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RESEARCH ARTICLE

AN ANALYSIS OF WATER QUALITY PARAMETERS OF DYE EFFLUENT TREATMENT PLANT

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ABSTRACT

In this study, inlet and outlet of two effluent water samples were taken from effluent treatment plant in Balammalpuram, Karur, Tamilnadu, India. The water parameters were analysed under standard methods and compared with WHO and BIS standards. The remedial measures were suggested.

INTRODUCTION

Karur town, the head quarter of Karur district, Tamil Nadu, India is situated on the bank of Amaravathi river. It is located at 10.95°N, 78.08°E and 396 km from Chennai on southwest direction. Amaravathi river is a tributary of river Cauvery. It confluence with river Cauvery at about 12 km downstream of Karur [12]. During the last three decades the town emerged as a major textile centre with its 1000 odd power loom and handloom units producing bedspreads, towels and furnishing. There are about 1000 units along a 17 km stretchon the banks of Amaravathi, which undertake bleaching, dyeing, weaving, tailoring, knitting, knotting, packing, transporting and trading. Out of which 487 are bleaching and dyeing units [13] The pollution from the bleaching and dyeing units has become a major issue though all the operational units are either provided with an Individual Effluent Treatment Plant (IETP) or Connected to a common effluent treatment plant (CETP). Due to discharge of dyeing industry effluent into the river Amaravathi, both the canal and open wells remains largely unusable for irrigation, particularly during summer season [14]. Jain *et al*. (2010) found that groundwater quality at most of the locations of Nainital District is not upto the mark due to the quartzite rocks in the region. Abdul Jameel and Sirajudeen (2006) identified that most of zones in and around Pettavaithalai area, Tiruchirappalli, Tamil Nadu-India is polluted due to the sugar mill effluent seepage into the groundwater Table. All the test results confirm that the ground water quality is not upto the mark and is slowly degrading. Aggarwal Shankar *et al.* (2001) identified [1]the rain and fog water samples collected from Bikunthpur and Korba sites were found to be acidic in nature (i.e. pH<5). However, samples from Ambikapur, Bilaspur, Raipur and Bhilai were slightly acidic and their pH values were always around 5.8. Concentrations of Al, Hg, Mn, Cd and Pb were higher in fish from acid, than from less acid waters Agrwal Madhoolika *et al.* (2001) quantified the atmospheric deposition and wet depositions at different sites in Singrauli area of Sonbhadra district, U.P., India. The monthly variation in rain water pH clearly indicate that early rainfall is more alkaline and as rainy season proceeds rainwater showed lower pH

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Heavy metal issues

Abraham Beena *et al*. (2002) identified that pollution of the natural environment from a wide range of sources and pollutants become an inevital feature of the present day living and look out for the distribution of toxic metals, mercury and lead and also different hydrographic parameters in the River Periyar. Efforts have also been taken to study the effects of different electrolytes and salinity on the adsorption, desorption and retention of Hg (II) ions [2]. Abraham Beena *et al*. (2002) identified the presence of chromium in industrial effluent and attempted to treat with a suitable method Islam *et al*. (2009) studied heavy metal (Pb, Cd, Zn, Cu, Cr, Fe and Mn) content in Textile sludge in Gazipur, Bangladesh found out all heavy metals concentration except chromium in the sludge samples were higher than that of in agricultural soil.

Impact by industrial effluents

Balakrishnan *et al.* (2008) studied [3] the impact of dyeing industrial effluents on the groundwater quality in Kancheepuram (India) marked as red colour industry. Most of the samples exceed the limits of BIS and WHO. Balasubramanian (2006) studied the reuse of textile effluent treatment plant sludge in building materials and found that ETP sludge up to 30% substitution for cement may be possible in the manufacture of nonstructural building materials and serve as an alternative solution to disposal [4] Hasan and Agarwal (2004) reviewed the recycle and reuse of wastewater has become a need of time due to limited water resource. A large number of effluents, domestic sewage and industrial wastewater can be reused to a significant extent after suitable treatment. Several steps have been taken by India in the direction of pollution control. The efforts have eventually resulted in the reuse of discharged treated effluents either in the same industry or for some other purposes.

Table 1. Water paremeters for the dye effluent treatment plant

Sample Number	Inlet	Outlet
Parameters		
Physical Examination		
Appearance	Blockish & Turbid	Slightly brownish
Odour	Objectionable	Objectionable
Turbidity NTU	200	12
Total Dissolved Solids Mg/L	6850	2030
Electrical conductivity (micro mho/Cm)	9800	2900
CHEMICAL EXAMINATION		
pH	9.2	8.5
Alkalinity Ph (as $CaCO_3$) mg/L	130	50
Alkalinity Total (as $CaCO_3$) mg/L	730	320
Total Hardness (as $CaCO_3$) mg/L	600	260
Sodium (as Na) mg/L	846	336
Potassium (as K) mg/L	30.1	18.4
Calcium (as Ca) mg/L	192	72
Magnesium (as Mg) mg/L	29	19
Iron (as Fe) mg/L	2.28	1.12
Manganese (as Mn) mg/L	Nil	Nil
Free Ammonia (as NH3) mg/L	0.52	0.47
Nitrite (as NO_2) mg/L	0.54	0.25
Nitrate (as NO_3) mg /L	----	----
Chloride (as Cl) mg/L	33.75	750
Fluoride (as F) mg/L	----	----
Sulphate (as SO_4) mg/L	180	77
Phosphate (as PO_4) mg/L	0.24	0.28
Tidy's test (as O) mg/L	78	24
BOD mg/L	234	81
COD mg/L	700	216
D.O.mg/L	2.8	4.1

River / Surface water issues

Abdul Jameel and Zahir Hussain (2011) identified that most of the groundwater sampling stations near the Uyyankondan channel, Tiruchirappalli are much polluted by the intrusion of channel water, dumping of waste and percolation of domestic sewage by inhabitants [5]. Animesh Agarwal and Manish Saxena (2011) carried out study at river Gagan with regression analysis which is not only time saving but also cost effective. Water resource shortage and pollution has seriously threatened the survival and development of developing countries. Because of India's specific economical and social circumstances, complete adoption of developed countries experience is unrealistic. At present, India needs to develop strategies and technologies in source water pollution control and industrial and municipal environmental remediation that embrace the country's specific need to battle the water resource problem [6] Ahamed. A Jafar and Loganathan K [7] has been made to evaluate the current status of physico-chemical contaminants and their sources in surface and groundwater of Amaravathi river basin. 33 water samples including 11 surface water samples and 22 groundwater samples were collected from different location of Amaravathi river basin during November 2011.The physico-chemical parameters such as pH, EC, TDS, TH, TA, NO_3, SO_4, PO_4, Na, K, Ca, Mg, Cl and F have been analyzed. The results were compared with water quality standard prescribed by ISI/ICMR/WHO and an attempt has been made to find whether the quality of groundwater suitable for drinking purposes or not. The correlation coefficients were calculated for water quality assessment. Jafer *et al.* [8] focused on groundwater quality assessment of some parts of Than thoni and Karur block in Karur District, Tamilnadu. Groundwater quality of the tudy area was evaluated for its suitability for drinking purposes by collecting ten samples during pre-monsoon season August 2012) by adopting standard analytical techniques of APHA (2005). The water samples collected in the stations were analyzed for electrical conductivity (EC), pH, Total Dissolved Solids (TDS), Total Hardness (TH), major cationslike calcium, magnesium, and anions like bicarbonate, chloride, nitrate, fluoride and sulphate. The study revealed that some water sources in the region are not suitable for drinking with respect to total hardness, calcium and magnesium content. Proper maintenance and treatment of water can improve the quality of drinking water and thereby a safer life.

Various samples of ground water [9] were collected from different areas in and around the Punnam village of Karur District, India and analyzed for their physicochemical characteristics. The results of this analysis were compared with the water quality standards of WHO and CPHEEO. In this analysis the various physicochemical parameters such as pH, electrical conductivity, turbidity, total dissolved solids, Cl^-, F^-, $SO4^{2-}$, NO_3^-, Na^+, K^+, Fe, Cr, calcium and magnesium *etc.*, were determined using standard procedures The quality of groundwater samples were discussed with respect to these parameters and thus an attempt were made to ascertain the quality of ground water used for drinking and cooking purposes in the sampling areas. It is known that the groundwater [10] quality is important as it is the main factor determining its suitability for drinking, domestic, agricultural and industrial purposes. In order to assess the groundwater quality, 16 ground water samples have been collected from different places in cultivated Pugalur and uncultivated Pugalur during January 2012. The water samples collected in the stations were analyzed for Electrical Conductivity (EC), pH, Total Dissolved Solids(TDS), Total Hardness(TH), Total Alkalinity (TA), major cation like calcium, magnesium, sodium, potassium and anions like chloride, nitrate and sulphate in the laboratory using the standard methods given by the American Public Health Association (APHA, 2005). Water quality indices are generally used as a tool to convert a large data set into a much reduced and informative form. Water quality index (WQI) by weighing arithmetic index method is used to assess the suitability for drinking and irrigation purpose. The results were evaluated in accordance with the drinking water quality standards suggested by the World Health Organization and are presented. Chloride, alkalinity, hardness, EC and potassium were found excess in most of the samples. The results are analyzed in the light of USSL diagram and Piper tri linear plot using quachem software. The Piper diagram showed that the groundwater was of mixed Ca-Mg-Cl type followed by Na-Cl and Ca-Cl type. Cotton yarn bleaching and dyeing [11] is one of the major industrial activities in Karur Town, Tamil Nadu, India. The waste water let out from this industry is a major environmental concern. Out of 487 units, 391 units are member in common effluent treatment plant (CETP). 8 CETPs are in operation. The remaining 96 units have provided individual effluent treatment plant (IETP). After treatment the effluent is let into Amaravathi river a tributary of river Cauvery. The quality of effluent discharge from

CETPs was monitored for a period one year. The report of analysis reveals that the total dissolved solids, chlorides, bio chemical oxygen demand, and chemical oxygen demand are exceeding the permissible inland surface water discharge standards. The discharge of partially treated effluent has adversely affected the river water quality as well as the groundwater quality. In order to protect the river and the groundwater, Tamil Nadu Pollution Control Board (TNPCB) have directed all the dyeing units to provide Reverse Osmosis (RO) plant with Reject Management System (RMS) and recycle the entire treated effluent so as to achieve Zero Liquid Discharge (ZLD). The present work aims to analyse [15-17] the water parameters of dye effluent treatment plant which is located at Balammalpuram in karur, Tamilnadu, India.

Experimental

The sampling of two water dye effluent samples(inlet and outlet)from dyeing effluent industry were collected after running them for 10 minutes was done during the month of September to November – 2008. The water samples were analyzed in Tamil Nadu water testing laboratory at Karur. Before collecting water samples, the plastic water bottles were rinsed with concentrated hydrochloric acid and then with ground water to be analyzed totally about 26 water parameters were analyzed. Turbidity was measured by turbidity meter and TDS was measured by gravimetric method. Electrical conductivity was measured by electrical conductometer. pH was measured by using pH meter. The phenolphthalein alkalinity (PA), total alkalinity (TA),hardness, chloride, chemical oxygen demand (COD) , biological oxygen demand (BOD), dissolved oxygen (DO) and Tidy's test were measured by using titration methods. The amount of Na, K, Fe, Mn, free ammonia, nitrite, nitrate, sulphate and phosphate were measured by using spectrophotometer method. Fluoride was measured by visual comparison method.

RESULTS AND DISCUSSION

The data revealed that there were considerable variations in the samples with respect to chemical characteristics (Table 1). A comparison of physico-chemical characteristics of samples of dye effluent samples has also be made with WHO (1984) and BIS 1998 standards. The water has alkaline nature with pH, ranging from 9.2 to 8.5; this indicates that it has no direct effect on human health. Since recommended value for drinking purpose by WHO is 6.5 to 8.0 and BIS standard is 6.5 to 9.2 ground water chemistry charges as the water flows through the sub surface geological environment increasing in dissolved solids and major ion. The TDS values varied from 2030 to 6850 mg/L. The sample no. 1 had a high TDS value which was collected from dye effluent industry (Inlet). TDS value of outlet is beyond the permissible limit of BIS and WHO standard for potable purpose. The reason for high TDS and chlorides in the treated effluent is, the units are using common salt in the dyeing process for efficient fixing of dye in the yarn and due to use of alum, lime, ferrous sulfate and polyelectrolyte in the effluent treatment process. EC values of inlet and out let were 9800 and 2900.the inlet had high EC due to raw effluent due to no treatment process. But out let had low value due to various treatments of effluent industry which was above permissible limit. TA range varied from 320 to 730 mg/L. The overall results had revealed that the out let of CETP had high TDS, chloride, COD and EC. The remaing all paramemeters were within permissible limit of WHO and BIS standards.

Conclusion

In order to find a solution for the above water pollution, TNPCB is now insisting all the bleaching and dyeing units to provide Reverse Osmosis (RO) plant with complete reject management system and reuse the treated effluent for the process and ensure for Zero Liquid discharge (ZLD). Now the dyeing units are in the process of installing RO plant to meet ZLD. The bleaching and dyeing units in Karur shall also go for cleaner production including elemental chlorine free. Bleaching, hydrogen peroxide bleaching, and environmental friendly dyes [18-26].

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