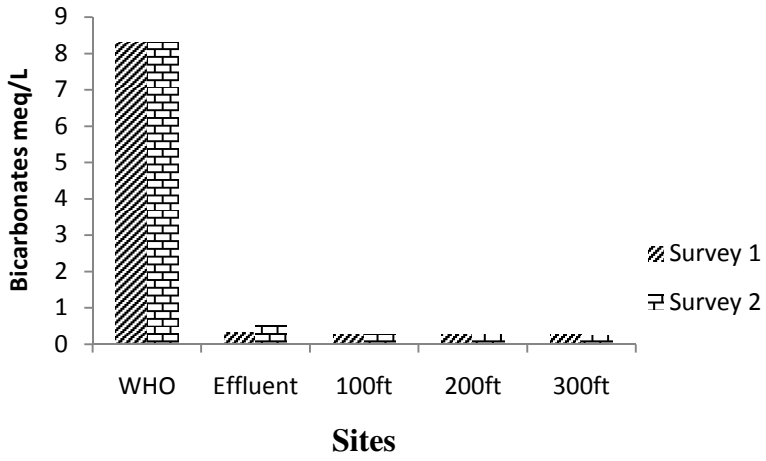
As shown in fig 4 the values of carbonate in effluent samples in first and second survey were equal (10mg/L, 10mg/L). The effluent samples have greater values then ground water all samples in both surveys. By comparison, the value of carbonate in ground water samples

decreased with increasing distances and at 200ft, 300ft the values were same (5meq/L, 5meq/L) in 1st survey. In survey the carbonate values were rapidly decreasing by increasing distances on 3 sites at (100, 200,300ft). The result shows that the values of carbonate in these surveys were within the permissible limit recommended by WHO (8.3meq/L). This type of results also been investigated for carbonates in ground water [14]. The below value than standard had also been determined in portable water [15].



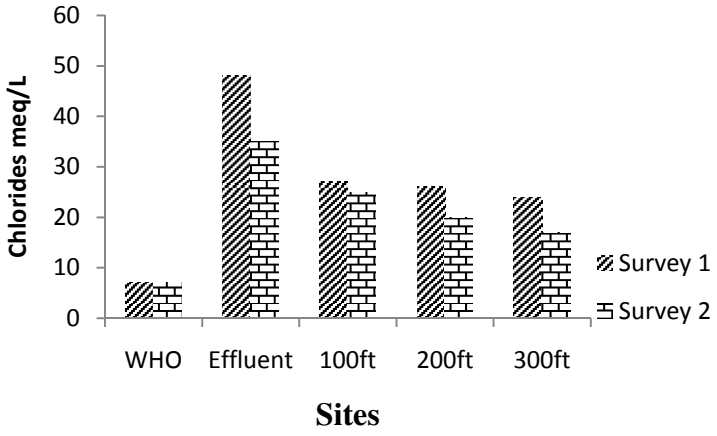
3.5. Bicarbonates:

The value of bicarbonates in effluent samples (0.3-0.5) were greater than the ground water samples. In 1 survey the values of bicarbonate at 100ft was 0.26 and having same values at 200ft and 300ft (0.25, 0.25) it showed that bicarbonates decreases with increasing distances in both surveys as shown in fig 5.Almost same pattern was seen in 2 survey. The values were within the permissible limit given by WHO (World health organization) 8.3meq/L. These results are accordance with some other previous study carried out for ground water were within the prescribed level [14].



3.6. Chlorides:

In accordance to fig 6, the values of chlorides in effluent samples of 1st survey was (48meq/L) was higher than the second survey (35meq/L). The concentration of chlorides was higher than all ground water samples. The value of carbonates ranges (27-24) in 1st survey and (25-17) in 2nd survey that decreases with increasing distances on 3 sites. The permissible limit of chloride for drinking water according to World Health Organization is 7.04 meqL^{-1}The result shows that the values of chlorides exceeds the permissible limit recommended by WHO. A previous study was also determined the chloride concentration goes beyond the WHO guideline values [18]**.** Overall results shown that the sewage water effecting the ground water used for drinking purposes.

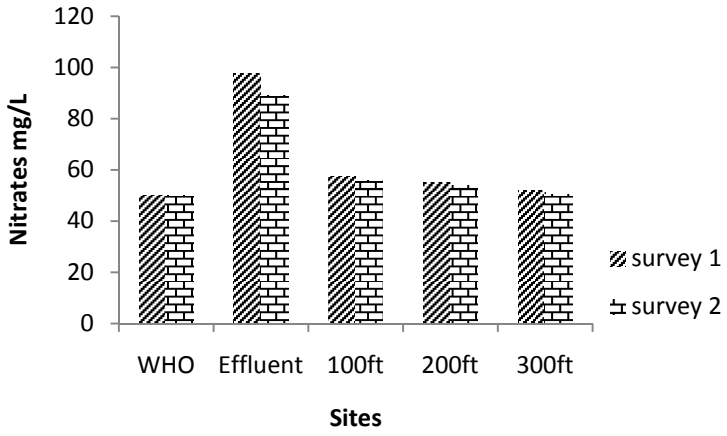


3.7. Nitrates:

The value of nitrates in effluent samples were within the range (97.72-89.13) in both of the surveys. The nitrate values were higher than the ground water samples in these surveys. In 1st survey the concentration of nitrates at 100ft to 300ft was (57.5- 52) that decreased with increasing distance. The same pattern was seen in 2nd survey ranges (56-50.5) as shown in fig 7.The values of nitrates in effluent and ground water exceed the permissible limit given by WHO (50mg/L). Overall results shown that the sewage water pollute the ground water due to higher values of nitrates [19].

3.8. Heavy metals:

The concentration of heavy metals was determined by *atomic absorption spectroscopy (AAS 550).*The result showed that heavy metals (Pb, Ni, Cd and Cu) in all water samples were present in traces amounts.



Conclusion

On the basis of the result obtained in this study, it can be concluded that the industrial effluents in Pharang region is affecting ground water in nearby regions to the effluents point and that some remedial strategies should be implemented to preserve the safety ground water.

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