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Quality examination of drinking water: a cause study of water filtration plants installed at Hyderabad city, Sindh, Pakistan

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Abstract

A study was carried out to evaluate the quality of water supplied by water filtration plants installed by tahseel municipal authority and Hyderabad development authority. A total of 14 plants were selected on the basis of their functionality in the different location of Hyderabad city. The sole objective of this study was to assess the quality of drinking water provided by water filtration plants to common citizens. A total 14 water samples were collected from different filtration plants and were analyzed for i.e. pH, electric conductivity, total dissolve solid, salinity, dissolve oxygen, chloride, total hardness, nitrate, chemical oxygen demand, iron and coliform test. It was observed that only one sample out of 14 filtration plants was meeting the National Environmental Quality Standards (NEQS).

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Introduction

Water is the most essential component for every living creature (Postel *et al.*, 1996) and all humans have right to get safe water (Peter H Gleick, 1998). It is unique liquid in the sense that without it life is impossible (Eldon D. Enger and Bradley F. Smith, 2000; Lemikkanra 1999; FAO, 1997). According WHO (World Health Organization), 780 million peoples do not have adequate water for survive (WHO, 2012) and 2 million people die every year due to water born disease (Hiroshi S *et al.*, 2013). On the global scale there is abundance of water but the problem is the availability of water in the right place at the right time and in the right form. The survival of mankind has always depended on water (Igor A Shiklomanov, 1998; Ranjini *et al.*, 2010). Only limited peoples use potable water for their requirements (WHO, 2004).

Without water life is impossible for that earlier time civilizations flourished on riverbeds. Excluding fat water composes approximately 70% of the human body by mass but the Water availability on a per capita basis has been declining at an alarming rate. More than 99% of Earths water in its natural state is not available or unsuitable for human use; the amount of water which is available for all people, plants and animals on the earth is less than 1% of the total amount. In most developed countries the water supplied to household's commerce and industry is all of drinking water standard even though only a very small proportion is actually consumed or used in food preparation.

It has been decreased from about 5000 cubic meters per capita in 1951 to about 1100 cubic meters currently, which is just above internationally recognized scarcity rate. It is projected that water availability will be less than 700 cubic meters per capita by 2025 (Pak-SCEA, 2006). It is also estimated that in Pakistan water related diseases cause annual national income losses of USD 380-883 million (UNDP. 2003; Hashmi *et al.*, 2009). The principal source of drinking water for the majority in Pakistanis is ground water (Shahid.M *et al.*, 2013). Most of the rural areas and many major cities relay on it, although some cities such as Islamabad, Karachi, and Hyderabad etc get water from a number of other sources. Water diseases are caused by pathogenic microorganisms which are directly transmitted when contaminated fresh water is consumed, as reported that 15% of all child deaths in developing countries results from diarrhea disease (Thompson,t and Khan,S , 2003; WHO 2003; WHO/UNICEF 2004).

Contaminated fresh water used in the preparation of food can be the source of food born disease. According to the world health organization diarrheal disease accounts for an estimated 4.1% of the total daily global burden of disease and is responsible for the death of 1.8 million people every year (Witt 1982; UNDP 2006; Cheema 1993; M.Ilyas 2008). It was estimated that 88% of the burden is attributable to unsafe water supply, sanitation and hygiene and is mostly concentrated in children in developing countries (A.Q.Khan, 2012).

For the availability of safe drinking water Hyderabad Development authority installed 14 water filtration plants in city on various locations (Table. 1), these filtration plants for insurance the good quality of potable water for citizens. These water plants according to current study are biologically contaminated. This study was conducted for the assessment of theses filter plants and comparing their water quality with the World Health Organizations standards (WHO), National Environmental Quality standards (NEQS) and United States Environmental Protection agency Standards (US-EPA). Aim of this study was monitoring the quality of filter plants.

Table 1. Location of Different Filtration Plants Installed in Hyderabad City.

S.No.	Location of Water Purification Plants	GPS Coordinates
1	Alamdar Chock Naseem Nagar	N 250 24.23 E 0680 20.67
2	Main Qasimabad public Park	N 250 23.60 E 0680 20.09
3	Old Wahdat Colony	N 250 22.94 E 0680 20.01
4	G.O.R Colony	N 250 22.74 E 0680 20.42
5	Bhitai Nagar Qasimabad	N 250 24.26 E 0680 22.70
6	Statelife Colony Qasimabad	N 250 21.67 E 0680 20.67
7	Mumtaz Colony kacha Qila Hyderabad	N 250 22.28 E 0680 20.70
8	Pathan Colony	N 250 24.26 E 0680 21.820
9	F.G Boys College, Sadar	N 250 24.26 E 0680 21.70
10	Chandni Center, Sadar	N 250 23.26 E 0680 21.73
11	Board office latifabad unit No.9	N 250 21.96 E 0680 21.29
12	Hilal – E- Ahmer Hospital latifabad No.6	N 250 22.14 E 0680 21.11
13	American Hospital Latifabad No.7	N 250 22.33 E 0680 21.34
14	Railway Station Hyderabad city	N 250 22.87 E 0680 22.38

Material and Methods

Sampling

There are 52 water filtration plants at different locations in Hyderabad (Clean Drinking Water Initiative for all 2008), from which 14 working filtration plants were selected for this study, location of each filtration plant was recorded using the geographical positioning system (GPS) Gaming Novi 250 model (Table.1). 1000 ml of Water samples were collected on Tuesday and Wednesday 20, 21/12/2011 in the pre-sterilized plastics bottles and on the same day transported to Environmental Chemistry laboratory of institute of advance Research Studies in chemical Sciences University of Sindh Jamshoro and stored at the room temperature 25 0C. Chemical Oxygen Demand (COD) (I. Vyrides *et al.*, 2009), chlorides (APHA 1992), Hardness, Nitrate, Iron (Fe) and bacterial contamination were assessed.

Method for Physical analysis

Parameters i.e. appearance, color, odor visually noted at the sampling sites and temperature (by Digital Thermometer by France), pH, electric conductivity, Salinity and Total Dissolved Solids (TDS) were also noted at the sampling stations by (instrument called Orin Digital 5star USA.)

Table 2. showing Sampling time, ambient and water temperature at the sampling time.

S.No	Location of water filtration plant	Ambient temperature	Water temperature	Time/Date
1	Alamdar chock Naseem Nagar	22.30C	20.70C	6:10 pm 21/12/2011
2	Main Qasimabad public Park	21.40C	21.30C	6:46 pm 21/12/2011
3	Old Wahdat Colony	21.40C	20.30C	7:03 pm 21/12/2011
4	G.O.R Colony	20.10C	20.20C	7:26 pm 21/12/2011
5	Bhitai Nagar Qasimabad	21.60C	19.80C	11:30 am 22/12/2011
6	State life Colony Qasimabad	21.70C	20.30C	12:49 pm 22/12/2011
7	Mumtaz Colony kacha Qila Hyderabad	22.10C	21.00C	5:51 pm 22/12/2011
8	Pathan Colony	24.80C	21.10C	11:37 am 20/12/2011
9	F.G Boys College, Sadar	24.60C	21.60C	11:58 am 20/12/2011
10	Chandni Center, Sadar	24.30C	19.80C	12:05 pm 20/12/2011
11	Board office latifabad unit No.9	23.20C	20.70C	12:28 pm 20/12/2011
12	Hilal – E- Ahmer Hospital latifabad No.6	24.30C	21.30C	12:54 pm 20/12/2011
13	American Hospital Latifabad No.7	27.80C	22.10C	01:05 pm 20/12/2011
14	Railway Station Hyderabad city	26.60C	21.00C	01:30 pm 20/12/2011

Method for Chloride and Hardness

The chloride in water was determined by titration method as reported (APHA 1992) The Hardness was determined by complex metric titration at pH 10 adjusted with (NH CL – NH OH) BUFFER SOLUTION. The titration was carried out with disodium salt of ethylenediamine tetra acetic acid (Na EDTA) by using Erichrome indicator. The color change from wine – red to blue was recorded as end point.

Method for Nitrate and Iron

The Atomic Absorption Spectrophotometer was used for assessment of Nitrate and Iron, the instrument was calibrated with standards and making sure that the results of the certified standards are within the confidence limit, the samples were than aspired into the flame and the Nitrate and Fe in each sample was noted.

Method for COD and Bacteriological contamination

For the Chemical Oxygen Demand; potassium dichromate, ferrous ammonium sulphate and ferrous indicator reagent were used for titration method (I. Vyrides *et al.*, 2009). For the bacteriological analysis reported method of (Nollet Leo 2007; M.A.Isa *et al.*, 2013) was followed.

Result and Discussion

Chemical Oxygen Demand

Water of filter plants was according to standards with respect of pH, EC, TDS, Salinity and DO (WHO 1996; US-EPA 1991) and National drinking water quality standards (NEQS 2008) (Table.3). COD was higher than the acceptable limit in sample five it was up to 32 mg/l, this sample was collected from Bhitai Nagar Qasimabad Hyderabad (Table.2.).On the Other hand in six samples COD was zero, sample 4 was also contain 30 mg/l of COD, it was collected from G.O.R colony. Sample no. 6, 7 and 11 was also containing more COD than standard of references. COD is measure of organic contamination in water, it measures the oxygen needed to oxidize the waste (Gilbert M. Masters 2004). It was observed during this study that those filter plants which were in rich colonies were contain less contamination where's colonies of poor people's were more contaminated. It is may be due to political influence.

Table 3. Showing test results of Water Filtration Plants.

S. No.	pH	EC µS/ cm	Chloride mg/L	Total Hardness mg/L	TDS ppm	Salinity mg/L	Nitrate mg/L	COD mg/L	Iron mg/L	*E. Coli* Qualitative Test
01.	7.52	660	102.80	20	323	0.3	0.97	0	1.38	+ve
02.	7.81	698	111.66	50	342	0.3	Nil	0	0.81	+ve
03.	6.31	721	118.70	30	353	0.4	Nil	0	1.39	+ve
04.	7.61	713	102.80	20	349	0.3	1.45	30	0.92	+ve
05.	7.75	691	095.70	50	339	0.3	0.145	32	1.51	+ve
06.	7.75	693	097.40	15	340	0.3	1.21	14	1.81	+ve
07.	7.65	664	095.70	20	325	0.3	4.37	13	1.00	+ve
08.	6.88	685	099.26	50	335	0.3	0.97	04	0.50	+ve
09.	7.17	670	097.48	20	335	0.4	1.12	0	0.70	-ve
10.	7.48	688	109.89	10	336	0.2	1.45	0	2.94	+ve
11.	7.46	675	101.03	30	331	0.3	0.24	13	2.28	+ve
12.	7.34	702	116.98	10	344	0.3	1.45	08	2.23	+ve
13.	7.45	685	110.98	25	336	0.4	2.18	0	1.34	+ve
14.	6.07	700	100.26	20	343	0.3	0.72	12	1.19	+ve
NEQS	6.5-8.5	NA	<250	<500 mg/l	<1000 mg/l	NA	≤50	NA	NA	0 in 100 ml
WHO	6.5-8.5	400 mg/l	250 mg/l	<1000 ppm	500 mgl	5 mg/l	50 mg/l	10 mg/l	0.3 mg/l	0 in 100 ml
US-EPA	6.0-8.5	300 mg/l	NA	500 ppm	500 ppm	0-5 mg/l	100 mg/l	4.0 mg/l	0.3 mg/l	0 in 100 ml

Bacteriological Contamination

13 out 14 water filtration plants were bacteriological contaminated (Table.3.) and only one filter plant which was under the cantonment area was safe, hence it is also a second proof of political in fluency in every development. Cantonment area is under the control of Pak Army so its water is free from any coliform contamination and other all the filter plants in Hyderabad were contaminated by coliform bacteria. In studies of other cities of Pakistan bacteria contamination is found in exceed (Bhutta *et al.*, 2008; Sun.O *et al.*, 2001; S.Mehmood *et al.*, 2013). Previous studies show Pakistan has not safe dirking water facilities for citizens (Farooq S *et al.*, 2008), even the bottled water also contain contaminates and not follows the NEQS (Rosemann N 2005; Nils R 2005). Safe drinking water is a serious problem of country government should have to take emergency steps for this.

The *Coliform* group of bacteria which is a common group of gram negative bacteria. The principal species in this group are *Escherichia Coli* and *Enterobacter*. Total *Coliform* level is the criterion of sanitary quality of water for a number of reasons; first many are native to the intestinal tract of warm blooded animals and man and enter water with fecal discharge. While relatively harmless, they, coliform organisms are found in the company of such enteric pathogens as those responsible for typhoid fever, cholera and dysentery. *Coliform* is a useful indicator because they normally survive longer than their disease producing fellow's travelers. Thus, once they have died off, the danger is normally past. Fecal Coliform is positive indication of presence of harmful bacteria. Water quality standards World Health Organization (WHO 1996), guidelines for drinking water quality states that *E.coli* or thermo tolerant coliform bacteria must not be detectable in 100ml sample of drinking water.

Iron Contamination

Concentration of iron was also exceeded in all samples of water. Sample no. 10, 11 and 12 were more contaminated by iron (Table.3.). This was may be due to erosion of water pipes. It was clear that iron was not removed from this kind of filtration technology. It was required to install proper filtration plant which the efficiency and which grantee the removal of all contamination from water and make it suitable for citizens. As reported by (S.Mehmod *et al.*, 2013; Hashmi I *et al.*, 2009; Farooq S *et al.*, 2008) iron contamination also serious issue, from their studies iron was found more than standard limits.

Conclusion

Taluka Municipal Administrations and Hyderabad Development of Authority have to play their role in proper functioning of water filtration plants. Proper treatment and responsible administration of water filtration plants should be given top priority to safeguard the public health of common citizens of Hyderabad city. Possible causes of contamination may be the leaking water mains and cross connections between water mains and sewers due to close proximity. It was also observed that compulsory chlorination at water was highly recommended.

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