WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 14, 1165-1174. Research Article ISSN 2277– 7105

ENVIRONMENTAL IMPACT OF GROUND WATER QUALITY PARAMETERS IN DINDIGUL DISTRICT, TAMIL NADU, INDIA

P. Pavatharini[1], R. Umamaheshwari[1]* and S. Krishnamoorthy[2]

[1]PG and Research Department of Zoology, A.P.A College for Women, Palani, Dindigul District.

[2]Department of Biotechnology, The Madura College, Madurai.

Article Received on
20 Sept. 2017,
Revised on 10 October 2017,
Accepted on 31 October 2017
DOI: 10.20959/wjpr201714-10055

***Corresponding Author**
R. Umamaheshwari
PG and Research Department of Zoology, A.P.A College for Women, Palani, Dindigul District.

ABSTRACT

In this present study, Tannery effluent and four ground water samples were randomly collected from the observation wells and analyzed for various physiochemical constituents by APHA methods. Water samples were collected in sterilized clean high density polythene bottles from Dindigul district. Water sampling areas mentioned as GW1 to GW4 (GW1-Nagal Nagar; GW2- Angu Nagar; GW3-Begampur; GW4- Palani road). The study report shows that pH of Dindigul district ground water is ranges from 6.6 to 8.1. Total dissolved solids and Electrical conductivity were found moderate in GW1 to GW3 but in GW4 is slightly increase the conductivity were recorded maximum. The Calcium, Mg, and Fe were recorded maximum in GW4 site rest of others were permissible limit. Free NH_3 was found maximum in GW4 (0.6 mg/L), in tannery effluent water (3.45mg/L). The calcium values were recorded between 220 and 320 mg/l. The magnesium values are recorded between 118 and 135 mg/l for the groundwater samples. Nitrite was observed high in Tannery effluent (1.0mg/L). The value of chloride for all the ground water samples is ranged from 100 - 340 mg/l. Phosphate was found objectable limit in GW 4 (1.4mg/L) and Tannery effluent (1.4mg/L).The fluoride values for all the ground water samples are well exceeding the permissible limit. The sulphate values for the ground water samples are exhibited between 20 and 38 mg/l. Finally, the result was concluded that the Tannery effluent water discharges impact on the ground water quality and makes contaminated at few sampling sites namely GW4 (Palani Road) > GW3 (Begampur) > GW1(Nagal Nagar) > GW2 (Angu Nagar). These ground water samples are not advisable to take as drinking purpose.

KEYWORDS: *Tannery effluent, Ground water, Water pollution, Dindigul district.*

INTRODUCTION

Pollution is an undesirable change in physical, chemical and biological characteristics of our environment that may or will destructively affect the human life and living conditions (Yadhav, 2012). Industrialization is generally thought to be the universal remedy for economic backwardness. Mounting pressure on industrialization to withstand, in the context of advancement towards economic stability is constantly degrading the environment through air, water and soil pollution (Rao *et al.,* 1995). Pollution by industrial effluents is a global phenomena. The acidic and alkaline impurities, heavy metals, toxic substances and solids from electroplating, textile, fertilizers, pulp and paper mills, sugar mills cause damage to metal and concrete structures by their corrosive activity and destroy micro organisms affecting the aquatic life. If the effluent is let on land for solar evaporation, or used for irrigation of agricultural crops, the pollutants may reach ground water table and thus contaminate ground water (Manivasakam, 2008).

Ground water was once considered to be free from pollution. But the rapid industrialization made a paradigm shift to this concept. The various uses include industrial, agricultural, and human needs. The arbitrary disposal of industrial wastes on mother earth slowly makes the groundwater vulnerable to pollution. Groundwater when once get polluted, its cleansing is hopelessly difficult. Many researchers had reported that a large number of monitoring studies have been carried out in the last 3-4 decades to evaluate the underground water pollution and its impact on human health, animals and agricultural crops (Shrinivasa Rao and Venkatashwaralu, 2000; Jain, 2002;Shyamala *et al*., 2008; Patil and Patil 2010 and Gopalakrishna, 2011). These studies have reported the presence of hazardous chemical species due to natural as well as anthropogenic sources in the underground water.

The tanning industry is one of the oldest and fastest growing industries in south and south-east Asia. The states of Tamil Nadu, West Bengal and Uttar Pradesh together have 88% of the tannery units of the country. About 55% of total leather processed in the county is from Tamil Nadu and tannery units mainly spreads over Pallavaram and Chrompet in Chennai, Ranipet, Ambur, Vaniyambadi, Pernambut of Vellore, Begambur of Dindigul, parts of Erode district and Sembattu in Trichy district.

Dindigul is the second important trading centers now a day in India. Tanneries use a large number of chemicals during the process, discharging toxic wastes (effluents) into the streams, which drain into ponds, thereby polluting the groundwater. Over the years the groundwater in the areas where tanneries are located, has become intolerably polluted.

In order to understand better the water quality, nature of the source and pollutant migration and distribution, the present study investigates the several aspects of ground water of Dindigul city.

MATERIALS AND METHODS

Tannery effluent and four ground water samples were randomly collected from the observation wells and analyzed for various physiochemical constituents by APHA methods. Water samples were collected in sterilized clean high density polythene bottles from Dindigul district. Acidifying the water samples after every collection and take to the samples at laboratory within a day. The samples were analyzed at TWAD BOARD, Madurai, TamilNadu (Physical and Chemical parameters) by BIS, (2012) and APHA, (1998) method. The following parameters were analyzed such as Color, Odour, Turbidity, TDS, Electrical conductivity, pH, Total Alkalinity, Total Hardness, Ca, Mg, Fe, Manganese, Free NH_3, NO_2, NO_3, Cl, F, SO_4 and PO_4 . Water sampling areas mentioned as GW1 to GW4 (GW1-Nagal Nagar; GW2- Angu Nagar; GW3- Begampur; GW4- Palani road).

RESULTS AND DISCUSSION

In this present study, analysis of tannery effluent water and ground water quality in four locations was carried out to determine the physical and chemical characteristics of water. pH is determined by using pH meter; Dissolved Solid is determined by using TDS meter. The other parameters are measured by using different standard methods. (APHA, 1998). Total alkalinity was determined by visual titration method using methyl orange and phenolphthalein as indicator. Total hardness and calcium were measured by EDTA titrimetric method using EBT indicator respectively. Chloride is determined by Argentometric method using potassium chromate indicator.

In present study results indicates that the quality of water varies from location to location. The pH value of a water source is a measure of its acidity or alkalinity. For most reaction as well as for human beings, pH value 7.0 is considered as best and ideal. The pH is range from 6.85 to 7.35which was the permissible limit. But in tannery water effluent shows that pH of

5.20 is acidic condition.The permissible limit of pH for drinkingwater is 7.0 - 8.5 (WHO). The groundwater sample s found tobe within the acceptable limit of WHO. There is no abnormalchange of pH in the groundwater samples. If the pH is foundbeyond the permissible limit, it affects the mucous membrane ofcells. Mohamed and Zhair (2013), reported that pH of dindigul district ground water is ranges from 6.6 to 8.1 (Fig.2).

Total dissolved solids and Electrical conductivity were found moderate in GW1 to GW3 but in GW4 is slightly increase the conductivity were recorded maximum. In tannery water samples electrical conductivity was found in beyond the tolerate level.The electrical conductance is a good indicationof total dissolved solids which is a measure of salinity that affectsthe taste of potable water. Several factors like temperature, ionicmobility and ionic valences also influence the conductivity.The high conductivity in some of the samples is likely due to the prolonged and extensive agricultural practices such as irrigation coupled with the inherent geological conditions acquiring high concentrations of the dissolved minerals (Sathiskumar*et al.*, 2011).

The total dissolved solids inwater are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides,phosphate, organic matter, and other particles (Patil et al., 2012). The values ofthe total dissolved solids for all the groundwater samples vary between 1260 and 1960 mg/l. The maximum allowable limit oftotal dissolved solids in groundwater for domestic purpose is 2000 mg/l (WHO). The maximum value (1960 mg/l) is recordedat station GW4 and minimum value (1260 mg/l) is recorded atstation GW1. According to classification of drinking water on thebasis of TDS values, all the groundwater samples are found tobe non-saline. In this study, the TDS value for all thegroundwater samples are well within the permissible limit of1500 mg/l (Fig.1).

Water hardness has no known adverse effects; however, it causes more consumption of detergents at the time of cleaning and some evidence indicates its role in heart disease (Patil et al., 2012). Excess hardness is undesirable mostly for economic and aesthetic reasons (Gopalakrishna, 2011). Total hardness is due to industrial effluent mixed directly on river basin (Sankar*et al.*, 2011). In present study indicates the total hardness and alkalinity also recorded maximum in Tannery water sample and GW4 site than that remains.

Mohamed and Zahir (2013) reported that the calcium level in beyond the permissible limit in their sampling areas of Dindigul city. In the present study, the Calcium, Mg, and Fe were

recorded maximum in GW4 site rest of others were permissible limit. Free NH_3 was found maximum in GW4 (0.6 mg/L), in tannery effluent water (3.45mg/L) (Fig.4).

Calcium may dissolve readily from carbonaterocks and lime stones or be leached from soils. But calcium isan essential nutritional element for human being and aids in themaintaining the structure of plant cells and soils (Shyamala *et al.*, 2008). In this investigation, the estimated calcium values are recordedbetween 220 and 320 mg/l. For most of the groundwater samples, the calcium values are found within the maximum permissiblelimit (200 mg/l). The calcium value is slightly higher thanpermissible limit at all stations, this may be due to the cationicion exchanges with sodium (Fig.3).

The magnesium values are recorded between 118 and 135 mg/l for the groundwater samples. The highest value of magnesium is observed at station GW2 and thelowest value of magnesium is observed at station GW3. Oncomparison with the WHO standard value of magnesium, in thisstudy it is confirmed that the magnesium value for all thegroundwater sample is within the maximum permissible limit(100 mg/l). Magnesium generally occurs in lesser concentrationthan calcium because of dissolution of magnesium rich mineralsis slow process and calcium is more abundant in earth crust (Jain, 2002) (Fig.3).

The high concentration of nitrate in drinking water is toxic and causes blue baby disease/methaemoglobinaemia in children and gastric carcinomas (Subramani *et al.*, 2012). Most of the locations the source of nitrate in groundwater occurs by direct anthropogenic pollution (septic tanks etc). In urban areas urbanization is leaching of fertilizers in agricultural area is the source for the high concentration of nitrate in all locations. The result indicates that nitrate concentrations exceed the standards and are not fit for drinking purposes. Nitrite was observed high in Tannery effluent (1.0mg/L).

The value of chloride for all the groundwatersamples is ranged from 100 - 340 mg/l. Most of the groundwatersamples show chloride values within the acceptable limit (250mg/l) of WHO. The groundwater sample at station GW3 has slightly excess chloride (258 mg/l). Excess chloride (>250 mg/l) imparts a salty taste to water. Excessive chloride in potablewater is particularly not harmful but the criteria set for chloridevalue is based on its potentially high corrosiveness. Soilporosity and permeability also play an important role in buildingup the chloride value. Increase of chlorine level in water isinjurious to people suffering due to heart and kidney diseases (Fig.5).

The fluoride ion content should be within 0.5 to 1.0 ppm as suggested by WHO (2011).Subramani *et al.*,(2012) showed his study on fluoride contamination more than acceptable limit in Coonor Nilgiri district. In present study Fluoride contents were found permissible limit in all sampling sites. Phosphate was found objectable limit in GW 4 (1.4mg/L) and Tannery effluent (1.4mg/L).The fluoride values for all the groundwater samples arewell exceeding the permissible limit. High concentration offluoride in groundwater may be due to breakdown of rocks andsoils or infiltration of chemical fertilizers from agriculturalland. The high concentration of fluoride in the study areaposes a sign of water quality problem. Skeletal fluorosis is animportant disease due to presence of high fluoride content ingroundwater.

The sulphate values for the groundwatersamples are exhibited between 20 and 38 mg/l. The maximumvalue (38 mg/l) is noted at station GW3 and minimum valuesulphate (20mg/l) is noted at GW4. The sulphate values for allthe groundwater samples are well within the permissible limit(200 mg/l) of WHO. High concentration of sulphate may causegastro – intestinal irritation particularly when magnesium andsodium ions are also present in drinking water resources (Fig.4).

The value of phosphate in the groundwater samples lie between 0.2 to 1.0mg/l. Highest value (1.0 mg/l) is recorded at station GW4 and minimum value (0.2 mg/l) is recorded at station GW2 and Gw3. In this present study, the phosphatevalues are found within the permissible limit (0.1 mg/l) ofWHO. Normally groundwater contains only a minimumphosphorus level because of the low solubility of nativephosphate minerals and the ability of soils to retainphosphate (Yadav, 2012). The phosphate values of all the groundwatersamples do not pose any water quality problem (Fig.4).

In the present study water is very hard and crossed the permissible limits. It is well known that hardness is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cation, although other cation likes barium, iron, manganese, strontium and zinc also contribute. The high concentration of total hardness in water samples may be due to dissolution of polyvalent metallic ions from sedimentary rocks, seepage and run off from soil. As we know calcium and magnesium, are the two principal ions. The concentration of total hardness in drinking water sources ranged between 75 and 1110 mg/l (Gopala Krishna, 2011), the obtained value of many of the parameters of some area exceeds and some area does not exceeds permissible limit of WHO

(2011) standards. In the present study it is observed that several parameters were notwithin the permissible limit of the International Standards.Water quality standards vary significantly due to different parameters like environmental conditions and ecosystem. The variation observed is probably due to various factors such as trace metal contents, environmental pollutions due to organic pollutant, domestic usage etc.,

Table 1: Showing results of physico-chemical parameters in Ground water of tannery effluent water nearby surroundings of Dindigul city.

Parameters	Acceptable limit	Permissible limit	Tannery effluent	GW1	GW2	GW3	GW4
TDS	500	2000	16800	1358	1313	1260	1960
EC	-	-	24000	1940	1875	1800	2800
pH	6.5-8.5	6.5-8.5	5.20	6.85	7.30	7.35	6.93
T.A	200	600	460	420	410	100	460
T.H	200	600	4480	1280	1470	1460	1700
Ca	75	200	1120	220	320	280	275
Mg	30	100	448	120	135	118	125
Fe	0.1	0.3	0.1	0.1	0.1	0.1	0.1
Mn	0.1	0.3	0	0.1	0	0.1	0.1
Free NH_3	0.5	0.5	3.4	0.4	0.2	0.2	0.6
NO_2	0.5	0.5	1.0	0	0	0	0
F	1.0	1.5	1.4	0.8	1.2	1.2	1.4
Cl	250	1000	6580	120	100	340	260
SO_4	200	400	110	26	31	38	20
PO_4	0.5	0.5	3.6	0.4	0.2	0.2	1.0

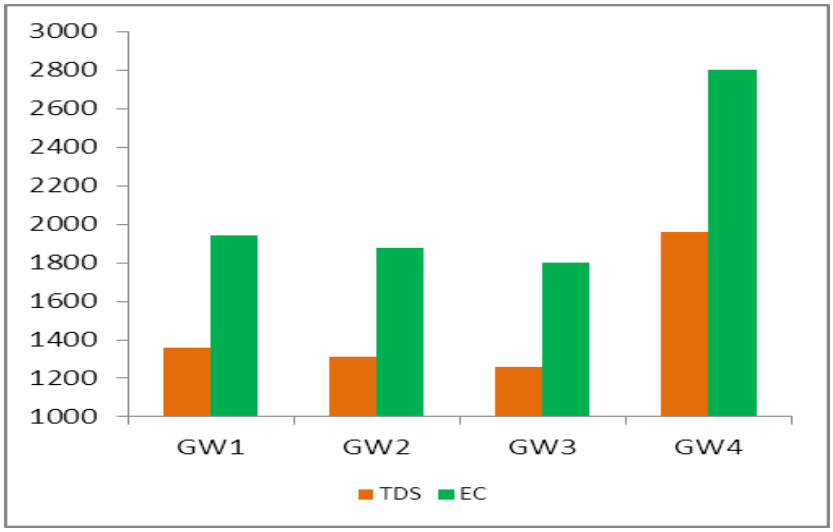

Fig.1: Total Dissolved Solids and Electrical Conductivity.

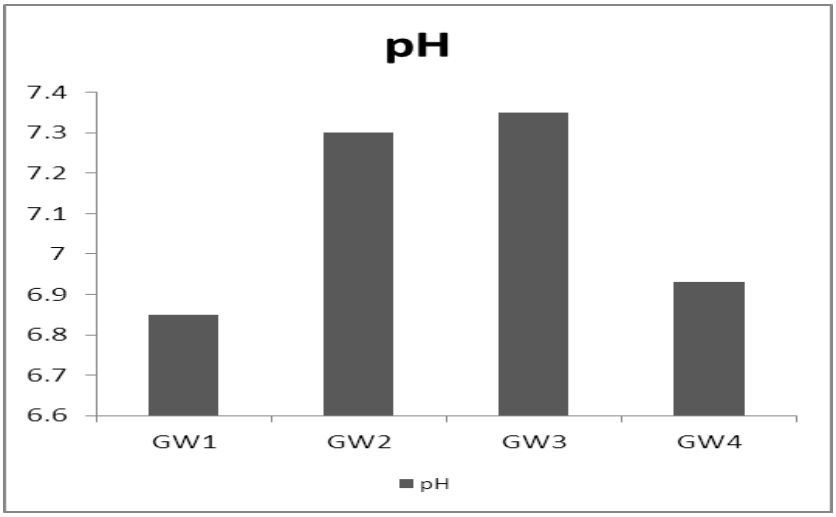

Fig.2: pH.

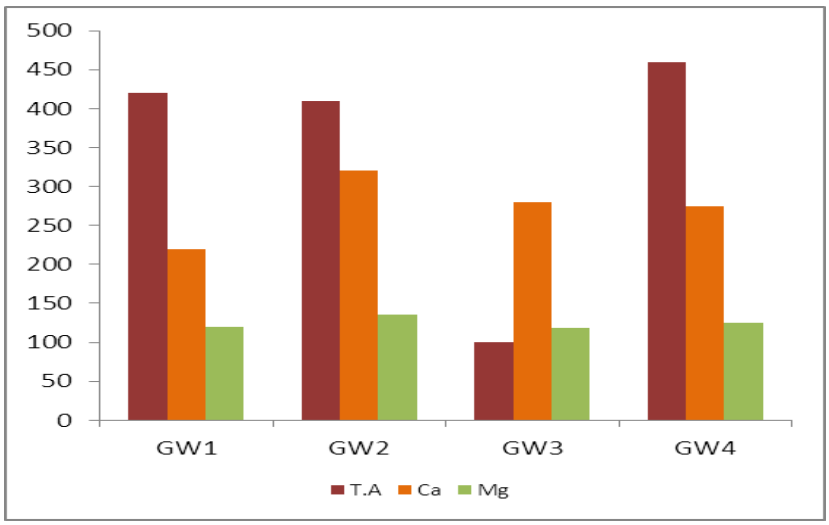

Fig.3: Total alkalinity, Calcium and Magnesium.

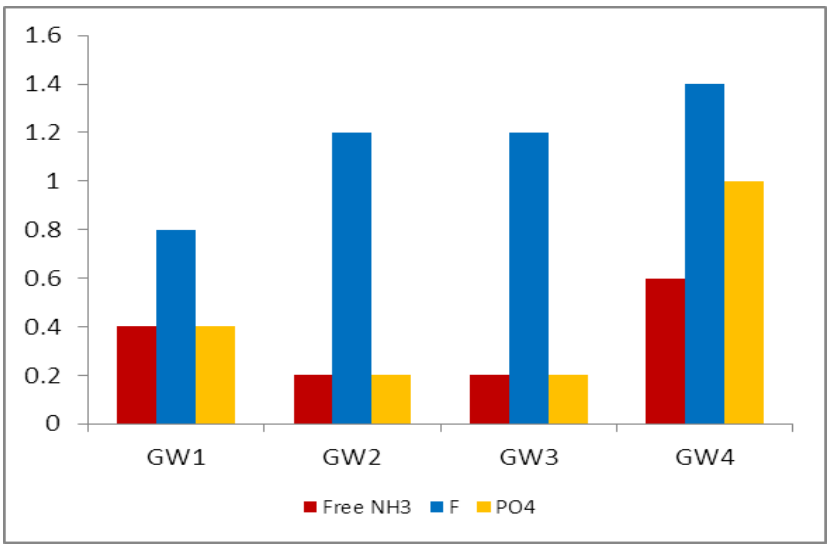

Fig.4: Free Ammonia, Fluoride and Phosphate.

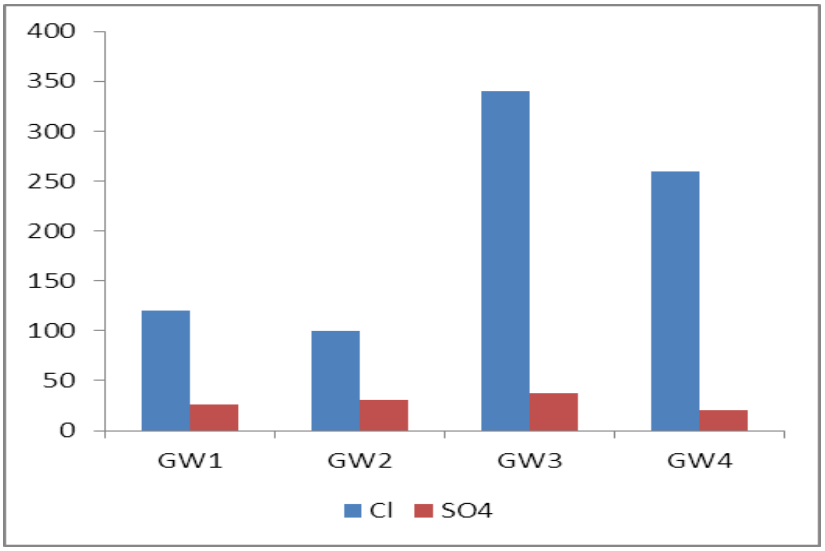

Fig. 5: Chloride and Sulphate.

CONCLUSION

We conclude that all the water samples GW1 to GW4 have common chemical parameters such as hardness, total dissolved solids, and electrical conductivity, calcium, sulphate, and chloride alarmingly above the prescribed limit. The parameterslike copper and fluoride are in the acceptable limit, if changes occurs it will cause some harmful effect. Almost in other station water samples are influenced in the large amount due to the improper management of waste water, over exploitation of water sources and rapid growth of industrialization in these areas. An attempt has been made to study about the impact of tannery effluent containing the inorganic, heavy metals and organic pollutants in Dindigul district. The effluents includes suspended solids, phenols, toxins, acids, salts and dyes.The sustainability of groundwater for drinking purpose in Dindigul block is assessed by its physiochemical constituents present in the groundwater samples. Finally, the result was concluded that the Tannery effluent water discharges impact on the ground water quality and makes contaminated at few sampling sites namely GW4 (Palani Road) > GW3 (Begampur) > GW1(Nagal Nagar) > GW2 (Angu Nagar). These ground water samples are not advisable to take as potable water.

REFERENCE

1. APHA, APHA, American Public Health Association, Standard Methods for stimation of water and Wastewater, AWWA, Water Pollution Control Federation, New York, 1998; 19.
2. BIS, and Bureau of Indian Standards (BIS): Indian Standard Drinking Water Specification. ManakBhawan, New Delhi, India, Second revision of IS., 2012; 10500.

3. Gopalkrishna, H.M. Assessment of physico-chemical status of ground water samples in Akot city, *Res. J. Chem. Sci.*, 2011; 1(4): 117-124.
4. Jain C.K. A hydro-chemical study of a mountainous watershed: the Ganga, India. *Water Res.*, 2002; 3: 1262-1274.
5. Manivaskam N. Physico-chemical examination of water sewage and industrial effluent. PragatiPrakashan, Meerut, 2008; 34–57.
6. Mohamed Hanipha M. and Zahir Hussain A. Study of Groundwater Quality arDindigul Town, Tamil Nadu, India., *International Research Journal of Environmental Science*s, 2013; 2(1): 68–73.
7. Patil P.N. Sawant D.V. and R.N. Deshmukh. Physico-chemical parameters for testing of water: A review, *Int. J. Env. Sci.*, 2012; 3: 1194-1207.
8. Patil V.T. and R.R. Patil. Physicochemical analysis of selected groundwater samples of Amalner Town in Jalgaon District, Maharashtra, *India. E J. Chem.*, 2010; 7: 111-116.
9. Rao , A.B., Gopal, V., Karthikeyan, V., Pius, G.A. and Meenakshi, S. Ground water pollution due to tannery effluent in certain areas of Dindigul town of TamilNadu. India., *Ind. J.Environ. Prot.*, 1995; 11: 568-571.
10. Sankar K., Aravindan S and Rajendran S. Assessment of Groundwater Quality in Paravanar River Sub-basin, Cuddalore District, Tamil Nadu, India, *Pelagia Research Library*, 2011; 2(5): 92-103.
11. Sathish Kumar S. and Ravichandran S. Groundwater Quality Assessment in Cheyyar Region, *International Journal of ChemTech Research,* 2011; 3(3): 1060-1062.
12. Shrinivasa Rao B and P. Venkateswaralu. Physicochemical analysis of selected groundwater samples, Indian J. Environ. Prot., 2000; 20: 161-164.
13. Shyamala R., M. Shanthi, P. Lalitha. Physicochemical analysis of borewell water samples of Telungupalayam area in Coimbatore District, Tamilnadu, India, *E-J. Chem.*, 2008; 5: 924-929.
14. Subramani T., Krishna S and Kumaresan P.K. Study of Groundwater Quality with GIS applications for Coonoor Taluk in Nilgiri District, *International Journal of Modern Engineering*, 2012; 2(3): 586–592.
15. WHO. Guidelines for Drinking-Water Quality, World Health Organization, Geneva, Switzerland, 4th edition, 2011; 224-334.
16. Yadav K.K. Physicochemical analysis of selected ground water samples of Agra city, India, *Recent Res. Sci. Technol*, 2012; 4: 51-54.