Physico-Chemical Characteristics of Ground Water at Pappankuppam (Tamil nadu), India

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KEYWORDS	A B S T R A C T
Pappankuppam village, Ground water, Pollution	An investigation was undertaken to study of chemical & physical properties of Ground water at Pappankuppam in Tamil Nadu have been carried out and the parameters studied were pH, total alkalinity, total hardness, turbidity, chloride, sulphate, fluoride, total dissolved solids and conductivity. Village waste if discharged into surface water can give rise to significant deterioration in its quality. This paper presents water quality of Ground water in pappankuppam village. Four different locations were selected for the study and compared. From overall analysis, it was observed there was a slight fluctuation in the physicochemical parameters among the Ground water samples studied. Comparison of the physico-chemical parameters of the river water sample with WHO and ICMR limits showed that the Ground water is highly contaminated and account for health hazards for human use.

Introduction

Water is an absolute necessity if life must be sustained on earth (Hiremath *et al.,* 2011). Therefore, the importance of natural water bodies does not need elaborate emphasis; this is because, whatever that affects water bodies has direct or indirect effect on human health. Naturally, water is second only to air among

the most important resources for human existence; however, it is the most threatened. The impact of village toxic and hazardous wastes on aquatic life including microorganisms has recently received alarming concern globally (Obire *et al.,* 2008). The human race is under tremendous threat due to undesired changes in the

physical, chemical and biological characteristics of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activities, water is highly polluted with different harmful contaminants (Patil *et al.,* 2012). It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrheal sickness every day. Some 90% of cities suffer from some degree of water pollution and nearly 500 million people lack access to safe drinking water (APHA, 1995). In addition to the acute problems of water pollution in developing countries, developed countries continue to struggle with pollution problems as well. The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. High concentrations of naturally-occurring substances can have negative impacts on aquatic flora and fauna.

Oxygen-depleting substances may be natural materials, such as plant matter (e.g. leaves and grass) as well as man-made chemicals (BIT, 1995). Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species. Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry includes acidity (change in pH),

electrical conductivity, temperature, and eutrophication (Tiwari and Goel, 1986). Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations (Aruna Sharma and Khan).

Study Area

Pappankuppam village is part of Thiruvallur Dist. The project location is geologically placed at Latitude $13^0 21'$ $31''$N to $13^0 22'80''$N and Longitude $79^0 58'$ $41''$ E to $79^0 59'49''$E. The mean sea level is +50m. Underground water is the only source of water for Pappankuppam. The ground water quality of Pappankuppam (Sipcot Industrial Park, Thervoykandigai, Gummidipoondi Taluk, Thiruvallur District) is continuously degrading due to village activities and the soils of the nearby fields are also being affected. Therefore, we have decided to analyze its effluents so that some remedies for the improvement could be possible (Fig. 1) shows the study area and sampling locations.
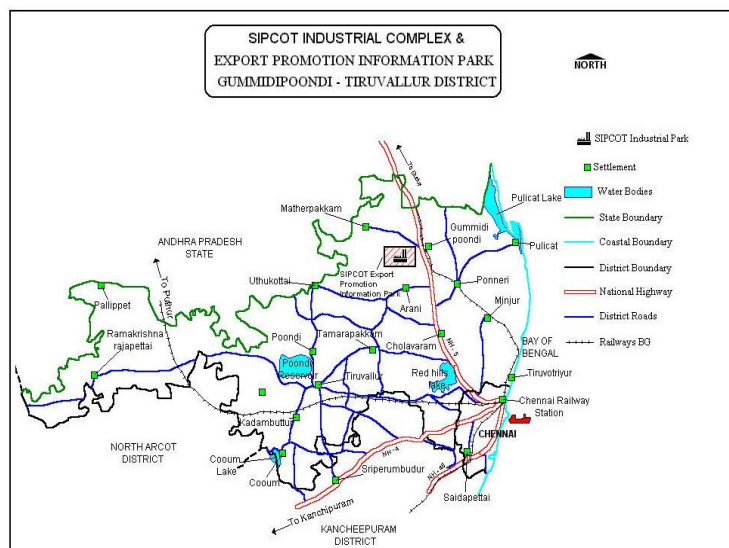
Materials and Methods

The Water samples were collected from ten different locations of Pappankuppam village during the postrainy season (Jan-Feb 2014). Borosilicate glassware, distilled water and good quality reagents were used throughout the testing. Samples were collected in sterilized screw-capped polyethylene bottles of one litre capacity and analyzed in laboratory for their physico-chemical parameters. Samples collected from study sites were properly labeled and a record was prepared (Table 1). The various physiochemical parameters were analyzed (Sorg *et al.,* 1998) (Table 2) and health effects of chemical parameters are reported (Table 3). Total alkalinities of the water samples were determined by titrating with N/50 H_2SO_4 using phenolphthalein and methyl orange as indicators. The chloride ions were generally determined by titrating the water samples against a standard solution of $AgNO_3$ using potassium chromate as an indicator. The conductivity of the water sample was measured using the conductometry method. The total hardness of the water samples was determined by complexometric titration with EDTA using Erichromebalck-T as an indicator. Sulphate and fluoride of the water samples were estimated by UV-visible spectrophotometer. TDS of water sample were measured using Turbidometric method (Singh and Chandel, 2004).

Results and Discussion

The sample collected from Ground water was analyzed. The analysis (Table 3) of ground water samples includes the determination of concentration of inorganic constituents. The physico- chemical parameters, which were analyzed in post monsoon season Jan-Feb 2014, have been shown in table 4. The desirable pH range necessary for drinking water is from 7.0 to 8.5. The pH value of water sample in the study area ranged from 6.56 to 6.71. On an average, pH of all samples was in desirable limit as prescribed for drinking water standard. This shows that pH of water sample was slightly alkaline (Manish Upadhyay, 2014).

Total alkalinity of water in terms of $CaCO_3$ varied from 40–100mg/l. The values of total alkalinity were comparatively moderate. The water for domestic use having alkalinity less than 100mg/l is safe. The high content of alkalinity is shown in the table 4. Total hardness was found in the sample water ranges from 90–110mg/l, which shows that water is safe for drinking purpose. Hardness has no known adverse effects on health. However, maximum permissible level prescribed by WHO for drinking water is500 mg/l as set. According to some classifications, water having hardness up to 75mg/l is classified as soft, 76–150mg/l is moderately soft, 151–300 mg/l as hard and more than 300 mg/l as very hard. On this basis, the results show that all the samples were soft except sample 01.

Chloride content of the water samples was low in rainy season. According to WHO, maximum permissible limit for chloride is 500mg/l. The value observed in present study is in the range of permissible limit. The sulphate content varies between 3 to 8 mg/l and the fluoride content varies between 0.06 and 0.35 mg/l. The sulphate and fluoride values were also found to be within the prescribed limits. Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro granular suspended form. The permissible limit of TDS of drinking water is 500 mg/l. The observation shows that the TDS is within the permissible range as prescribed by WHO (2004).

Table.1 Sampling Points

Sampling place	Sampling point number
Open well	1
Open well	2
Bore well	3
Bore well	4

Table.2 Methods used for estimation of various physicochemical Parameters

Parameters	Method
Temperature	Thermometer
pH	pH metry
Total Alkalinity	Conductometry
Total Hardness	EDTA Titration
Turbidity	Turbidity Meter
Chloride	Silver nitrate Method
Sulphate	Turbidometric Method
Fluoride Ion	Spectrophotometer
Total Dissolved Solids	Conductivity Meter
Conductivity	Conductometry

Table.3 Health effects of chemical parameters

Parameters of water analysis	BIS Guideline values (Max. allowable)	Potential health effects
P^H	6.5-8.5	Affects mucous membrane; bitter taste;Corrosion
Total Alkalinity	200-600mg/l	Boiled rice turns yellowish
Total Hardness	200-600mg/l	Poor lathering with soap; deterioration of the quality of clothes; scale forming
Chloride	250-1000mg/l	Taste affected; corrosion
Sulphate	200-400mg/l	Taste affected; gastro-intestinal irritation
Fluoride	1.0-1.5mg/l	Dental and skeletal fluorosis; non-skeletalManifestations
Total Dissolved Solids	500-2000mg/l	Undesirable taste; gastro-intestinalirritation; corrosion or incrustation

Table.4 Physico-chemical parameters of sampled waters

Parameters	Sampling point			
	1	2	3	4
Temperature(°c)				
P_H	6.69	6.58	6.56	6.71
Total Alkalinity(mg/l)	80	80	100	40
Total Hardness	99	110	238	90
Nitrate(mg/l)	3	10	20	12
Chloride(mg/l)	55	66	132	80
Sulphate(mg/l)	6	7	8	3
Fluorite(mg/l)	.22	.35	.24	.06
Total dissolved solids (mg/l)	258	325	478	240
BOD				

Conclusion

The results of water investigation show that the waters of the ground water are highly contaminated with total solids. As a result of high concentration of TDS, water loses its portability and reduces the solubility of oxygen in water. Water of almost all study points is hardened contaminated because of this, people of Pappankuppam area are prone for the immediate health problems such as stomach diseases, gastric troubles etc.

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